



## **TetraFlex® V7.6**

(w. US remarks)  
Manual version 1.00



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## INTRODUCTION

This manual is intended for installation and maintenance of BS4xx TetraFlex® Base Station, including additional units, installation software, and how to configure the system for operational use.

**Remark: TetraFlex® ver. 7.6 is not compatible with earlier versions! Please follow the update instructions or contact DAMM support if you have systems with older software versions.**

### Indoor Base station models

#### BS411



Max. 32 carriers



Max. 8 carriers

#### BS414




Max. 4 carriers

### Outdoor station

#### BS421 + SB 421



Max. 4 carriers

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	TetraFlex® 7.6 Manual - Introduction		

It is recommended that engineers doing the installation and configuration of a BS4xx have practical experience in installation of radio and computer systems, and have made themselves familiar with the BS4xx equipment through appropriate DAMM training courses and study of the content of this manual.


This installation guide covers the installation of indoor as well as outdoor Base Stations as well as single units. Please skip the sections, which are not relevant for the actual case.

The manual is divided into more sections which may be printed separately. When doing so please print the Table of contents, introduction, update sheets and Index (all pages prior to page 1-1 and after page 4-x) and insert these in the printed section

### **IMPORTANT:**

Updates / changes / important information related to the TetraFlex® system and software may be downloaded from the protected part of [www.damm.dk](http://www.damm.dk)

Please check this URL for updated information before attempting to install or correct errors

**NOTE:** Chapters marked with a  indicate areas where special care must be taken to avoid personal injury or damage to the equipment.



**Before starting installation and configuration, please read the entire manual carefully.**




**NOTE: It is the responsibility of the system owner / operator to ensure that only authorized service persons has access to the keys / inside circuits of the SB412 / BS4xx.**



**NOTE: It is the responsibility of the system owner / operator to ensure that all local legislation, rules and regulations are complied with.**



**The SB412 / BS4xx are protected by internal fuses. Always replace with fuses of equivalent value and type.**

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	TetraFlex® 7.6 Manual - Reference documents		

## General Warning

This manual contains important safety and operational information. Please read and follow the instructions in this manual. Failure to do so could be hazardous and result in damage to your device.

Changes and modifications to this device not expressly proved by DAMM could void the user's authorization to operate this device

## North America regulations

The Base Station Transceivers and products devices mentioned in this User Manual comply to FCC part 90 and Industry Canada (IC) RS119 regulations for such equipment.

The equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. The equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications.

## RF Exposure

The DAMM developed transmitting devices mentioned in this User Manual have the Nemko approval concerning "Maximum Permissible Exposure Calculations" which are the European limits for maximum permissible exposure defined in the document 1995/519/EC, Council Recommendation of 12. July 1999. The results are to be found in the Nemko Document 128948/5 in the appendix of this User Manual.

## Antennas

The outside antenna connected to this device must be installed on an outdoor permanent structure with a separation of at least 20 feet from all persons during normal operation.

## Notice

- ❖ Do not modify any part of this device for any reason
- ❖ Do not place any combustible material near the transceiver
- ❖ Do not spray any liquid over the device
- ❖ Ensure that the power and antenna connections are securely made, using cables recommended and with excess capacity for the power being utilized.

## REFERENCE DOCUMENTS

For detailed information's regarding the TetraFlex® release and features supported, please consult the documents listed below:


No.:	Document Title	Document Contents
1	TetraFlex v7.6 System description.pdf *	TetraFlex® system overview
2	TetraOM_7.6.pdf	TetraFlex® OM manual
3	TetraFlex_RN_7.60_2012-11-09_01.pdf *	TetraFlex® system release note
4	TetraFlex 7.6 update.pdf	Update guideline for ver.7.x to 7.6
5	TetraFlex 7.6 BS41x redundant setup.pdf	Redundancy sw setup guideline for BS41x
6	TetraFlex 7.6 SB421 redundant setup.pdf	Redundancy sw setup guideline for SB421

\*) These documents are a part of the TetraFlex® release and placed in the C:\tetraActive\Doc directory

All documents can be found on [www.damm.dk](http://www.damm.dk) extranet.

## TETRAFLEX® MANUAL BREAKDOWN

Section	Description	Level
Part 1	Physical hardware installation	Tech
Part 2	Software installation and configuration of software and system	Tech
Part 3	User manual intended for operators and non technical personnel	User
Part 4	Technical reference	Tech
Part 5	Hardware Units Ref.	Tech
Part 6	List of figures and Alphabetic index	All


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## REVISION

Software covered by this manual:

Product	Released date	Version
ApiDll	2012-11-02	7.60
Android Client	2012-11-02	7.60
BSC	2012-11-02	7.60
Dispatcher	2012-11-02	7.60
Dongle	2012-11-06	7.60
Group Bridge	2012-11-07	7.60
Log Client	2012-11-02	7.61
Log Server	2012-11-02	7.61
Log Server Tray	2012-11-02	7.61
NM	2012-11-02	7.60
OM	2011-05-12	7.50
PS421	2008.05.21	1.01
SNMP Agent	2011.06.29	7.47
TR412	2012-11-02	7.60
TR421	2012-11-02	7.60


### Record of Manual Versions Numbers

SW.	Ver.	Release Date	Main Cause of change	Author	Approved
7.40	2.00	01-11-2009	Initial release, Manual completely rearranged	BUK	JB
7.40	2.01	11-01-2010	Manual update, see record	BUK	JB
7.4	2.02	26-02-2010	Dispatcher new version 7.41, see record	BUK	JB
7.4	2.03	30-03-2010	Log server/client 7.42 TR421 / TR412 SW update to 7.41 See release notes and record of change	BUK	JB
7.4	2.04	29-04-2010	Dispatcher 7.42 + GIS-ESRI map option	BUK	JB
7.4	2.05	24-09-2010	General update, NM with SNMP added	JR	JB
7.5	1.00	08-12-2011	Updated for SW release 7.5	JR	JB
7.6	1.00	04-01-2013	Updated for SW release 7.6 incl. US remarks	JR	JB

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Man. ver.	Sec.	Page	Cause of change	Date	Initial
1.00	All	All	Complete revision	04-01-2013	JR



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## IMPORTANT:

DAMM will execute great effort to maintain and update this manual so it will always be up to date regarding information and readability.

To do this DAMM needs to get feedback from you.

So if you as reader find anything which could be done better, items which is not dealt with, sections which is difficult understandable etc. DAMM would appreciate your comments

Please mail support on [support@dammm.dk](mailto:support@dammm.dk)


or

Contact support on +45 73473520

Thank you for your input

## ABBREVIATIONS / DEFINITIONS

Short	Explanation / Definition
AIE	Air interface encryption
API	Application Programming Interface
Application Date	Is checked against the Dongle Application Date Limit. Software package execution is only possible if Application Date is equal or less than the Dongle Application Date Limit. The Application Date is hard coded into the software package and will normally be the same date as the Release Date, but can be set to an earlier date.
Application Date Limit.	All software packages with an Application Date earlier than this Application Date Limit can be executed
Application PC	Any PC, with the exception of RF nodes, which are running DAMM application(s)
BS	Base Station, BS41x or a combination of SB421's and BS421's
BSC	Base Station Controller
BSC.exe	Base Station Controller Software
BSS	Base Station Switch
CAD	Call Authorized by Dispatcher
CDR	Call Data Records
Cell	(Radio) Cell – a radio node with one or more transceivers
Cell ID	ID is broadcasted every 10 sec (configurable).
CF	Compact Flash memory card
CMoIP	Circuit Mode over IP
DB	Data Base
DCK	Derived Cipher Key
DGNA	Dynamic Group Number Assignment
Dongle	A USB dongle, programmed by DAMM, to be inserted in the node and/or application PC. The dongle controls which functions and applications can be executed
Dongle Date Limit	When this date is exceeded the dongle will not allow execution of DAMM software packages
DSP	Digital Speech Processing
E2E	End to end encryption
ETSI	European Telecommunications Standard Institute
FACCH	Fast Associated Control Channel
FTP	File Transfer Protocol
GCK	Group Cipher Key
GIS	Geographical Information system
GPS	Global Positioning System
GSI	Group Subscriber Identity
GUI	Graphical User Interface
GW	Gate Way
IP	Internet Protocol
ITSI	Individual Tetra Subscriber Identity
L1 Warning	System function is not likely to be affected
L2 Alarm	System function is partly affected
L3 Blocked	Some components of the system are not active
LAN	Local Area Network (For TetraFlex® meaning connection BSC/TR and IP backbone)
MCC	Mobile Country Code
MCCH	Main Control Channel
Missing	A node which has been visible is missing
NM	Network Management
MNC	Mobile Network Code
MS	Mobile Station (Terminal)
Node	Any unit, with exception of redundant BSC(s), running the DAMM bsc.exe application
OM	See TetraOM
OS	Operation System. Windows XP, Vista, 7, CE etc.
PABX	Private Automatic Branch Exchange
PC	Normally the BSC, but could also refer to a standard consumer PC
PD	Packet Data

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	TetraFlex® 7.6 Manual - Abbreviations / Definitions		

PEI	Peripheral Equipment Interface
PSTN	Public Switched Telephone Network
PTT	Push To Talk
RAM	Random Access Memory
Release Date.	The date where DAMM releases the software. This date is hard coded into the software package
Release number	Hard coded into the software package and have 2 levels, separated with a dot (example: 7.40)
SACCH	Slow Associated Control Channel
SCCH	Secondary Control Channel
SCK	Static Cipher Key
SDS	Short Data Service
SELV	Safety Extra Low Voltage
Site	Geographical position of equipment or nodes
SLA	Service Level Agreement, earlier called "Service and Maintenance Agreement" (SMA).
SNMP	Simple Network Management Protocol
Software package	A package containing all functions and applications available on the release date.
SSI	Short Subscriber Identity
Subscriber register	Register where the variable data regarding subscribers and profiles are stored.
TBD	To Be Determined
TCP	Transmission Control Protocol
TEA1...	Tetra Encryption Algorithm 1... 2.... 3... 4... etc.
TEI	Tetra Equipment Identification
TETRA	Terrestrial Trunked Radio
TetraOM	The DAMM Tetra Operations & Management command line application
ToIP	Tetra over IP
TSI	Tetra Subscriber Identity, consist of MCC:MNC:SSI
UDP	User Datagram Protocol
User number	Unique DAMM subscriber reference used as an example by the voice GW and to manage terminal exchange
UTP	Unshielded Twisted Pair
VoIP	Voice over IP
WAN	Wide Area Network (For TetraFlex® meaning connection to www, gateways etc.)



Damm Cellular Systems A/S, Denmark

Doc. No.

Rev.

1.00

Date

2013-01-04


TetraFlex® 7.6 Manual - SB421- Installation



# PART-1: Hardware Installation

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## 1.1 SB421- INSTALLATION

### 1.1.1 Environmental / climatic requirements

The SB421 (Service Box) is designed for outdoor operation, in such a way that it can be placed in the antenna mast close to the Base station(s)

The Service Box is designed to be able to operate at severe environmental conditions.

**The Service Box is guaranteed to operate from –20°C to +55°C with optional battery and –25°C to +55°C with CF card operation without battery.** Maximum SB421 cabinet temperature is +70°C. Storage temperature for the SB421 is from –40°C to +85°C.

Note that the guaranteed MTBF data is valid only when operating within the specified temperature range

Screening of SB421 to specific customer defined operating temperature range (from -40°C to +55°C ambient air temperature) is optional upon request.

The Service Box encapsulation complies with IP65

### 1.1.2 Placement

The recommended placement of the Service Box is as close to the base station(s) as possible to reduce possibility of system failure due to LAN cable being interrupted.

The placement of the Service Box shall be such that it is securely fastened to a mast or building that is able to carry the weight of the SB421 and withstand the local environmental conditions. All cables etc. shall be properly fastened to the mast or building using appropriate fixtures as to avoid damage to the equipment and possible injury to persons.

### 1.1.3 Grounding

The BS requires careful grounding.

Grounding is important to protect the equipment when inserting / removing cables and to protect the operator from faulty equipment.

An effective grounding is also important to protect the installation during thunderstorms (lightning).

#### 1.1.4 SB421 basic elements



##### 1.1.4.1 SB421 Variants

Item no.	SB421 Description	Processor	RAM	Storage
105102	General performance w/CF	Celeron M 1.0GHz	512Mb	2GB CF
105105	High performance with/CF Hardware Ver.1 (discontinued)	P4 Mobile 1.4GHz	1 GB	8GB CF (2+2+4)
105105	High performance with/CF Hardware Ver.2	Intel Atom D510 1.66 GHz	2 GB	8GB CF (2+2+4)

Figure 1-1: SB421 Variants

The above specifications are a minimum and may be changed according to availability of processors and storage media. Any change in specification will be for a superior value. To update to 8GB CF and 1GB RAM, order an upgrade kit from DAMM


##### 1.1.4.2 Mechanical Lock

Delivery option: System lock or standard lock, both options including 2 keys.

##### 1.1.4.3 Power supply / charger

The power supply / Charger is capable of supplying -48V DC / 6,5A for the transceivers, BSC and for charging of the internal or external battery pack.

Connection to the BSC1 via TetraOM, it is possible to monitor the Power Supply

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In OM enter AP <Enter> and the connection is established. Use <F1> for help menu and select PS421.

#### 1.1.4.4 BSC421 Base Station Controller

Please refer to appropriate information in section 1.1.4.1 Regarding the type and specification of the CPU board (High performance or general performance dependent of the type of SB421)

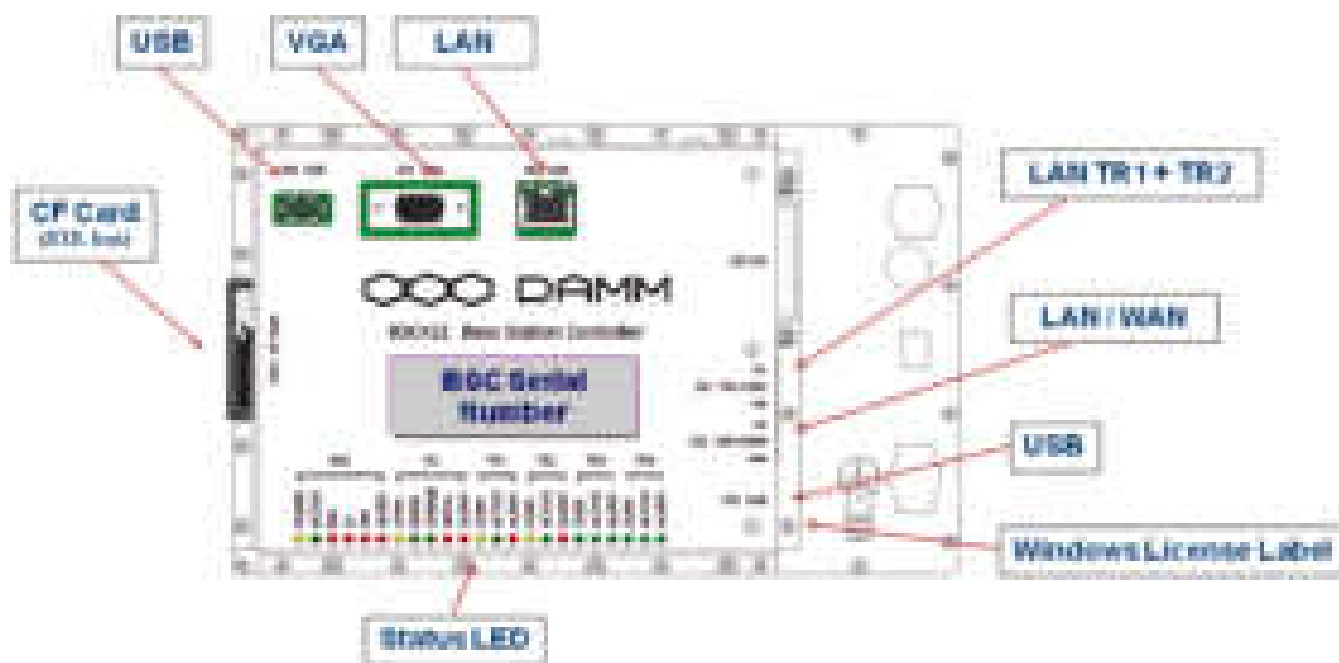


Figure 1-2: BSC421

##### 1.1.4.4.1 SB421 Processor board internal backup battery



**RISK OF EXPLOSION, IF BATTERY IS REPLACED BY AN INCORRECT TYPE**  
Dispose of used batteries according to local rules

##### 1.1.4.4.2 Storage unit

Please refer to appropriate specifications in section 1.1.4.1 regarding the type and size of storage, 8GB Compact flash Card of SB421

#### 1.1.4.4.3 BSC connections

##### Connections

- TR1 and TR2 LAN to Interconnection board (J31)
- LAN / Wan to Interconnection board (J32)
- I/O for PS etc. (J30)
- USB1 for Node Dongle (J33)
- USB2 for service and maintenance (J50)
- VGA for service and maintenance (J51)
- LAN for service and maintenance (J52)
- CF socket (J201)

#### 1.1.4.4.4 BSC421 LED's and Fuses

BSC Status and warning LED's: All LED's ON, BSC software is not running

Group	Activity	LED	LED on Means
ALL			<b>All LED's ON, BSC SW is not running</b>
BSC	POWER	Yellow	Power On
	ACTIVE	Green	BSC Active
	NETWORK	Red	No Ethernet
	BSS	Red	No connection to BSS
	BSC	Red	No connection to redundant BSC
	ALARM	Red	Other BSC alarm present
PS	LINK	Yellow	<b>Connected to PS</b>
	MAINS	Green	Mains present
	CHARGE	Green	Battery is charging
	DISCH	Red	Battery is discharging
	ALARM	Red	PS alarm
TR1	LINK	Yellow	Connection to BS421_1
	ACTIVE	Green	BS421 active. (Tetra mode TX on)
	ALARM	Red Steady	Blocking alarm
		Red Flash	Non-blocking alarm
TR2	LINK	Yellow	Connection to BS421_2
	ACTIVE	Green	BS421 active. (Tetra mode TX on)
	ALARM	Red Steady	Blocking alarm
		Red Flash	Non-blocking alarm
TR3	LINK	Yellow	Connection to BS421_3
	ACTIVE	Green	BS421 active. (Tetra mode TX on)
	ALARM	Red Steady	Blocking alarm
		Red Flash	Non-blocking alarm
TR4	LINK	Yellow	Connection to BS421_4
	ACTIVE	Green	BS421 active. (Tetra mode TX on)
	ALARM	Red Steady	Blocking alarm
		Red Flash	Non-blocking alarm

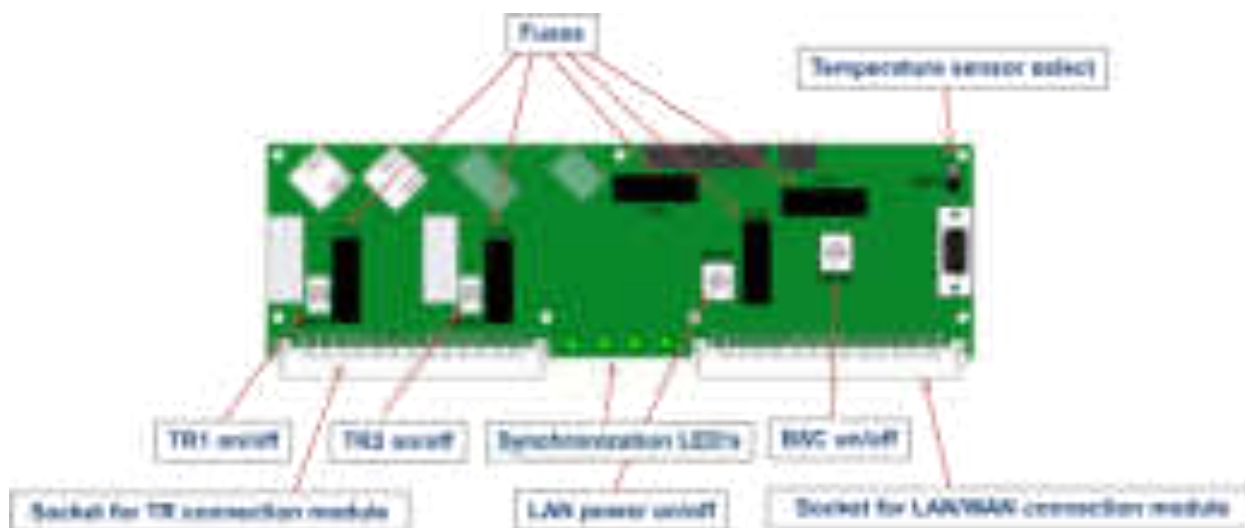
Figure 1-3: BSC LED's



Unit	Placement	Fuse Rating	Fuse Size
Interconnection Board			
Battery	F101	10A Slow	5x20
BSC421	F102	1A Slow	5x20
TR1	F113	3.15A Slow	5x20
TR2	F133	3.15A Slow	5x20
LAN/WAN Power	F153	1A Slow	5x20
Power Supply			
PS421	F101	6.3A Slow	5x20

Figure 1-4: Fuse Listing

#### 1.1.4.5 Interconnection Board



##### 1.1.4.5.1 Connections

- LAN TR1 and TR2 (J31)
- LAN / WAN (J32)
- -48V PS (J22)
- -48V Internal / external battery dependent of plug used (J40)
- TR1 and TR2 connection module (J11)
- LAN / WAN / SEC / Alarm connection module (J12)

##### 1.1.4.5.2 Switches

- TR1 On/Off (SW111)\*
- TR2 On/Off (SW133)\*
- LAN/WAN Power On/off (SW131)
- BSC421 On/Off (SW101)
- Temperature sensor internal / external (SW171)

\*) This on/off function is only active if the BSC switch is on and is used for cold start of the TR's. Be aware that the mains or/and the battery must be unplugged if making maintenance on the TR power cable else is 48V on to the TR's even the BSC switch is off.

### 1.1.4.5.3 Interconnections board LED's

- EXT SEC IN 2
- EXT SEC IN 1
- TR2 SEC IN
- TR1 SEC IN

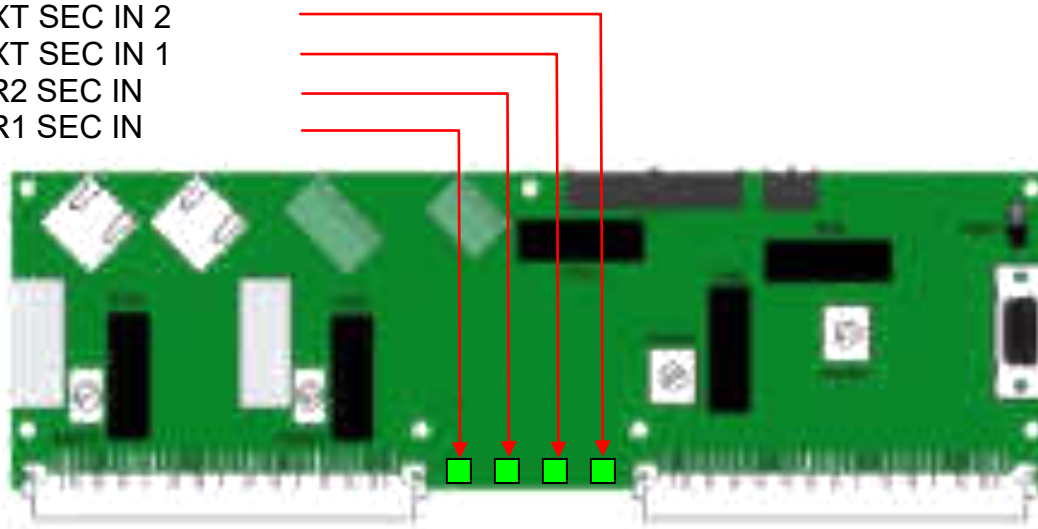


Figure 1-5: Interconnection Board

### 1.1.4.5.4 TR1/TR2 connection module

The TR1/TR2 connection module is located at the LEFT bottom side of the SB421 interconnection board

- -48V DC for TR1 (J1)
- LAN / 1 second synchronization pulse for TR1 (J2)
- -48V DC for TR2 (J3)
- LAN / 1 second synchronization pulse for TR2 (J4)

The TR1 / TR2 connection module is located at the left bottom side of the SB421 housing.

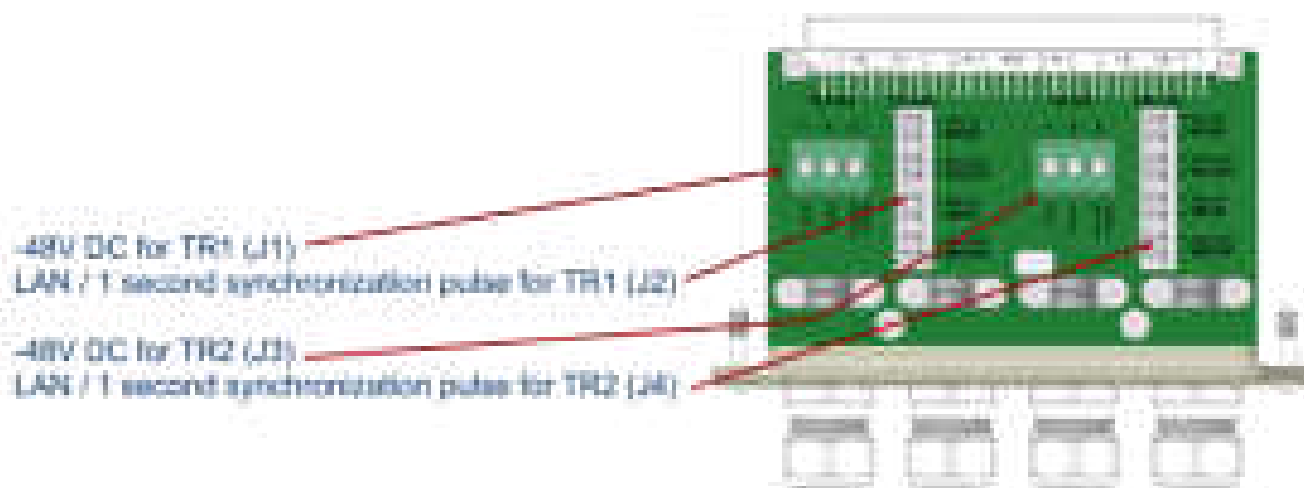


Figure 1-6: TR Connection Module

#### 1.1.4.5.5 PS Connection to TR1 and TR2

- The blue wire of the BS shall be connected to the minus terminal
- The black wire of the BS cable shall be connected to plus terminal.
- The green / yellow wire of the SB421 cable shall be connected to the ground terminal.

#### 1.1.4.5.6 LAN Connection to TR1 and TR2

Connect the following terminals:

Function	SB421	Function	BS421	Color
<u>ETH_IN</u>	8	<u>ETH_OUT</u>	1	White / Orange
<u>ETH_IN</u>	7	<u>ETH_OUT</u>	2	Orange
<u>ETH_OUT</u>	6	<u>ETH_IN</u>	3	White / Green
<u>ETH_OUT</u>	5	<u>ETH_IN</u>	4	Green
<u>SEC_IN</u>	4	<u>SEC_OUT</u>	5	Blue
<u>SEC_IN</u>	3	<u>SEC_OUT</u>	6	White / Blue
<u>SEC_OUT</u>	2	<u>SEC_IN</u>	7	White / Brown
<u>SEC_OUT</u>	1	<u>SEC_IN</u>	8	Brown

**NOTE:** Cable used must be 24AWG solid core. See recommended hardware

#### 1.1.4.5.7 LAN/WAN/SEC/Alarm Connection module

The LAN/WAN/SEC/TS/Alarm connection module is located at the inside RIGHT side of the SB421 interconnection board

#### 1.1.4.5.8 Connections

- -48V DC, 1A out for external units (router, switch etc.) (J5)
- LSA (8 pole) for LAN/WAN (J6)
- LSA (8 pole) for 1 SEC pulse / Temperature Sensor (J7)
- LSA (2x8 pole) for alarm inputs (8 pairs) (J8A + J8B)

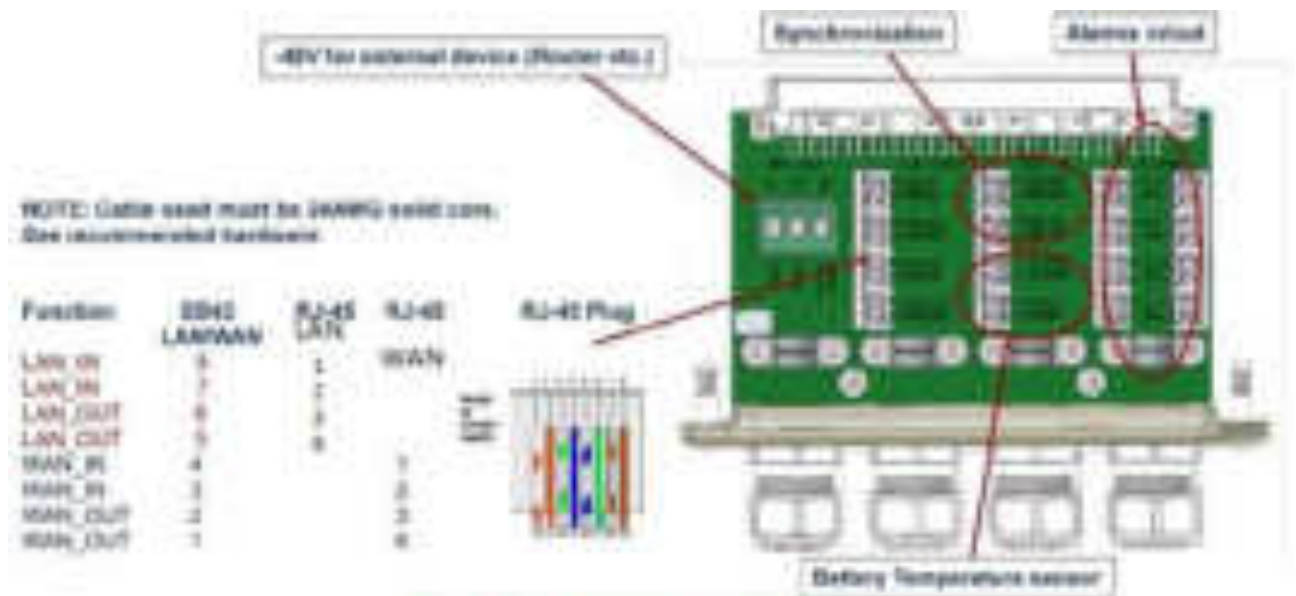


Figure 1-7: LAN/WAN and RJ-45 plug

#### 1.1.4.5.9 Redundant SB421 operation

A second SB421 (BSC) may be configured for redundant operation both as 2 carriers and as 3 - 4 carriers.

**Note:** A HW modification is needed for redundant and/or 3-4 carrier operation. See section 1.1.5 for further information.

##### 1.1.4.5.9.1 LAN Connection

**Note:** LAN in / out is used for redundant SB421. If redundant SB421 or multi node backbone is not used, connect cable to WAN part only. If environment permits, Y-splitter may be used to separate WAN and LAN, otherwise connect one or two Ethernet cables as desired.

For redundant SB421 (BSC) operation, connect the LAN from each SB421. Connection may be straight through (auto sense) or crossed cable as preferred.

##### 1.1.4.5.9.2 SEC Connection

In addition to the LAN connection, the SEC connection for synchronization must be established too.

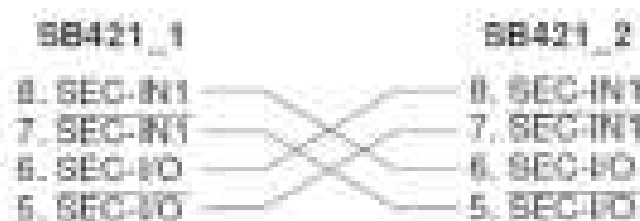



Figure 1-8: SEC Connections

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#### 1.1.4.5.10 Temperature sensor (TS) Connection

##### Terminals for External Battery Pack Temperature Sensor

For installation, refer to the instructions delivered with the external battery kit

When used, use SW171 on the interconnection board to select internal / external battery temperature sensor

#### 1.1.4.5.11 Alarm Connection

Terminal for external alarm input 1-8. Input 8 can be used for Tx Power reduction (see TR OM Command 13).

L1,L2,L3 output alarms please contact DAMM support for more information.

#### 1.1.4.6 Mains Connection block

The 3 screw connection block for the 100-240V AC mains power Phase, Null and Ground is located on the inner left side of the SB421 housing.



The 100-240V AC mains power connection shall be provided with an appropriate fuse according to the selected mains supply voltage as to ensure a consumption of 4,5A (110V) / 2A (230V).

The cables used for the 100-240V AC and -48V DC to the base stations must be equal to or more than 3 x 1,5mm<sup>2</sup>

The type of mains cable and fastening of cables must at all times be in accordance with local rules and specifications.


#### 1.1.4.7 Internal -48V battery assembly (option)

The SB421 is operated at -48V nominal DC (SELV) derived from the internal power supply. An internal or external battery pack may be connected for backup purposes.

If an internal battery assembly is installed, the battery serial connection wire located at the top front of the batteries is disconnected at delivery to avoid the battery from being drained. Please reconnect the wire before use.

Also make sure that the internal/external temperature sensor switch (SW 171 located at the top right hand corner of the interconnection board) is set to internal.

To ensure stable backup power, it is recommended to check/exchange the battery every 2 years.

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### 1.1.5 HW change for redundant SB421 / 3 and 4 carrier operation

**NOTE:** Operation with 3 and/or 4 carriers and/or redundant BSC require a change to the HW on both SB421 as well as a HW change on carrier 2 and 4 if BS421 HW version is 1. If BS421 HW version is 2, these settings can be made via the TetraOM application. (Please see the SB421 installation section for further details)

This change is required to ensure correct BSC handover and synchronization of the carriers.

A 3/4 carrier system and / or redundant SB421 is marked with a label close to the serial number label at the outside bottom of the SB421:

#### **REDUNDANT SB 421 3-4 CARRIER SYSTEM (SYNCHRONIZATION OPTION 2)**

The interconnection board NB what is meant! on the connector for the BS421 is marked with a label:

#### **SYNCHRONIZATION OPTION 2**

when delivered from factory.

If the hardware change is made in the field, i.e. outside DAMM facilities, it must be ensured that appropriate marking of the SB421 is performed.



**NOTE:** For change in the field, please order a change kit from DAMM. This kit includes a manual dealing with this issue, jumpers, screws, markings etc. This change operation includes soldering and unsoldering of SMD components and should only be done by skilled technicians familiar with SMD handling

The following hardware jumpers need to be changed for correct 3 and 4 carrier or redundant operation of the SB421:

Normally closed – change to open (marked with green):

J211  
J241  
J252  
J255

Normally open – change to closed (marked with red):

J212  
J242  
J251  
J254

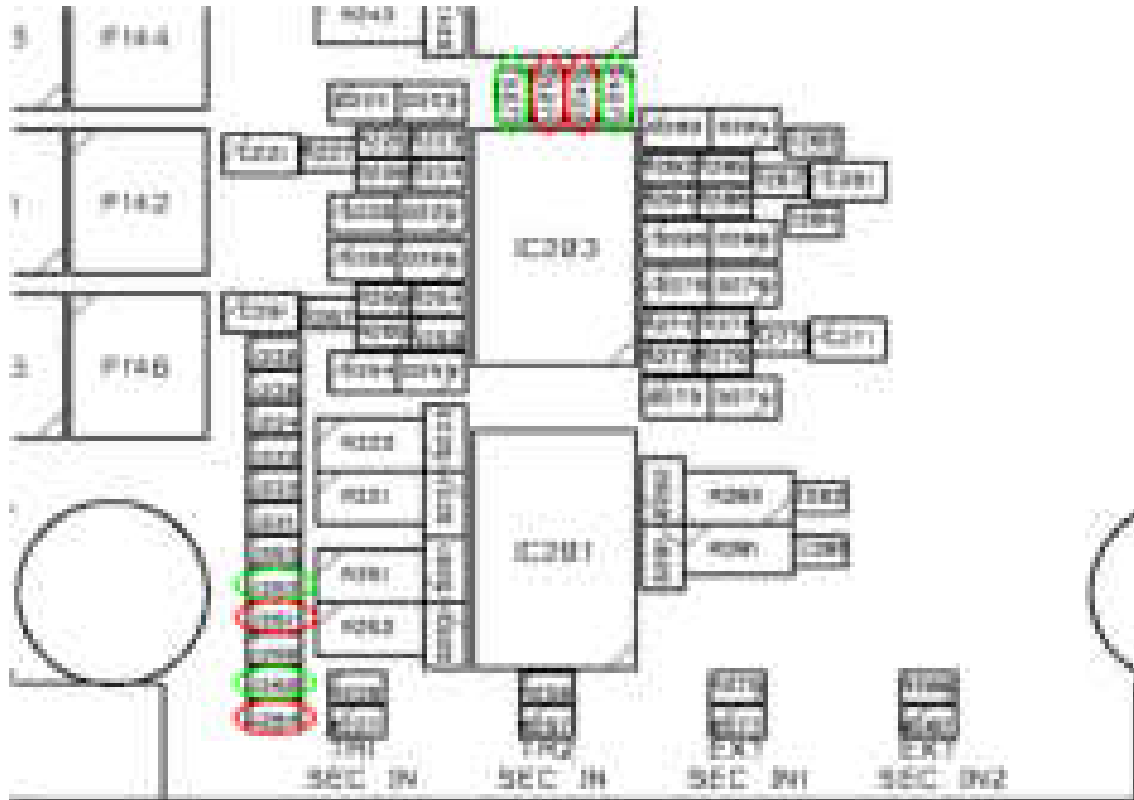


Figure 1-9: Interconnection board jumpers

## 1.1.6 SB421 Internal Battery Assembly

### 1.1.6.1 Battery kit maintenance

The battery is specified to a life time of 3-5 years depending on the use and environment. It is recommended that the battery is checked at least every second year and exchanged if necessary (please see chapter "Battery test SB421")

#### 1.1.6.1.1 SB421 - Installing batteries

##### 1.1.6.1.1.1 Preparation



**NOTE:** To prevent electrical shock, it is highly recommended to ensure that the battery terminals are disconnected and properly isolated, either with dummy terminal shoes or by isolating with thick tape, crimp hose or similar while removing and/or installing the batteries.



- Place the SB421 on the backside with the door opening facing upward
- Carefully unscrew the two screws holding the door cable assembly



Figure 1-10: Cable assembly

- Move the cable assembly to give access to the 1 nut holding the ground connection and the 4 threaded studs for battery base plate mounting
- Carefully remove the nut for grounding. Be careful not to damage the existing cabling



**RISK OF EXPLOSION, IF BATTERY IS REPLACED BY AN INCORRECT TYPE**  
Dispose of used batteries according to local rules

#### 1.1.6.1.1.2 Installation

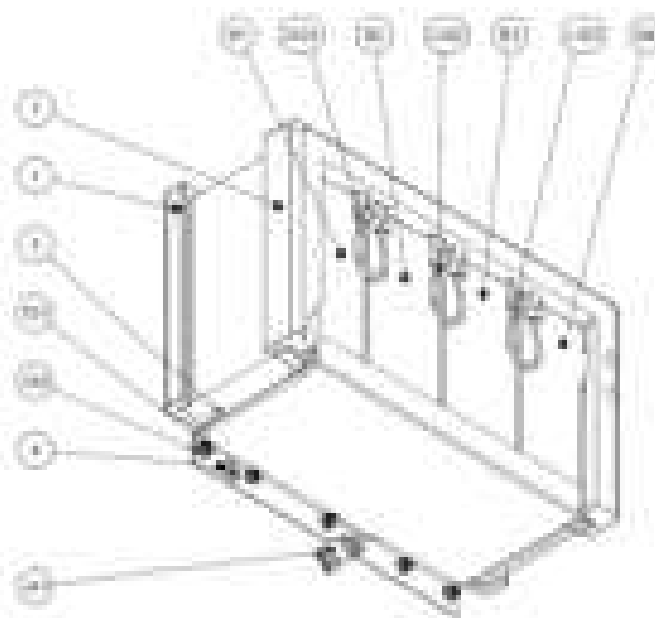


Figure 1-11: Internal battery assembly



- Install the “SB421 battery holder Lower” foam (pos.1) in the bottom of the SB421 casing.
- Install the “SB421 battery holder Upper” foam (pos.2) in the front of the SB421 casing
- Attach the blue wire of the battery cable (pos.J41) to the left terminal of a battery (pos.B1)
- Insert the battery into the battery holder foam and push the battery to the utmost left position.
- Attach the black wire of the battery cable (pos.J41) to the right terminal of a battery (pos.B4)
- Insert the battery into the battery holder foam and push the battery to the utmost right position.
- Insert the two remaining batteries (pos. B2 and B3) into the battery holder foam between the two already inserted batteries.
- Place the battery holder (pos.4) on the bottom of the batteries in such way that the threaded studs are fitting the holes of the battery holder. NOTE: Be careful to ensure the battery cable in placed on the outside of the battery holder.
- Mount and tighten the 5 washers and nuts (pos.101 and 102) and ensure that the grounding wire is placed under one of the nuts.
- Replace the door cabling assembly using the two screws previously removed.

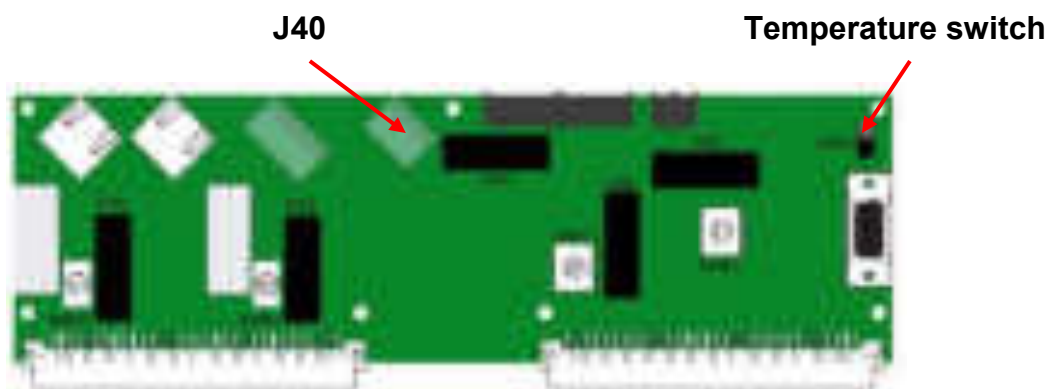


Figure 1-12: Interconnection Module

#### 1.1.7 External -48V battery kit (option) connection block

The 3 screw connection block for -48V DC, 0 and ground is located on the inner right side of the SB421 housing.

The SB421 is operated at -48V nominal DC (SELV) derived from the internal power supply. An internal or external battery pack may be connected for backup purposes.

In case of using an external battery pack; the plus pole of the battery pack shall be grounded with a 5mm<sup>2</sup> yellow/green wire.



**Note:** In case of using an external battery supply where the plus pole not is connected to ground then the connection shall include a disconnection device which disconnects both poles simultaneously,

otherwise there shall be a disconnection device, inserted in the connection to the minus pole.

The external battery pack consists of a DIN-rail containing a 10A circuit breaker, a 3-pol terminal strip, a 4-pol modular coupler and the necessary cabling.

The DIN-rail must be mounted as close to the external battery as possible.

When delivered, the temperature sensor cable is terminated with a 4-pol modular connector. Please cut the connector and mount the wires in the LSA block of the LAN/WAN connection module according to this:

SB421	Temperature	
J7	Sensor Cable	
Pin#	Function	Color
1	Gnd.	Yellow
2	+5V	Brown
3	/Data	Red
4	Data	Blue

**Figure 1-13: Temperature sensor**

**Note:** If an internal battery kit is mounted, pull out the battery connector J40 for the internal battery and insert the free connector for the external battery into J40 instead.

If no internal battery kit is present, the external battery plug is inserted from factory.




**WARNING:** Please observe polarity of the external battery leads. Serious damage to the SB421 **WILL** occur if not polarized correctly.

Also switch from internal temperature sensor to external temperature sensor using SW 171 on the interconnection board (top right hand corner)

- Unplug the external battery cable from J40
- Insert the internal battery cable plug into J40
- Place the battery temperature sensor switch in the upper position (internal battery)
- Connect the 3 jumper wires (pos.101-103) to the battery terminals.

The battery is now installed and ready for use.

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## 1.2 BS421- INSTALLATION

### 1.2.1 Environmental / climatic requirements

The Base Station is designed for outdoor operation, such that it can be placed in the antenna mast close to the antennas.

The Base Station is designed to be able to operate at severe environmental conditions.

The Base Station is guaranteed to operate under ambient air temperatures from –25°C to +55°C Celsius. Maximum BS421 cabinet temperature is +85°C. Storage temperature for the BS421 is from –40°C to +85°C.

Note that the guaranteed MTBF data is valid only within the standard specified temperature range

Screening of BS421 to specific customer defined temperature range (from -40°C to +55°C ambient air temperature) is optional upon request.

The Base Station encapsulation complies with IP65

### 1.2.2 Placement

The recommended placement of the Base Station is as close to the antennas as possible to reduce cable loss. The placement of the Base Station shall be such that it is securely fastened to a mast or building that is able to carry the weight of the BS421 and withstand the local environmental conditions. All cables, antennas etc. shall be properly fastened to the mast or building using appropriate fixtures as to avoid damage to the equipment and possible injury to persons.

### 1.2.3 Grounding

The BS requires careful grounding.

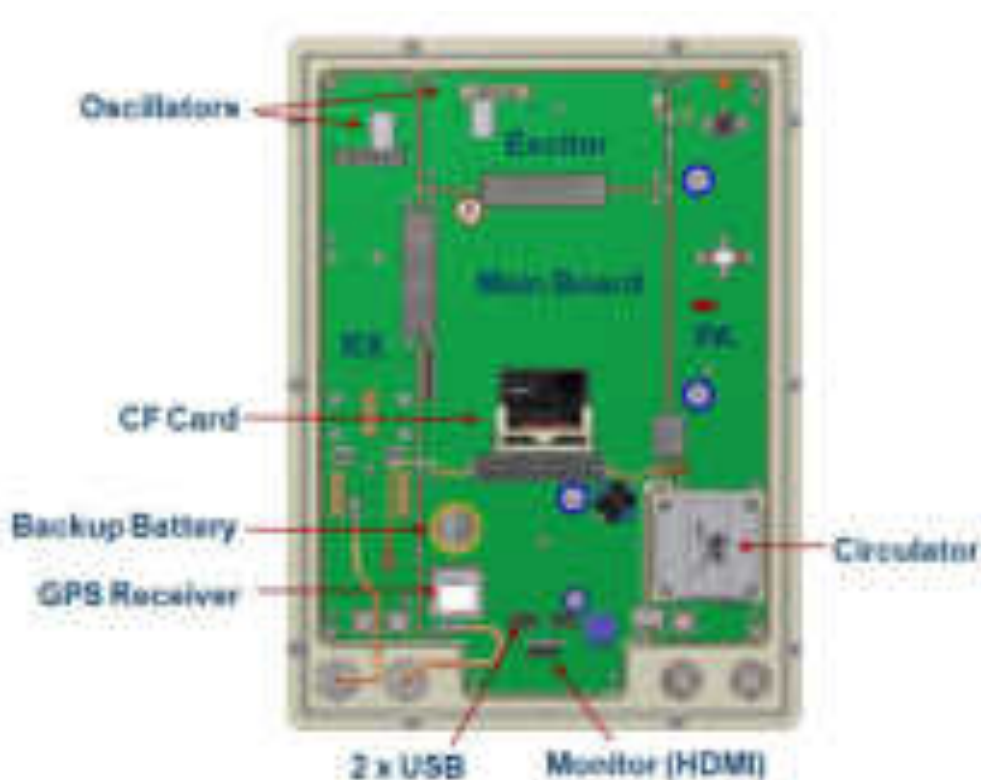
Grounding is important to protect the equipment when inserting/removing cables and to protect the operator from faulty equipment.

An effective grounding is also important to protect the installation during thunderstorm (lightning).

The grounding shall be as specified in paragraph “1.2.6 Power connection to SB421”

## 1.2.4 BS421 main components

Filter cover and filters removed. BS viewed from the filter (back) side



**Figure 1-14: BS421 main components**

The HDMI monitor connector together with the USB connector allows a connection of a standard monitor and mouse/keyboard connection

If monitor, keyboard and mouse are connected, the WindowsCE operation system in the BS421 can be accessed directly for configuration or fault finding purposes

To access the connectors, remove the filter cover

To access the CF card also remove the filter mounting plate

The connectors need not to be unscrewed, just carefully lift the filter base plate slightly and the CF card can be removed / inserted

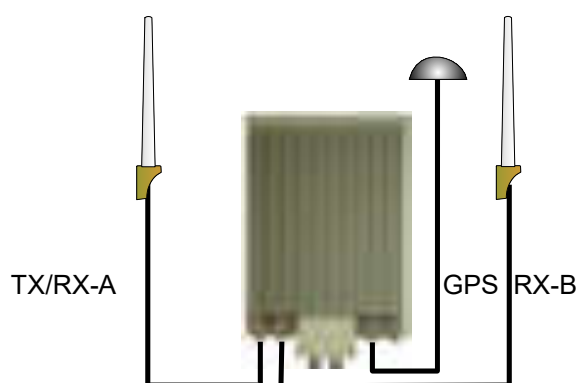
### 1.2.5 Attaching RX/TX antennas

Before installing the Base Station please read the application note in this manual about the Antenna Systems.

The following antenna cables shall be attached:

#### 1.2.5.1 Single Carrier BS installation recommendation (1 x BS421)

- 3 cables to the BS421 (one for Tx/Rx-A, one for Rx-B, and one for GPS)

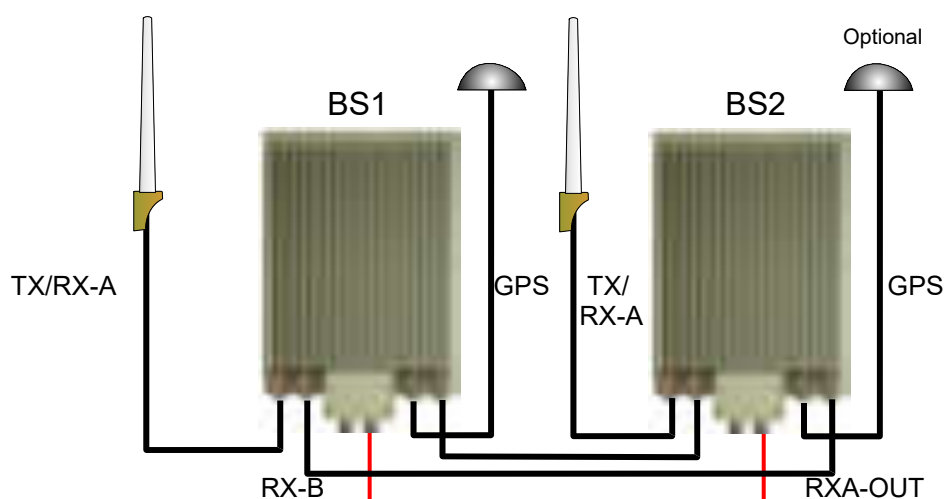


**Figure 1-15: Single carrier**

NOTE: The BS421 will function with only Tx/Rx-A and without GPS antenna with the following limitations:  
Timing via GPS will not be available (BS421 runs on internal oscillator - Not recommended) and there will be no Diversity when only using on Rx antenna.

#### 1.2.5.2 Dual Carrier BS installation recommendation (2 x BS421)

- Cables to the 2 x BS421 (two for TX/RX, two for GPS and two for RX-B / A-OUT between the BS421's)



**Figure 1-16: Dual carrier**

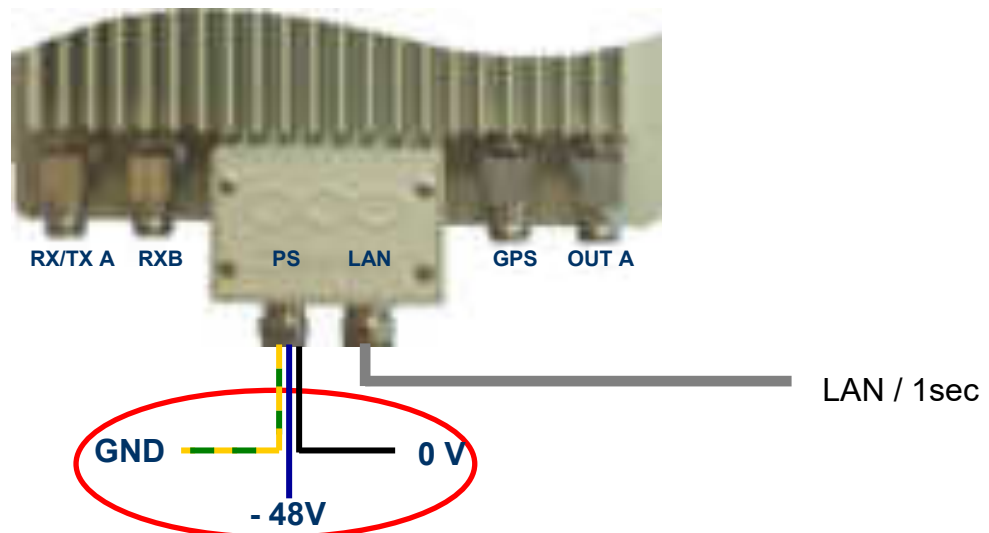
NOTE: The shown cable (red) is part of the LAN cable and is connected through the SB421.  
Cable is shown for system overview only.

NOTE: 2 x BS421 with 2 GPS antennas will provide full GPS redundancy  
(Antenna and GPS receiver)

## 1.2.6 Power connection to SB421



**Before starting this task, please read the entire chapter carefully.**



**Figure 1-17: Power connection**

The BS421 is operated at -48V nominal DC SELV (Safety Extra Low Voltage). The provision of power is done via the SB421 TR1/TR2 connection module. See the SB421 installation section for information on the connection pin out for SB421.



**DO NOT UNDER ANY CIRCUMSTANCES USE A POWER SUPPLY THAT HAS THE MINUS CONNECTED TO POWER SUPPLY CHASSIS**



The cables used for power supply must be equal to or more than 3 x 1,5mm<sup>2</sup>

Connect the three wires in the power connection cable according to the color markings inside the BS421 system connector.

### 1.2.6.1 System Connector

Use a LSA tool for the Ethernet connection

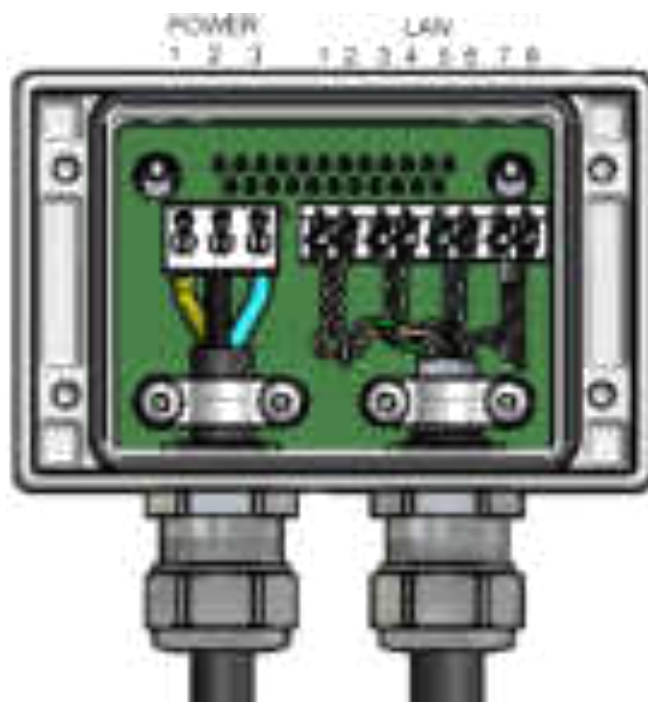


Figure 1-18: System Connector

Connect the following terminals:

**NOTE:** Cable used must be 0.4mm<sup>2</sup> to 0.6mm<sup>2</sup> (24AWG) solid cores

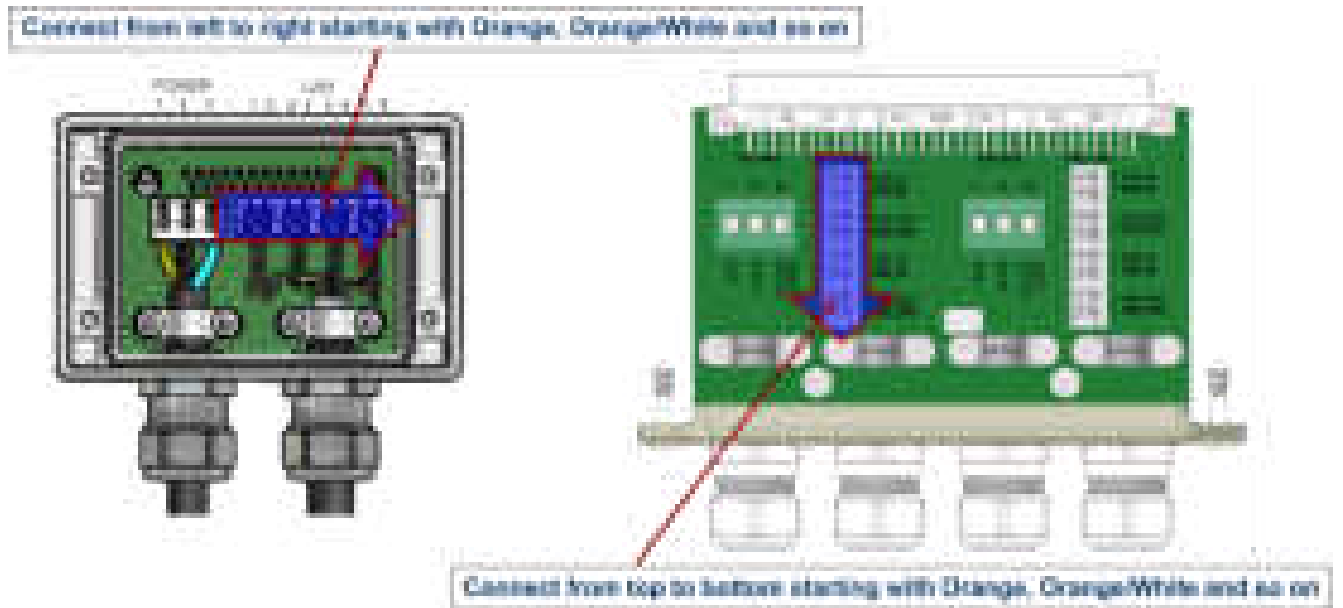
Function	SB421	Function	BS421	Color
<u>ETH_IN</u>	8	<u>ETH_OUT</u>	1	White / Orange
<u>ETH_IN</u>	7	<u>ETH_OUT</u>	2	Orange
<u>ETH_OUT</u>	6	<u>ETH_IN</u>	3	White / Green
<u>ETH_OUT</u>	5	<u>ETH_IN</u>	4	Green
<u>SEC_IN</u>	4	<u>SEC_OUT</u>	5	Blue
<u>SEC_IN</u>	3	<u>SEC_OUT</u>	6	White / Blue
<u>SEC_OUT</u>	2	<u>SEC_IN</u>	7	White / Brown
<u>SEC_OUT</u>	1	<u>SEC_IN</u>	8	Brown

POWER:

**NOTE:** Cable used must be equal to or more than 3 x 1,5mm<sup>2</sup> (e.g. DAMM no. 883013)

Ground	GND	1	Yellow/Green
0	+	2	Black
-48Volt	-	3	Blue

### 1.2.6.1.1 Easy connection scheme

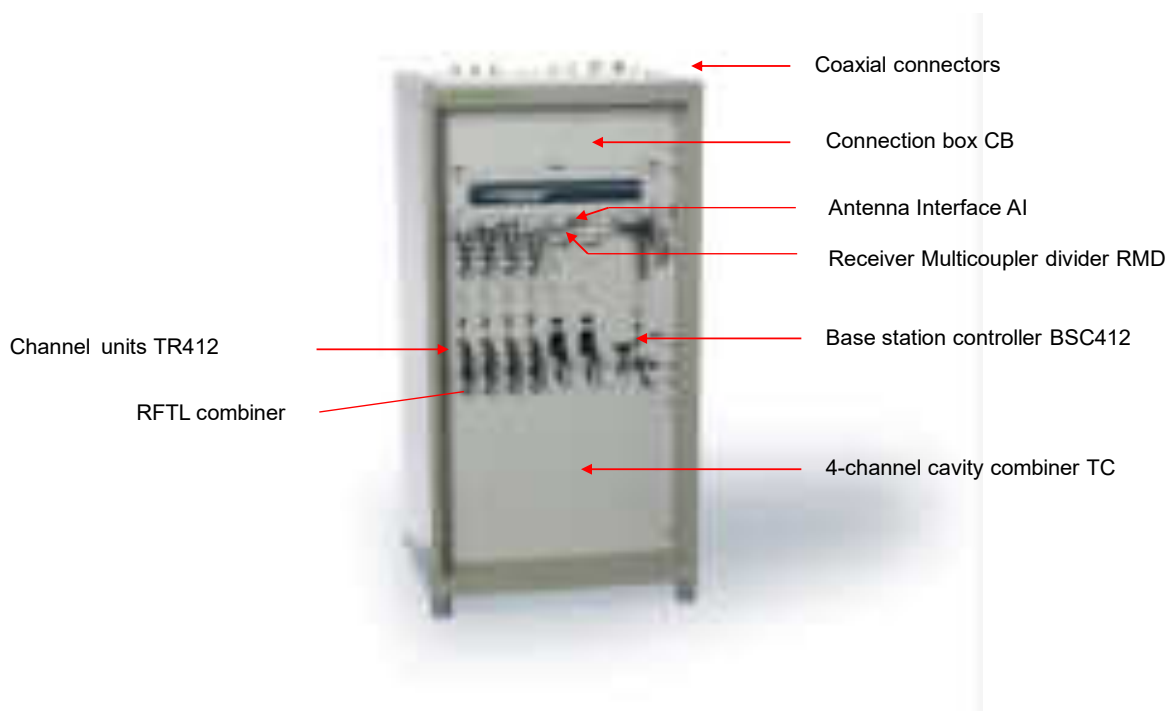


See the SB421 installation manual for further details,



## 1.3 BS41x - INSTALLATION

### BS 414



#### 1.3.1 Environmental/climatic requirements

The Base Station is designed to be able to operate at severe environmental conditions. It is however recommended to install the BS in rooms with controlled environmental conditions in order to optimize its reliability and lifetime.

It is important, that the room is free of dust. Condensing humidity is not allowed.

The Base station is guaranteed to operate from  $-20^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ .


Note that the guaranteed MTBF data is valid only within the standard specified temperature range

The BS41x encapsulation complies with IP20

#### 1.3.2 Placement

The Base station shall be placed on a solid floor. It can be either free standing or standing with the rear against a wall. For normal service rear access to the BS is not needed.

After placement the four legs under the BS can be adjusted for accurate vertical position to compensate for an uneven floor.

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In areas with the possibility of earthquakes, it is recommended that the BS be secured to the floor with bolts. Access to the base may require removal of the lowest TX combiner in the rack.



Figure 1-19: Level adjustment

### 1.3.3 Grounding


The BS requires careful grounding. For temporary operation, the mains earth connection can be used. For permanent installations an effective ground shall be established and connected to the grounding screw on the rear right top of the BS with a 15sq. mm yellow/green wire.

Grounding is important to protect the equipment when inserting/removing cables and to protect the operator from faulty equipment.

An effective grounding is also important to protect the installation during thunderstorm (lightning).



Figure 1-20: Grounding

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### 1.3.4 Attaching antennas

Before installing the Base Station please read the application note in this manual about the Antenna Systems.

The following antenna cables shall be attached:

If the jumper between ANTA and RXOUT is NOT connected (Separate RXA, RXB and TX antennas)

- 3 cables to the TMD412 (two RXA and RXB and one for Test)
- 1 cable to the TX antenna
- 1 or 2 cables to the GPS antennas

When a jumper coaxial wire is connected between ANTA and RXOUT on the TMD.

- 3 cables to the TMD412 (one RXA/TX, one RXB and one for Test)
- 1 or 2 cables to the GPS antennas



Figure 1-21: Antenna connectors

### 1.3.5 BS41x Status and warning LED's:

Device	Label	LED	LED on Means
<b>BSC412</b>	POWER	Yellow	Power On
	ACTIVE	Green	BSC Active
	BSC		NC*
	CP	Red	Coprocessor alarm present
	GPS	Red or blinking	GPS alarm, no or low signal from GPS antenna(L1 blinking Red) or error in GPS receiver, (L2 - Red)
	MISC and SIGN		NC*
<b>PS411</b>	POWER	Yellow	Power On
	RECTIFIER	Red	230V to 48V rectifier power missing (ex. 230 switch off) latching alarm
	CHARGE	Green	Battery charging
	DISCHARGE	Red	Battery is discharging
	+14V	Red	Alarm on +14 supply (14V missing)
	+26V	Red	Alarm on +26V supply (26V missing)
	PS	Red or blinking	Power supply alarm (blinking when output switch is off) latched alarm
<b>TR412</b>	PWR	Yellow	Power on
	TETRA	Green	Tetra Mode on
	TX	Green	Transmit power on
	NMT	Green	NMT mode (not used in TetraFlex)
	LB	Red	Local Blocking on
	TX	Red	Transmitter alarm
	RFTL	Red	RFTL output active (used for testing)
	RX	Red	Receiver alarm
	PCM	Red	Alarm on internal bus (clock signal missing) ex. when BS is not configured
	DSP	Red	Digital Signal Processor alarm
	HW	Red	Hardware error
	ANT	Red	Antenna or Combiner alarm
	H/E	Red blinking	External alarm active (ex. door open)
	RM	Red or blinking	Receiver Multicoupler divider alarm (TMA or AI) L1 Blinking Red, L2 Red
<b>AI</b>	PWR (A and B)	Green	Power on
	TMA (A and B)	Red	TMA alarm (ex. power to TMA missing)
	AMPL(A and B)	Red	AI amplifier alarm
	PWR (testloop)	Green	Power on
	ANT (testloop)	Red	Antenna test on
<b>RTC</b>	Led(s) on	Red	Blower alarm(s)
Power on cycle or re-initializing	ALL	ALL LED's	All LED's ON or blinking in different pattern, BSC412 and TR 412 SW is not running or is initializing after restart

Figure 1-22: BS41x LED's

\*NC: Not Connected - this LED are not assigned to any function.

### 1.3.6 Connection to Battery

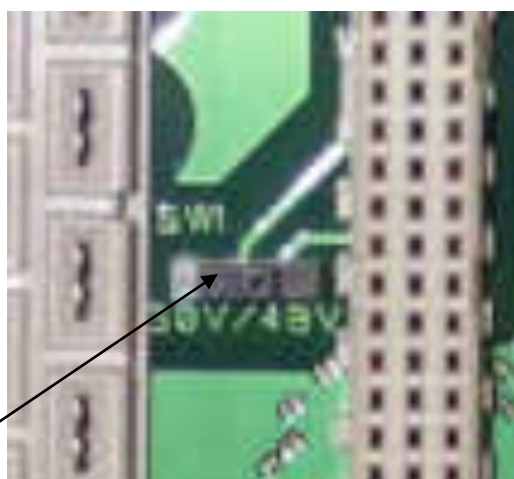
Before starting on this point please read the section 1.3.9.3 in this manual about Battery attachment.

The BS may be connected to a 48V battery, which the BS can charge.

The Base Station is prepared for –60V battery operation, wherefore a switch is placed on the back plane of the BS to indicate to the PS411's, whether a –48V or –60V battery is used.

Note that the present version of PS411 can only operate with –48V DC, wherefore this feature is not active, and the switch shall be placed in the –48V position.

The Switch is accessible by removing the PS411 Power Supplies.




**Figure 1-23: Power selection**

Left position = 60V, Right position = 48V

The external battery shall be connected in the connection box in top of the BS. Minimum recommended cables dimension is 10mm<sup>2</sup> with black for plus (ground) and blue for minus.



**Figure 1-24: Power terminals**

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The battery connection shall be provided with a circuit breaker close to the battery to protect against over-current at short circuits in the connection cable or internal in the Base Station.

If the BS shall charge the battery, the TS411 Temperature Sensor shall be placed at the battery and connected to the BS in the connection box.



**Figure 1-25: Temperature sensor connection**

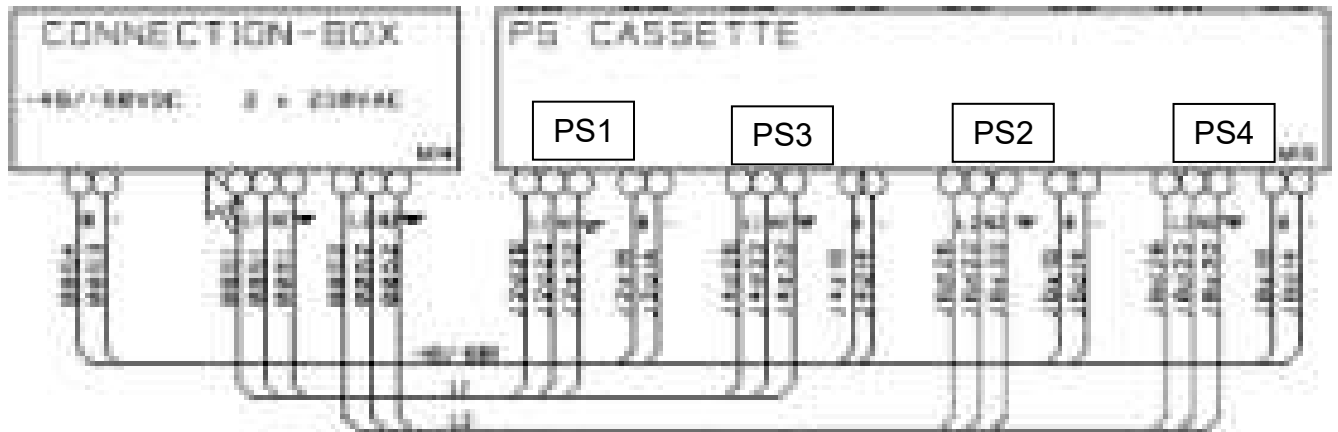
The plus pole of the Battery shall be grounded with a 15mm<sup>2</sup> yellow/green wire. A protective ground connection shall also be established from the Battery to the BS.

**Note:** In case of using a DC mains supply where the plus pole not is connected to ground then the connection to the DC mains supply shall include a disconnection device which disconnects both poles simultaneously, otherwise there shall be a disconnection device, in the connection to the minus pole.

### 1.3.7 Connection to AC Mains

The BS is provided with Power Supplies supporting direct connections to 100V-240V AC and 47-63 Hz, one phase. Mains connection shall not be established, when the BS is running on an external battery with separate charger.

Mains are connected in the connection box (See 1.3.8). Two separate connections are available and both shall be connected. The first (and third) PS411 is powered from the left connection and the second (and fourth) PS411 from the right connection. The split makes it possible to run the BS on two different mains phases to obtain redundancy in case of a phase dropout (fuse blown). The two connections can also be parallel connected in the BS.



The mains connection is provided with a protective earth connection. If a separate earth connection is provided on the BS, it is recommended to leave it open.



Figure 1-26: Mains connection block

**Note:** Each of the installed power supplies are individually connected to the AC mains therefore in order to disconnect the Base Station from AC mains, the AC switch of all installed power supplies shall be switched to off.

**Note:** It is recommended that the main power installation includes short circuit back protection which reacts in case of the current is exceeding 16A.

### 1.3.8 Connection Box CB412



**Figure 1-27: Connection box**

#### 1.3.8.1 Ethernet connect

Eight Ethernet connections are present for BSC1 and BSC2:


- BSC1 LAN1 and BSC2 LAN1 for connection to other nodes, routers, log server, Network Management etc.
- BSC1 LAN2 and BSC2 LAN 2 is for local connection ex. a Local PC for service and monitoring etc.
- BSC1 WAN1 and BSC2 WAN1 are for connection to corporate network, SIP units, Remote desktop, Switch board (PABX), Dispatchers, API application etc.
- BSC1 WAN2 and BSC2 WAN2 are for local connections ex. a local PC for service and monitoring etc.



**Figure 1-28: CB412 connection board**

The connection from BSC1 and BSC2 is coming from the LAN and WAN connector on the front of the BSC412 front plate and connected on the backside of the connection box and split out to LAN1 / LAN2 and WAN1 / WAN2.



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**NB: When using two BSC412's there is a connection between the BSC1 and BSC2 LAN and WAN on the backplane connection, this will be switched off by an electronic switch device when there is an activity in both BSC1 LAN1 and BSC2 LAN1 and the same goes for the WAN connector. This is to avoid looping of the signals**

**There is no disconnecting of the signal on the backplane if using the TEST / Laptop connection so please be carefull if connecting this to avoid IP – loops !**

See also section 2.7.3 for Ethernet software configurations description.

### 1.3.8.2 External alarm connections

The BS is provided with 8 external alarm inputs. One of these is reserved for the “Door Open” alarm and the rest are currently not pre-defined for a specific function. All alarm inputs are provided with a 1Kohm resistor to +5V. To activate an alarm the input shall be grounded.

The BS is also provided with 3 alarm outputs for L1,L2 and L3 alarms. The outputs are open collector outputs capable of sinking 0.25A. The outputs are protected for inductive transients with 36V zener diodes.

The alarm connections are provided with LSA-type connections, accepting **solid** wires with the dimension 0.4mm<sup>2</sup> to 0.6 mm<sup>2</sup>.

### 1.3.9 Back-up battery for BS41x

#### 1.3.9.1 Introduction

This application note describes how to attach a backup battery to the BS41x Tetra Base Stations.

All the BS41x versions are powered with one or several PS411 Power Supplies.

The PS411 can be powered directly from an external DC source of –48V.

The PS411 can also be powered directly from AC mains of 100 to 240V, 47-63Hz without any battery backup. This mode is convenient at test of the Base Station.

The standard installations, however, is the combination of AC mains power feed with a –48V lead-acid backup battery connected. The PS411 has all the built-in features to have the battery connected and charge it. This allows uninterrupted service for a period depending on the size of the battery. For very service-critical systems this can be extended with a Diesel generator starting automatically after a certain period of battery operation.

All BS versions can be connected to an external –48V lead-acid battery. The external battery kit includes a circuit breaker to protect the battery and the TS411 temperature sensor to allow the PS411 to provide a temperature compensated charging voltage.

### 1.3.9.2 Selecting external batteries

Several issues should be taken into account, when selecting batteries. In general, only battery types intended for use as back-up battery in telecom systems should be used.

The battery lifetime is a critical parameter. High quality back-up batteries normally have a specified lifetime of 10-15 years at normal room temperature.

The batteries should also be of the gas-tight type when co-located with the BS to avoid corrosive gases, which may damage the electronics.

A battery capacity of 48V 50Ah would be a typical choice for a 4-carrier BS. The picture below shows an example of such a battery.



The following estimated back-up times is being achieved with a 50Ah battery (weight about 130kg):

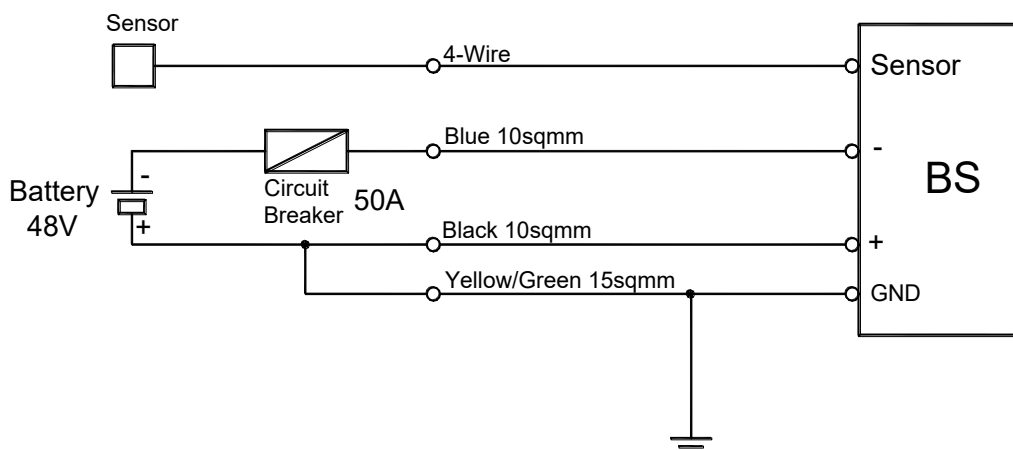
Base Station size	Current	Backup time
2-carrier	6A	8 hours
4-carrier	11A	4 hours
6-carrier	16A	2.5 hours
8-carrier	21A	1.8 hours

Note that for higher load current the efficiency of the battery drops considerably below the 100%.

For the 8-carrier Base Station a 100Ah battery could be considered (weight about 250kg).

### 1.3.9.3 External battery installation

The connections needed for the battery attachment is shown on the schematics below



The minus pole of the battery shall be provided with a circuit breaker as close to the battery as possible in order to protect for any excess current flow at a short circuit. The nominal current shall be higher than the peak charging/discharging current to avoid unintended disconnects.

The Base Station should be connected to the battery with 10 mm<sup>2</sup> blue and black wires. In addition, a 15mm<sup>2</sup> yellow/green wire shall connect protective ground on the rack to ground on the battery, which should be connected to the plus-pole of the battery. The Base Station itself (and optionally the battery) shall be provided with an effective grounding.

The TS411 temperature sensor shall be located at the battery and connected to the BS in the connection box with the delivered 10m of cable. The cable is a standard 4-wire telephone cable provided with two 4-pole RJ11 plugs (narrow types). The cable can be extended if needed.

### 1.3.9.4 Battery charging

The PS411 contains configuration settings to control the charging of a –48V battery. If charging is not selected the PS411 gives a fixed output voltage of –48V DC.

If charging is selected and the TS411 is properly attached, the PS411 changes to charging mode. The output voltage is then increased to the correct charging voltage selected with the configuration settings normally controlled from the BSC.

The output voltage is calculated from the nominal charging voltage at 25 Celsius, e.g. 2.25V DC per cell and the required temperature compensation, e.g. –72mV per Celsius. With these values the voltages would be:

Temperature	V-charge
-20 Celsius	57.2V
+25 Celsius	54.0V
+55 Celsius	51.8V

#### 1.3.9.5 Battery deep discharge protect

The Base Station is provided with a feature to switch off the load, when the battery is close to being discharged in order to protect the battery.

The Base Station is prepared for –60V battery operation, wherefore a switch is placed on the back plane of the BS to indicate to the PS411's, whether a -48V or -60V battery is used.


Note that the present version of PS411 can only operate with -48V DC, wherefore this feature is not active, and the switch shall be placed in the –48V position.

Battery	48V
Turn-on voltage	45.0V
Turn-off voltage	40.0V



## PART-2: SW Installation and Configuration

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## 2.1 BASIC SYSTEM PARAMETERS

TetraFlex® 7.60 software is not compatible with earlier versions, and nodes with e.g. version 7.4 and 7.5 cannot interact with nodes with version 7.6

Please consult the document “Update guideline for ver.7.x to 7.60” for upgrading to TetraFlex 7.60


### 2.1.1 System capability

The System is preconfigured with the full TetraFlex® SW package, but some functions may be restricted by the dongle setting.

The following is the compiled Standard software parameters of the system, but they can be increased on request. The max numbers can be decreased by dongle setting. Readout can be done with TetraOM command and the Dongle Reader program. The system can be ordered as “Standard” and “Optional Enhanced” system size.

Function	Standard	Optional Enh.	Dongle
Organizations max.	1.000	1.000	Yes
Profiles max.	10.000	10.000	Yes
Subscribers max.	20.000	150.000	Yes
Nodes max.	254	999	Yes
Voice GW connection max.	32	32	Yes
Application GW connections max.	20	20	Yes
Application GW Streams max.	100	100	Yes
Application GW Streams/Application max.	32	32	Yes
Terminal GW Connections max.	200	200	Yes
Terminal GW Streams max.	200	200	Yes
Terminal GW Streams/Term max.	2	2	Yes
Numbers of Log servers max.	25	100	Yes

You can check these parameters with OM command: S00/C

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## 2.2 VIRUS PROTECTION

### 2.2.1 Introduction

The DAMM system is designed with the LAN area as a completely closed IP area without any connection to the outside world.

That means, that BSC's, TR's etc. without a WAN connection cannot access the outside world and cannot be accessed from the outside world.

Only system components with a WAN connection have a risk to get infected, including Gateways, Log Servers, Terminal Servers etc., all entities, which - if present need external access.


Regarding system components WITHOUT a WAN connection, it is most safe to proceed without any virus protection. This is of cause under the presumptions that the operator has control with external media as USB sticks, CD etc. These media must be virus free before inserted or connected to the system. Installing a virus protection would create the need of opening up access to an update server, which would increase the risk that viruses could penetrate into the internal LAN area.

### 2.2.2 Virus Threat

The major threat for a system is that viruses will infect the system components with WAN access. These components will either be a Damm BSC running Windows or a PC with a full Windows installation. The major source of infection is normally via E-mails and via Home pages. It is therefore strongly recommended never to use any computer in a system for these tasks.

#### 2.2.2.1 Standard PC

For standard PC's running Windows and used for tetra applications or running a BSC the firewall can be kept activated. It is just needed to include the programs in the exception list. Window XP SP3 and Windows 7 ask automatically, whether you want to do that. In addition, it is recommended to have an anti-virus program running on these computers. Internally at DAMM, AVG antivirus is used and can be recommended. This gives a reasonable protection, and no issues have been seen regarding conflicts between AVG and Tetra applications. The Log Server (TetraFlex® only) could have some performance degradation during scanning, whereas the BSC is running with higher priority and is not expected to be degraded. Scanning should be setup to run in the night when system activity is low. No experience has been gained with other anti-virus programs.

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### 2.2.2.2 BSC

Regarding the DAMM BSC's running Windows Embedded the risk of infection is much lower as a lot of the services giving problems are not installed here, although the risk of infection still exists. Attempts have earlier been made to get AVG installed, but AVG does not accept the product code of Windows Embedded, and DAMM has not succeeded to get AVG to implement the needed changes.

### 2.2.3 MS Security Essentials

Microsoft has recently released their new Microsoft Security Essentials. At present this is not compatible with the BSC.


In case installation has been attempted, an error message

***DATA ENCRYPTION detected an error in the protocol stream and has disconnected the client*** may appear when attempt is made to connect via the remote desktop

To correct this, refer to the following Microsoft KB article

<http://support.microsoft.com/kb/323497>



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## 2.3 DONGLE CONFIGURATION

### 2.3.1 License Dongles

#### 2.3.1.1 Site versus Node:

Until the DAMM TetraFlex® system software was introduced the word “Site” has been used to indicate number of Radio Sites in a system. There was coherency between number of “Sites” and number of “Radio sites”.

The DAMM TetraFlex® concept opens for “Sites” that is not a “Radio site” but a “Gateway site”, a “NM site” or a “Log Server site”, and that one physical “Site” can be both a “Radio site” but also a “Gateway site”.

Therefore “Node” is introduced.

A node is consequently:

Any PC running BSC.exe software, except for a redundant BSC that belongs to the same node.

A site is consequently:

The geographical position of nodes or equipment

#### 2.3.1.2 Dongle types

NOTE: TetraFlex® V7.20 and forward require a new type of dongle. If no encryption key is required in the dongle, it is possible to order a number of empty spare dongles and remotely upgrade these as needed. If encryption key is required and dongle is to be used at the node containing the master subscriber register, the dongle must be ordered from DAMM sales.

Currently there are these types of dongles:


- Node license dongle
  - Including possible settings for Node, Application GW, Terminal GW, Packet Data GW, Voice GW and Log Server
- API client dongle/ Dispatcher dongle
- Log Server/ log client dongle
- Spare dongle

All dongles are programmed with:

- Dongle hardware serial number.
- DAMM dongle serial number.

A Node dongle is programmed with:

- Application Date Limit.
- Dongle Date Limit. (This is intended for demo system and special projects only and will as default be set to infinity).
- Nodes Max (must be equal to or higher than the highest defined node number)
- Radio Cell TR's max

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- Voice Gateway connections max
- Packet Data Gateway
- Application Gateway connections max
- Terminal Gateway connections max.
- Voice Streams max
- Air Interface Encryption
- Air Interface Encryption KSG

An API Client dongle is programmed with:

- Dongle Date Limit
- Dispatcher, Yes - No

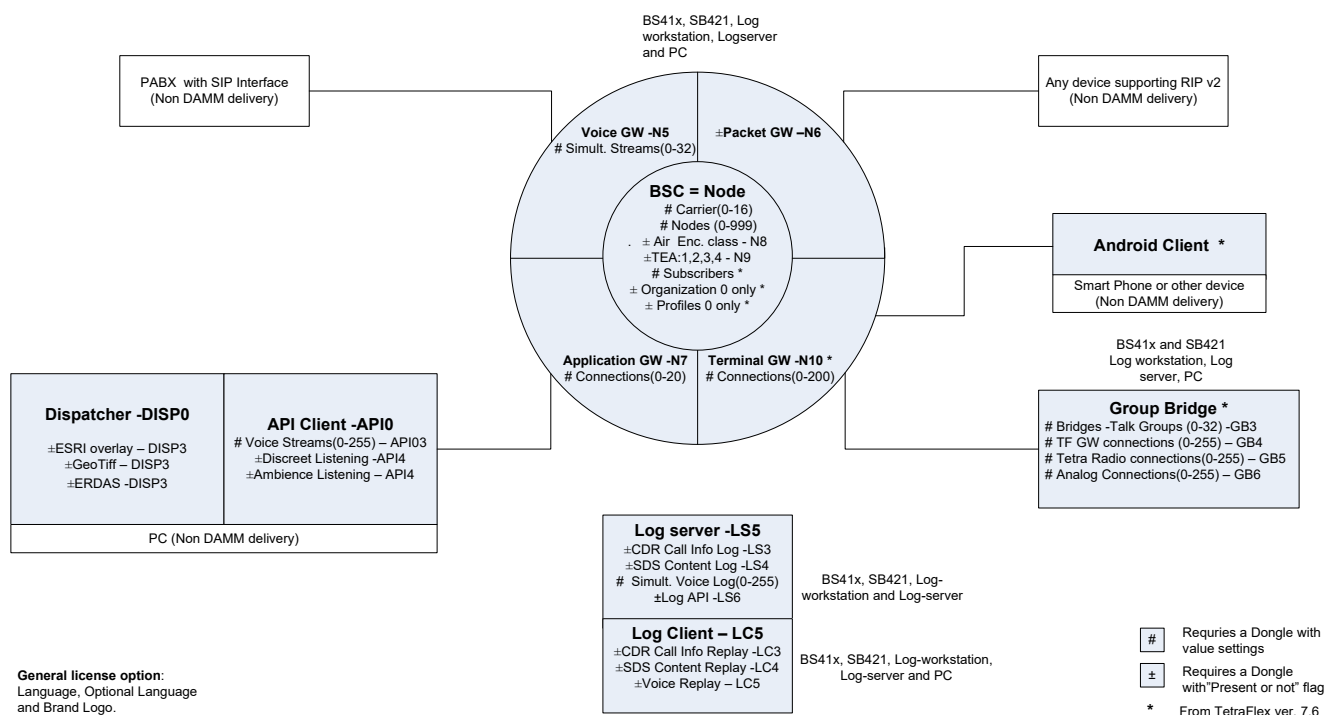
A Log Server dongle is programmed with:

- Dongle Date Limit
- Application Date Limit
- Call Info Log
- SDS content Log
- Voice Log Max

By means of the dongle read out software or the TetraOM commands the End-User can read:

- Dongle hardware serial number
- DAMM dongle serial number
- System and Node license's settings.

#### TetraFlex ver. 7.6 License overview



### 2.3.1.3 Dongle Update

The dongle can be reprogrammed by means of an update file. The file can be sent by e-mail from DAMM to the Partner, and downloaded locally to the system by means of the Remote Desktop icon in the node and thereafter executed. The update file is linked to the Dongle hardware serial number and can only be executed on the node where the specific dongle serial number is installed. The update file (.exe file) can be placed on any driver on the target e.g. C:\ or the desktop and executed from there.

It is also possible to mount the Dongle in a USB port on a PC for updating and execute the license .exe file from here.

The update is not active before the BSC or the application (ex. Dispatcher, Log server) is restarted.

The special encryption key cannot be updated. The dongle must be returned to DAMM for change/update of encryption key, but other parameters may be upgraded remotely.

### 2.3.1.4 Spare part Dongle:

- A Spare Part Dongle will be offered at a nominal price. If used in the node containing the master subscriber register, the dongle can only be used as spare dongle if the

original dongle has no encryption key programmed. In case that encryption key is present, the replacement dongle must be ordered from DAMM sales.

- An order for Spare Part Dongles shall follow the Administrative procedure for ordering.
- A Spare Part Dongle is programmed with all settings at “zero”.
- When needed, the Partner must inform DAMM about the serial number of the faulty / missing dongle and DAMM will send a mail with a file containing the System and Node license’s settings from the original dongle.
- An invoice will be issued with the value of the System and Node licenses in the dongle, which will be credited when the original dongle is received by DAMM

### 2.3.1.5 Dongle exchange and information of content

At startup the BSC.exe is checking if a dongle is present, and if missing or the Dongle date limit has expired, the BSC will not start.

To view the preprogrammed BSC settings in the dongle, the following TetraOM commands may be used:

S04            Shows the license settings of the dongle for the BSC:

```

S04
***** TetraFlex License Dongle *****
03 Damm Serial Number..... 09001421
05 Brand..... DAMM TetraFlex
06 Language..... 01 English only
07 Language 2..... 01 none
15 Key Ref. Serial Number... 09001421
Security Key Register..... YES
***** BSC Node Dongle block *****
01 Dongle Date Limit..... Unlimited
02 Application Date Limit... 2030-01-01
03 Nodes max..... 354
04 Tetra Cell TMs max..... 8
05 Voice Gateway conn. max.. 12
06 Packet Data Gateway..... YES
07 Application Gateway max.. 1
08 Air Interface Encryption.. YES
09 B00: AIR *SG TEA1..... YES
   B01: AIR *SG TEA2..... YES
   B02: AIR *SG TEA3..... YES
   B03: AIR *SG TEA4..... NO
   B16: Organization ID only.. NO
   B17: Profile 0 only..... NO
10 Terminal Gateway max.... 0
11 Subscribers max..... Unlimited

```

Figure 2-1: Dongle Readout

### 2.3.1.6 Dongle Reader:

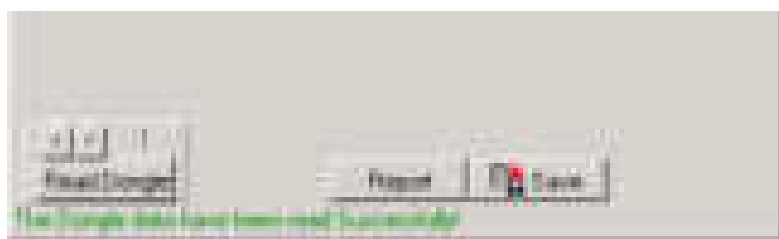
The total numbers of dongle settings can only be shown with the license dongle reader program that can be found on the “Startmenu” – “Tetraflex” – “Dongle” – “License dongle”:

You can also make a copy of the The dongle reader program folder and place it on a PC for investigating dongles.

In the top of the Dongle reader program there is a number of tabs that show what contents the dongle has . The “Dongle” tab is always present. If a tab is set to None there isn’t any license programmed for that tab:



The Read Dongle button can be used for re-read a dongle. This has an option so that you can have more dongles in a PC and even in a BS412 or SB421 and by selecting the number you can read the contents of this dongle. The Report button starts a reporting tool that reports the contents of the dongle. The Save buttons saves a text file with information of the dongle contents.



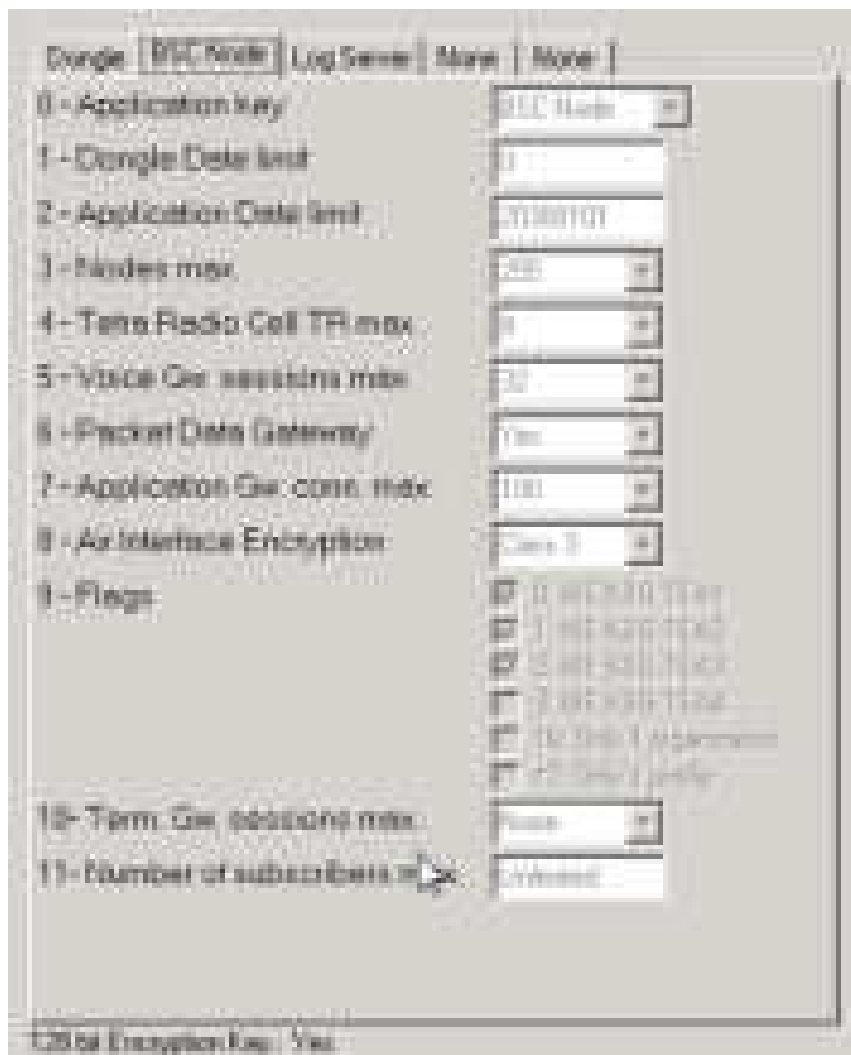
### Dongle:



Item	Value
1 - Reserved	0
2 - Reserved	0
3 - Device Serial Number	1000000000000000
4 - TetraFlex Dongle Code	1000000000000000
5 - Brand/Logo	0 - DAMM TetraFlex
6 - Language 1	0 - English
7 - Language 2	0 - None

- DAMM serial number (the dongle hardware number can be read by S04/I)
- Brand, in this case DAMM TetraFlex® (OEM version are available)
- Language
- Key Ref. Serial number and if the “128 bit Encryption” is set to YES the dongle is programmed with a security key for Authentication / Encryption

## BSC Node:



- Dongle Date Limit: If set, the dongle ceases operation when the specified date is reached
- Application Date Limit: The License Dongle check date in the SW package is compared to this date for SW update allowance
- Nodes Max: The maximum node number which can be defined in the system
- Radio Cell TR's max: Maximum allowed transceivers per radio cell
- Voice Gateway Conn. max: Maximum telephone connections per node
- Packet Data Gateway: Packet data allowed or not
- Application Conn. max: Maximum application connections (API interfaces)
- Air Interface Encryption: Encryption allowed or not
- Air Interface Encryption: The encryption Class used (Class 1-3)
- Flags: The Air encryption type used in the BS (TEA1, TEA2, TEA3 or TEA4)
- If the Only one Organization and only one Profile flags is set means that there is a limit on only using 1 Organization (org. 0) and 1 Profile.
- Terminal Gateway max: Maximum terminal connections (Group bridge and Tetraflex Clients)
- Numbers of subscribers max.: The max. number of subscribers that can be defined and used.

The next dongle settings are not shown with the S04 command only in the Dongle reader program:

### Log Server:



- Dongle Date Limit: If set, the dongle ceases operation when the specified date is reached
- Application Date Limit: The License Dongle check date is compared with this date for SW update allowance
- Call Info Log: Call information logging (CDR) set Yes or No
- SDS content Log: SDS contents logged Yes or No
- Voice Log Max: Maximum of voice streams that can be logged simultaneously
- Output Destination:
  - SQL DB: The logs are stored in the SQL database,
  - API: the logs can be streamed to an external application using the Log API interface.

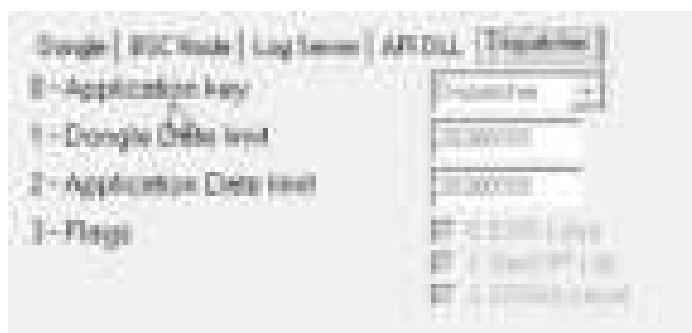


## API DLL:



- Dongle Date Limit: If set, the dongle ceases operation when the specified date is reached
- Voice Streams max: Number of simultaneous voice streams in the application
- Flags: Discreet listening – if flag is set discreet listening into an ongoing calls is possible on the API (e.g. when using the dispatcher)  
Ambience listening- if flag is set ambient listening is possible on the API (e.g. In the dispatcher)
- Application Server:(not included in this version)

## Dispatcher:



- Dongle Date Limit: If set, the dongle ceases operation when the specified date is reached
- Application Date Limit: The License Dongle check date is compared with this date for SW update allowance
- Flags: When flag is set ESRI (.shp), GeoTIFF (.tif) and ERDAS (.ecw) maps can be used in the dispatcher.


## Group Bridge



- Dongle Date Limit: If set, the dongle ceases operation when the specified date is reached
- Application Date Limit: The License Dongle check date is compared with this date for SW update allowance
- Number of Bridges max: The number of bridges (Group Calls) that can be defined in the Group Bridge
- TetraFlex GW conn. Max.: The max. numbers of TetraFlex Gateway connections that can be setup in the Group bridge (Terminal SSI user numbers)
- Tetra Radio conn.max: The max. numbers of Tetra Radio devices (like Piciorgros DVI-100) that can be setup in the Group Bridge
- Analog conn. Max.: The max numbers of Analog radio devices that be defined in the Group Bridge.

### 2.3.1.7 Partners access to Software Releases:

- Any Partner with access to the restricted area on <http://www.damm.dk> can download all software packages available, and save them locally in his administrative system, for later use. If a Partner needs a software package not saved locally and not available on <http://www.damm.dk>, he can require this package by means of a mail to [support@damm.dk](mailto:support@damm.dk)
- An End-User can only execute software packages on a BSC4XX or PC, when the dongle is inserted and the software Application Date is earlier than the Application Date Limit programmed into the dongle.
- In case a Partner has an SLA, and wishes to have the Application Date Limit extended, he can place an order for extension of the SLA. He will then receive a

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dongle update for the total population of dongles. This update can be implemented when convenient or together with a new software releases, at an appropriate time.

- In case a Partner does not have a SLA, and wishes to have the Application Date Limit extended for one or more dongles, he can order a SLA. He will then receive a dongle updates for the total population of dongles. This update can be implemented if convenient together with the new Software Releases, at an appropriate time.
- In case a Partner does not have a SLA and does not intend to order one, but wishes to execute a new Software Release on one or more systems, he can order the new Software Release and he will receive dongle updates with new Application Date Limit for the concerned dongles, which can be implemented together with the new Software Releases, at an appropriate time.

#### 2.3.1.8 Programming of Dongle Application Date Limit:

This setting is subject to change without notice

- The Application Date Limit for execution of software packages is set to:
  - Partners without SLA: - the delivery date plus warranty period.
  - This can be set individually.
  - Partners with SLA: - 24 months and can be extended with periods of 24 months

#### 2.3.1.9 Consequences for Partner and End-User:

- The Partner can at any time execute all software packages with an Application Date that is earlier than the Application Date Limit programmed in his dongle.
- This ensures that a Partner has support in the warranty period alternatively the SLA period and can run the latest software available just before the warranty period alternatively the SLA period expires.
- The End-User can decide to continue running a software package after the Application Date Limit is passed
- The End-User can also decide via an agreement with Partner to obtain new released and to have the Application Date Limit changed in order to run new releases

## 2.4 SOFTWARE INSTALLATION

All software is preinstalled from factory on the CF Storage media in the SB421 or BSC412. This includes also the BS421, TR412, Power supply- and combiner software.

The next chapter is covering the re-installing or updating of software on these units. Also installation of relevant software on external PC is covered.

Please also read the relevant release notes and upgrade guides.

### 2.4.1 CF Storage media

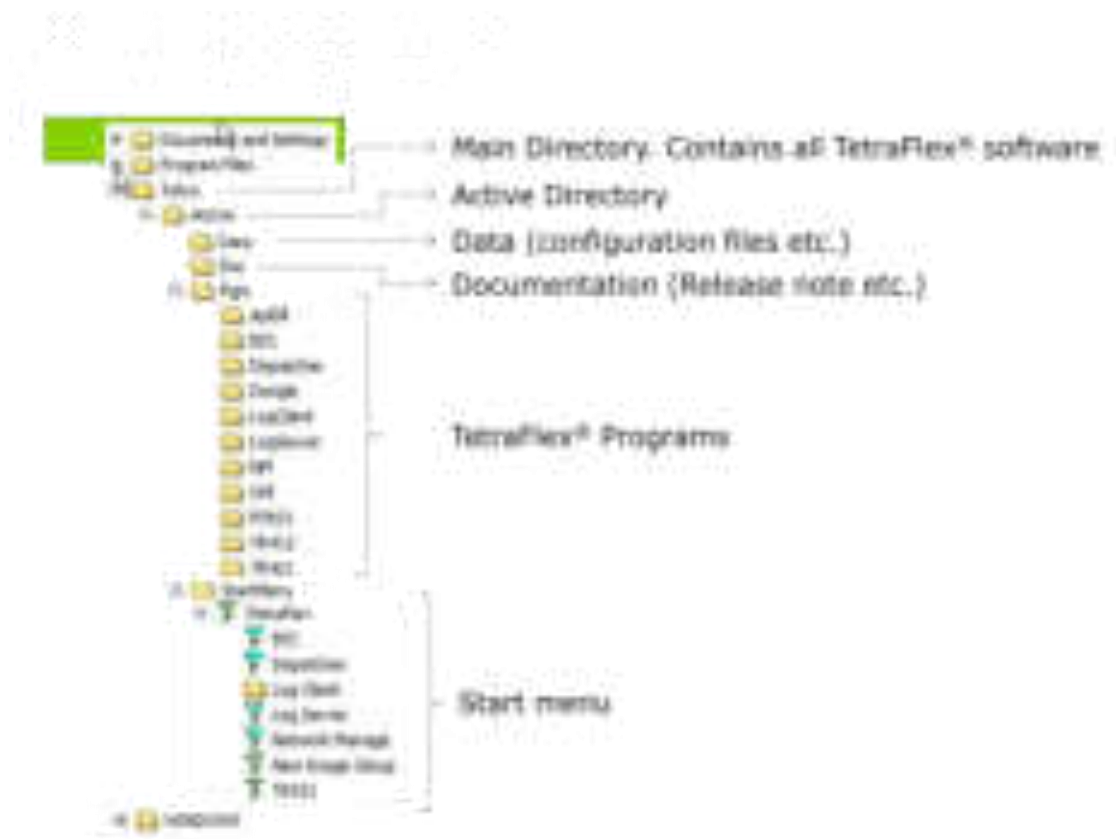
The TetraFlex® system uses an 8GB Compact Flash (CF) Card as storage media  
The CF card is divided in to 3 partitions

8GB CF Card – Order no. 105126* (V7.30 and forth)		
Partition No.	Name	Usage
1 (2 Gbyte)	CF-P1 (C:drive)	Primary partition (system) -TetraFlex® and operation system
2 (2 Gbyte)	CF-P2 (D:drive)	Secondary partition for Upgrade TetraFlex® and operation system
3 (4 Gbyte)	CF-P3 (E:drive)	Log Server database files

\*Please inform about sw version when ordering a new flash card.

On previous versions (Pre Ver.7.x) a build in hard disk was installed having the drive letter C:

Apart from the standard Windows Operation System (OS) directories, the CF card contains the directory “c:\Tetra” where the primary Tetra functionality is stored



## 2.4.2 Windows License

The TetraFlex® has previously been delivered with the Windows XPe embedded OS. Due to outdate of XP from Microsoft, future systems will be delivered with Windows Embedded Standard 2009 (WES2009).

The license label on the BSC will state which version is initially delivered.

Be aware that it is a violation of license to upgrade an XPe OS with WES2009 unless a new license is purchased from sales.

A WES2009 can legally be downgraded to XPe should this be decided.


## 2.4.3 TetraFlex® Installation/Upgrade

### 2.4.3.1 Preconditions

The software package can be installed on either the SB421, BSC412 or on an external PC.

The Log Client, Dispatcher and ApiDII, applications are compatible with the following operating systems:

- Microsoft Windows XP
- Microsoft Windows 7
- Microsoft Windows 8
- Microsoft Windows Server 2012

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The BSC, Log Client, Log Server, NM and OM are compatible with the following operating system:

- Microsoft Windows Embedded Standard 2009 (WES2009 DAMM image)
- Microsoft Windows XP
- Microsoft Windows 7
- Microsoft Windows 8
- Microsoft Windows Server 2008 R2
- Microsoft Windows Server 2012

Installing the new Release can be done in different ways:

- Installing the whole image including XP - relevant when upgrading SB421 and BSC412 from releases older than 7.30 e.g. 7.21 or new installation
- Installing the whole image including WES 2009 (if the SB421 or BSC412 has a license for WES2009) - relevant when upgrading SB421 and BSC412 from releases older than 7.30 e.g. 7.21 or new installation
- Installing the TetraFlex packet or individual parts of the packet

#### 2.4.3.2 Log Server running on Service Box with 2 Gbyte CF Card

If the Service Box has to run the Log Server program, the CF card has to be exchanged to a 8GByte CF card with the full TetraFlex packet including a preinstalled Log Server. The actual TetraFlex configuration should be copied from the old to the new CF card (the configuration is stored in C:\Tetra\Active\data\).

The Service box with the Log Server also needs to have at least 1GB RAM to function properly.

#### 2.4.3.3 Installing a new image on SB421 and BSC412




**If this procedure is not followed, and the upgrade is done remotely, the remote connection to the system might be lost and it is necessary to go on site for configuration.**

**NOTE:** Always use CF-card delivered from DAMM that are prepared to be bootable from either BSC 412 or SB421. Having any configuration files on the cf-card they should be backed up, otherwise they are lost. If you want to be able to use the old sw version again Copy drive C: (CF-P1) to drive D: (CF-P2).

The new image can be downloaded from DAMM's web site (see chapter "Partners access to Software Releases").

Before using the image – please unzip. Use a PC and place the unzipped files in a directory e.g. \Image.

Always check the Application Date Limit on the Dongle before installing new software. If the the Application Date Limit is older than the date of the software version you are installing, it will not work.

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Also check that the image is compatible with the BS412 or SB421 hardware version. Use Disk image HW ver.1 for hardware version 1 and Disk image HW ver. 2 for hardware version 2 (see serial number label on BSC /CPU unit).

- Move the flash disk to an external card reader and check if it is formatted (C: NTFS format, label CF-P1) and copy the new image to the partition CF-P1)
- Place the CF Card in the BSC412 or SB421 and reboot. After a while the “FBReasele” dialog appears, please be patient it takes a while.
- Go to ...\\Tetra\\Active\\Pgm\\BSC directory and open the file ImageSetup.bat file for editing
- Edit the file (delete REM notes) for the configuration needed (recommendation is all except headlines)
- Insert the correct IP and data (PC Name) in the top “set” lines (do not edit the bottom “set” lines)
- Save the file
- DO NOT RUN. The bat file will be executed and then deleted the first time the BSC.exe is started
- To prepare the BSC service for starting, make a copy of bsc.exe to bsc\_.exe
- For installing the BSC service, run BSC.vbs with the parameter INSTALL

The system configuration is stored in the the files CnfgBsc.txt, CnfgBss.txt, CnfgMain.txt, CnfgFact.txt and CnfgBs.txt in the \\Tetra\\Active\\Data folder. These files are missing until the BSC service is installed and will be auto-generated when the BSC service is started for the first time (with default values).


These files can also be generated with the following OM commands:

```
F70/SAVE → CnfgBsc.txt
S70/SAVE -> CnfgBss.txt
M70/SAVE ->CnfgMain.txt
M90/FACTORYUNLOCK
M90/SAVE -> CnfgFact.txt
M90-
H71/SAVE-> CnfgBs.txt (used by BSC412 only)
```

After the files have been generated they must be edited with the correct IP address and other parameters. Please see the chapter “*SB421 configuration*” and “*BS41x Configuration*” for more details.

If you want to use DHCP server (recommend for SB421) this must be started manually. Go to \\Program files\\DHCPserver and start the program DHCPsrv.exe. Install as service.

- **NOTE** This does NOT include the configuration of the LAN and WAN network card settings in Windows. This must be done manually.

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#### 2.4.4 Installing individual parts of the TetraFlex package.

All applications are preinstalled from factory on the SB421 and the BSC412, but can be re-installed or installed on different external PC's. Be aware of having the appropriate dongles when running the applications on various machines. Also check the Application Date Limit before installing new releases.

**Note: Also see relevant upgrade guidelines and release notes when installing new software.**

##### 2.4.4.1 BSC


1. If the system is already installed with TetraFlex® release 7.6 you only have to install the new BSC software:
  - Copy "...\\Pgm\\BSC\\BSC.exe" into the active folder in the BSC "C:\\Tetra\\Active\\".
  - Restart the BSC by using the NM, BSC-GUI or TetraFlex menu – "BSC Restart".
  - Repeat the above two points for all BSC's in the system.
2. If the system is installed with older TetraFlex releases please follow the Update guideline for ver.7.x to 7.6
3. If the installation is done on a new XP/ Windows installation, the following files should be executed (If not already there the files could temporary be placed in the following path "C:\\Tetra\\Active\\pgm\\BSC"):
  - XpQosSetup.reg
  - WinPcap\_4\_0\_1.exe
  - Restart the BSC via start menu "BSC Restart" or execute BSC.vbs and select RESTART
4. If the installation is done on a PC with Windows 7, 8 or Server, the following files should be executed (If not already there the files could temporary be placed in the following path "C:\\Tetra\\Active\\pgm\\BSC"):
  - vbs-runas.reg (to allow BSC and BSC-GUI to run as administrator)
  - XpQosSetup.reg
  - WinPcap\_4\_0\_1.exe
  - Restart the BSC via start menu "BSC Restart" or execute BSC.vbs and select RESTART

In the "C:\\Tetra\\Active\\" you will find a number of directories beside the pgm directory - mentioned above-, these directories contain: system configuration files, the subscriber database, and sound files to be used as part of the Tetra core features.

If a specific audio file doesn't exist it is copied to the disk, when the service starts. User generated sound files (in the C:\\Tetra\\Active\\Audio folder) with different names as the standards are kept.

Authentication keys need to be re-imported from the security key file from where they originally were imported (and a renew of all keys must be performed).



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#### 2.4.4.2 Start Menu

The various TetraFlex parts can be started from the Windows start menu if the C:\Tetra\Active\StartMenu\TetraFlex folder with all its content is copied to C:\Documents and Settings\All Users\Start Menu.

#### 2.4.4.3 OM

Stop the OM program - when running - before proceeding.

1. If the system is installed with TetraFlex release 7.6:
  - Copy all files from "...Pgm\OM\" into the active folder: "C:\Tetra\Active\PGM\OM".
  - Repeat this for all nodes in the system.
2. If the system is installed with older TetraFlex releases please follow the Update guideline for ver.7.x to 7.6

Having an OM shortcut on the desktop, change it to point at "C:\Tetra\Active\pgm\OM\OM.vbs".

#### 2.4.4.4 NM

Stop the NM program - when running.

1. If the system is installed with TetraFlex release 7.6:
  - Copy all files from "...Pgm\NM\" into the active folder: "C:\Tetra\Active\PGM\NM".
  - Repeat this for all nodes in the system.
2. If the system is installed with older TetraFlex releases please follow the Update guideline for ver.7.x to 7.6


If there is a NM shortcut on the desktop, change it to point at "C:\Tetra\Active\pgm\NM\NM.vbs".

#### 2.4.4.5 Dispatcher

The dispatcher application can only run on an external PC (not SB421 or BSC412) and the PC must be provided with the appropriate dongle for starting the dispatcher.

If the Dispatcher is installed on a PC with Windows 7, Service Pack 1 (SP1) must also be installed.

The dispatcher requires also that .NET 3.5 and DirectX is installed.

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The installation programs for the Dispatcher are default placed at a shared folder (distribution point) on the SB421 and BSC412 and can be installed on an external PC(s) from there.

For updating the dispatcher installation program on the the SB421 or BSC412, place the dispatcher files in c:\tetra\share\dispatcher and c:\tetra\active\pgm\dispatcher.

Having any unwanted files in any of the above mentioned folders (e.g. from older installations) please delete them before copying the new Dispatcher installation files.

If you are allowed to restart the BSC you may place the Dispatcher files in c:\tetra\update\pgm\dispatcher\ They will then be copied to the right directory when activating "BSC Backup\_Update\_Restart" or "Update\_Restart".

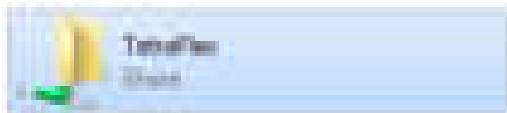
Having any unwanted files in any of the above mentioned folders (e.g. from older installations) please delete them before copying the new Dispatcher installation files.

When (re)starting the BSC, a Dispatcher distribution point is created via the TetraFlex share under the folder structure: C:\Tetra\Share\Dispatcher\.

Install the dispatcher on an external PC by executing the **Setup.exe** file from this folder. To find the share use the File Explorer on the PC where you want to install the Dispatcher and search for the share:

Ex. files:\\<BSC name> or files:\\<WAN IP address>

This shows the TetraFlex share:




Where the Dispatcher installation programs are:



The Dispatchers that are running on the network have an option that can be set to detect updated version on the TetraFlex share and will prompt the user for allowing to run the update.

#### 2.4.4.6 Log Server

The Log Server is available either as an external Log Server or installed on the 8GByte Compact Flash card. The Log Server requires at least 1GB RAM to operate properly. The log server is from factory not activated on BS41x and SB421 and need to be activated when needed.

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To upgrade an existing Log Server to release 7.6 the Log Server must be stopped, all files and folders from C: \Tetra\Active\Pgm\LogServer\ and C: \Tetra\Active\Pgm\LogClient\ must be copied to the unit where the Log Server is installed. The Log Server can then be restarted using the start menu TetraFlex → LogServer Restart. The Log Server is now running and the Log Client installation files are ready for distribution via the "TetraFlex" share C:\Tetra\Share\LogClient\

**Note:** The database for ver. 7.6 is not compatible with earlier versions. When restarting - the new log server is making a copy of the old database - and it is starting with a new empty database. The old database is stored in a folder with ver. no and date like:  
\TetraFlexLogDB\_4\_0\_20110912\_103145

The subscriber description in the log database are also lost when updating from an older version, but can be imported by importing the subscr.txt file (see chapter TetraFlex log client).

#### 2.4.4.7 Log Client

The Log Client applications may be installed on an external PC work station with the appropriate dongle.

Install the Log Client by connecting to the Log Server (on SB421, BSC412 or external logserver) with the file explorer. Find the folder Log Client using the TetraFlex share (C:\Tetra\share\LogClient) and execute the LogClientInstall.vbs. When the Log Client shortcut is executed, the new and the old LogClient.exe are compared. If they differ a backup of the old Log Client files will be made and all the Log Client files are copied from the Log Server to the local machine, except for the LogClient.ini file. If they are equal the local Log Client files will be executed without copying.

The Log Clients that are running on the network can detect updated version of the log server and will prompt the user for allowing to run the update from the TetraFlex share directory.

#### 2.4.4.8 PS421

The power supply software (PS421.hex) is placed in c:\tetra\active\pgm\PS421 directory. The PS421 can be upgraded by using the OM command

M68/PS421/+


#### 2.4.4.9 TR412

When unpacking the software package the TR412.bin file will be placed in \Tetra\Active\Pgm\TR412.

Download this file to all TR412 by using the TetraOM command:

H68/TR412/A

#### 2.4.4.10 BS421

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Overwrite the existing TR421.dll file at C:\Tetra\Active\Pgm\TR421 with the new TR421.dll  
On the local BSC execute the BS421Download.bat file (Path: C:\Tetra\Active\Pgm\TR421).  
Restart all the TR's by help of TetraOM commands:

99/RESTART

#### 2.4.4.11 Installing TEA2 encryption

Files for TEA2 encryption are not part of the software package, but have to be ordered separately. The TEA2 version of TR421.dll and TR412.bin are installed in the same way as described above for BS421 and TR412.

## 2.5 SB421 CONFIGURATION

The SB421 enables you to connect a VGA monitor and a USB keyboard directly to the SB421 without having an external PC.

In case no graphics is shown, press <Ctrl> + <Alt> + <F1> to reset the connection.

### 2.5.1 Initial setup

#### 2.5.1.1 Ethernet Connection

The SB421 supports the following Ethernet connections, all auto negotiating

- 2 x 10/100 Mb/s Ethernet LAN connection for the Base Stations
- 1 x 10/100 Mb/s Ethernet WAN/LAN connection for remote operation and multi-node backbone connection
- 2 x Ethernet type DC 1 second pulse connection for BS421 timing.

The Ethernet connections are LSA-type connections accepting only **solid wires** with the dimension 0.4mm<sup>2</sup> to 0.6mm<sup>2</sup>.

The Ethernet connections are protected by arresting devices.

The Ethernet connections are limited to SELV

The Ethernet WAN connection is connected to an Ethernet switch or directly to the PC / Network by means of a straight or crossed Ethernet cable.

The Ethernet LAN connection shall solely be connected to the BS421(s) and optionally to a redundant SB421 and/or IP backbone for multimode operation.

For redundant BSC operation, please see the chapter describing setup and requirements.

#### 2.5.1.2 Turn on the SB421

Turn on the power to the BSC using SW101 on the Interconnection Board

Turn on the power to the BS421(s) using SW111 (TR1) and SW133 (TR2)


If changes in the BIOS are required, press F2 key shortly after applying power (while screen is still blank)

Power up will take 2-3 minutes, mainly dependent on the startup time of operating system on the SB421.

After successful power up, check the BSC LED's for proper function as described in section 1.1.4.4.4

#### 2.5.1.3 System BIOS configuration

To enter the BIOS setup application, press F2 during initial boot of the SB421

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**WARNING:** Be careful not to disable the USB ports in the BIOS. When USB ports are disabled, the dongle cannot be read and there is no way of getting direct access to the SB421 PC by means of a monitor and keyboard / mouse.

#### 2.5.1.3.1 Hard disk disable

**NOTE:** In case of an internal hard disk is present, disable this totally before booting from the CF card. After initial boot the HD may be enabled again and should appear as D:\ drive with a 2GB CF card installed and F:\ with an 8GB CF card installed.

DO NOT try to reconfigure drive letters with the build-in drive manager in the OS

#### 2.5.1.3.2 BIOS setup for the BSC412 and SB 421 Hardware ver. 2

BIOS configuration for BSC412 and SB421 with **MSC-PV510** computer board (marked with hardware ver. 2 on BSC).

Press F2 at power on to enter Bios Setup Utility

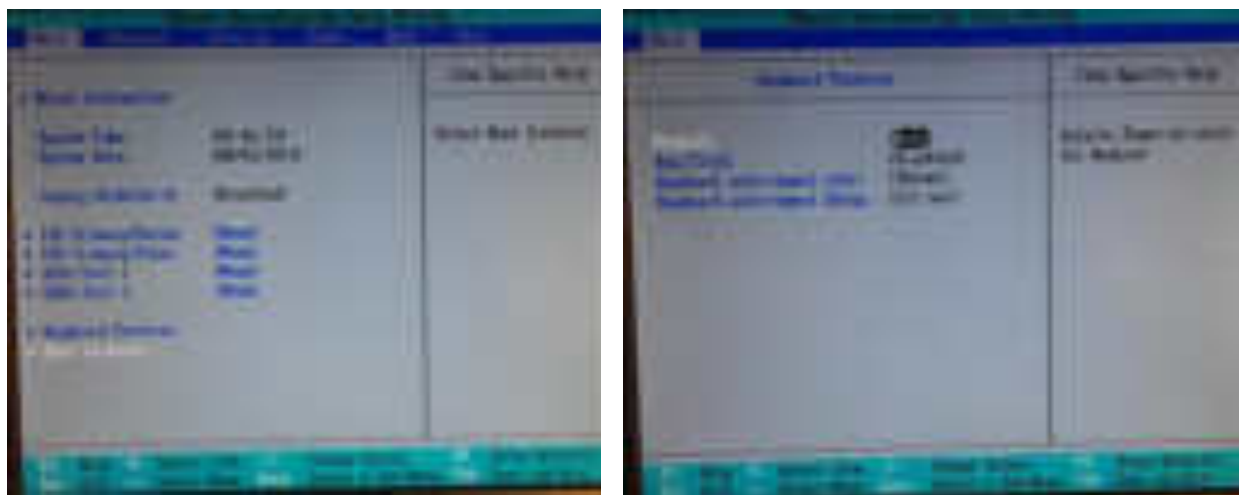


Figure 2-2: Main and Keyboard Feature







Figure 2-5: Advanced – Video (Intel IGD) Control and advanced Integrated Device Control

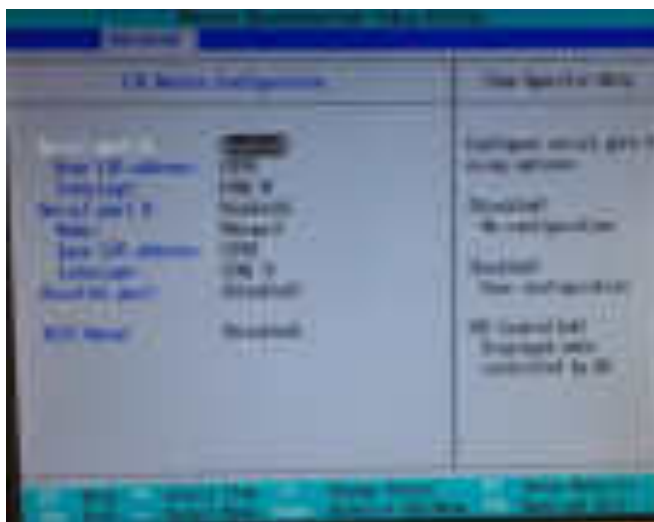


Figure 2-6: Advanced – I/O Device Configuration and Advanced – Clock Control

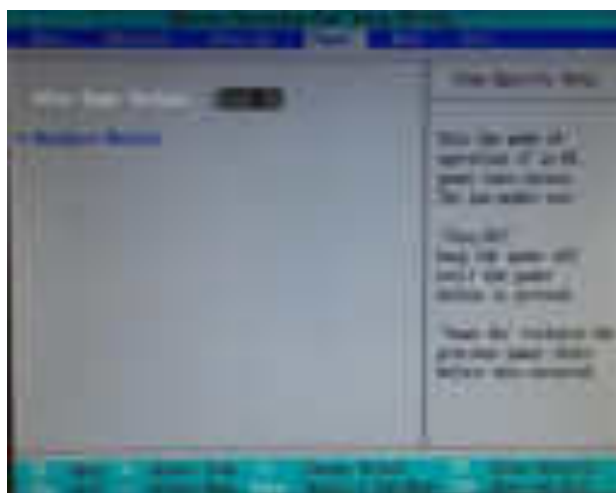



Figure 2-7: Power and Boot

- After changing a parameter Press <F10> to save the setting and exit the BIOS setup



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#### 2.5.1.4 IP address set-up

For the TetraFlex® system all IP addresses except for multi node networking is preset upon delivery. The only setup necessary is the IP addresses for the WAN used for application GW, network management, remote desktop connection, log server client, and dispatcher client. These IP addresses are entirely user dependent and they are setup using the WAN Ethernet board configuration in Windows operation system.

##### 2.5.1.4.1 Default network card IP address setup

As default the IP addresses are defined as

- LAN Network Card: 172.16.1.10

This IP address must be equal to the IP address defined for the BSC  
If these IP's addresses are miss-configured, in addition to a non working system, also a PS alarm may show on the BSC LED's

- WAN Network Card: DHCP

#### 2.5.1.5 MAC address Set-up

*On delivery from DAMM, the MAC is set to the correct value*

BSC's delivered from 01.01.2008 has the MAC address stored in a flash device. No action needed.

BSC's delivered before 01.01.2008 (MAC address label may be present on the BSC unit) may have the MAC redefined.

The MAC is stored on the storage device (HD or CF). This means that if the system is cloned from another SB421 or reinstalled with the image file available at the <http://www.damm.dk>, the MAC address MUST be changed from the MAC specified in the source file to the actual value valid for the specific SB421 serial number.

If MAC cannot be determined, contact [support@damm.dk](mailto:support@damm.dk) with the serial number in question

To enter / change the MAC, follow the procedure as stated.

- Lookup and write down the MAC address noted on the label placed in the upper right corner of the CPU (BSC) unit in the SB421. See
- Figure 1-2: BSC421
- Use the file explorer and go to C:\Programs\MacMakeUp\MacMakeup.exe




**Figure 2-8: Start MacMakeUp Application**

- In the MacMakeUp application select the 8255xER PCI Adapter
- Enter the MAC address (Enter value like 000FE3000431)
- Press “Change”
- Close the application
- Re-open MacMakeUp and check that the MAC is actually changed / saved
- Disable and then enable the WAN net card to make MAC change valid.



**Figure 2-9: Change MAC**

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## 2.6 BS421 CONFIGURATION

### 2.6.1 Ethernet Connection

The BS421 supports 1 x 10/100 Mb/s. Ethernet connection and 1 x Ethernet type DC connection for timing.

The purpose of the connections is

- To establish SB421 connection for control of the base station
- To establish connection to another BS421 for timing and synchronization. (1 sec Pulse).

The Ethernet connections are limited to SELV (Safety Extra Low Voltage) connections.

The Ethernet connection shall be connected directly to the SB421 TR connection board.

The DC timing connection is connected through the SB421 LAN cable. Arresting units are an integrated part of the SB421.

#### 2.6.1.1 Set-up of IP address

##### 2.6.1.1.1 DHCP (Typical TetraFlex® single node)

The IP address and the net mask is setup by means of DHCP.

When the system is delivered from DAMM, the BSC and the BS421 are paired and should start-up without any need of configuration change.

However, if the BS421 is connected to another BSC, the IP address configuration must be reset.

##### 2.6.1.1.2 How does DHCP work with the SB421 (BSC)?

The IP address may be assigned by means of DHCP.

This means that the SB421 must first be started. When the SB421 is started here after the BS421/1 must be started and then in a dual carrier system the BS421/2.

The BS421 gets an IP address from the PC's DHCP server. This IP address is tied to the BS421 MAC address.

If the MAC address is unknown to the PC, the BS421 will be assigned an IP in the range 172.16.1.200 - 249.

In this case the BS421 IP address must be changed.

### 2.6.1.1.3 Changing the BS421 IP

- Open C:\Program Files\DHCPServer\dhcpsrv.ini with notepad or another text editor.
- (Hint: save a backup of the original file before editing)

**NOTE:** All entries above the dotted line are factory presets and must only be changed for redundant SB421 (change IP Bind to 172.16.1.19) or when IP address segments must be changed ex. from 172.16.1.1 to 172.16.2.1.



```

[General]
CLASSID=255.255.255.0
MODIFIED=0 ; hybrid id
IPADDR_1=172.16.1.1
IPADDR_2=0.0.0.0
DOMAINNAME=tetra

[Settings]
frames=1

[ipaddr]
ipaddr_1=172.16.1.200-249
ipaddr_2 ... ipaddr_8
ipaddr_1=172.16.1.10

; - [just keep quiet on unknown clients]
; 0 - decline requests from unknown clients
; ignore unknown clients=1

;-----
[00-00-00-00-00-00]
IPADDR=172.16.1.11
MACSCRIPT=00/00/00/00/00/00

```

Figure 2-10: DHCP Setup

- Below the dotted line one or more MAC [In Brackets] / IP addresses are shown.
- If only one MAC / IP is shown, change the IP address to 172.16.1.11
- If more IP's are shown and only one BS421 is connected, determine which IP address is valid by use of a ping command to the IP's. Delete the wrong IP / MAC entries and change the remaining IP to 172.16.1.11
- If more IP's are shown and two BS421 is connected, determine which IP's are valid by use of a ping command to the IP's. Delete the wrong IP/MAC entries and change the remaining IP's to 172.16.1.11 for the first BS421 and 172.16.1.12 for the second BS421 and so on. Observe the correct MAC / IP combination.
- NOTE: It is highly recommended to assign IP's to one BS at a time by shutting of the power to the other.
- Save the dhcpsrv.ini file
- Restart BS421 by means of the appropriate switch (SW111 and SW133 ) inside the SB421 or use TetraOM PS command 11- / 11+ and 12- /12+
- Ping the 172.16.1.11(TR1) and 12 (TR2) to check if the addresses are correct

### 2.6.1.1.3.1 DHCP with redundant SB421

With redundant SB421 the procedure for DHCP also applies, but the redundant SB421 communication with the BS421(s) is (are) initially off line (DHCP server stopped).

To stop the DHCP server, log in to C:\ProgramFiles\DHCPserver and double click on the dhcpsrv.exe file

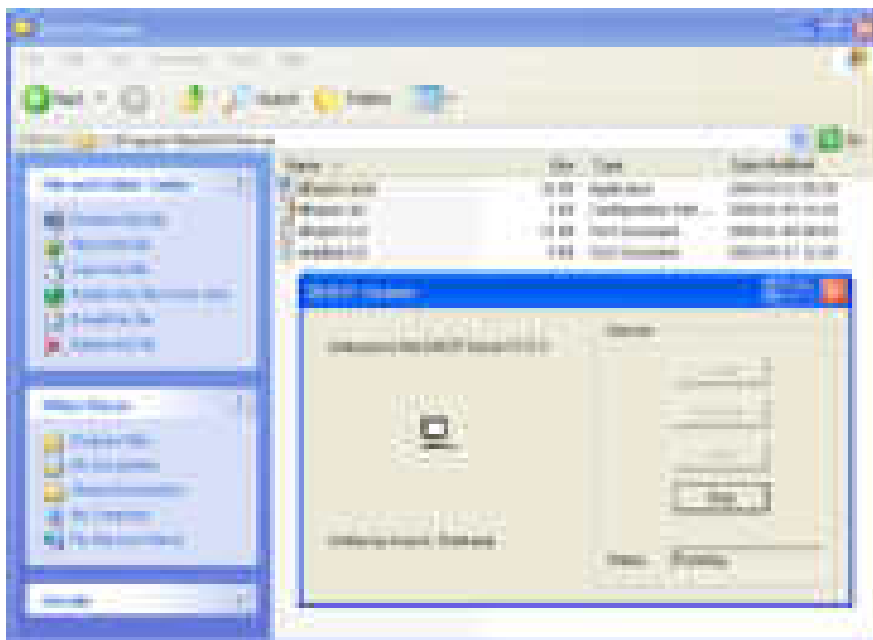


Figure 2-11: DHCP Redundant Setup

Then select "STOP" to temporarily stop the DHCP server.

When the IP setup of the main SB421 is finished,

- The dhcpsrv.ini file must be copied to the C:\ProgramFiles\DHCPserver of the redundant SB421
- The IPBIND setting must be changed from IPBIND\_1=172.16.1.10 to IPBIND\_1=172.16.1.19
- The DHCP server must be started up again

#### 2.6.1.1.4 Static IP

Setting the TR with Static IP address (Default is dynamic ) using VNC:

- Open the VNC for the selected BS421
- Select START -> Settings -> Network and dial up connections
- Open the AU1MAC1
- Select Specify an IP address and enter the relevant data into the fields
- Select OK and exit the program




Figure 2-12: Static IP setup

- Check SB421IP setting to match the settings of the BS421. (use BSC-GUI or OM M71)

The static BS421 IP address can also be set with OM command:

06/IPADDR/xxx.xxx.xxx.xxx and  
06/IPMASK/yyy.yyy.yyy.yyy

The BS421 must be restarted by using 99/HWRESET or Power cycle off and on before the changes is taking place.

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### 2.6.1.1.5 TR421 Update / Install

For updating the transceiver program; TR421.dll on the BS421, use this procedure:

- Change the IP addresses used in “TR421Download.bat” file (path c:\tetra\active\pgm\TR421\ ) with the actual IP addresses to match the TR421's.
- The address of the first TR is default 172.16.x.11 where x is the node number (IP must be written in the bat-files without the leading zeros).
- “Rem” out all unused TR421's

Default TR421Download.bat:

```
@echo *****
@echo *****      TR421 file download      *****
@echo *****
@echo Copyright 1985-2009
@echo Damm Cellular Systems A/S, Denmark
@echo Ver. 7.40 2009-09-17

@echo Change all the IP Addresses below to match the BS421's
@echo rem out all unused BS421's

@echo ***** Copy files to TR421-1 *****
net use Z: \\172.16.1.11\CF-Card tetra /USER:tetra /PERSISTENT:NO
copy TR421.dll Z:\Tetra\Pgm\Tr\*. * /Y
copy TR421.bat Z:\Tetra\Pgm\Tr\*. * /Y
net use Z: /DELETE

rem @echo ***** Copy files to TR421-2 *****
rem net use Z: \\172.16.1.12\CF-Card tetra /USER:tetra /PERSISTENT:NO
rem copy TR421.dll Z:\Tetra\Pgm\Tr\*. * /Y
rem copy TR421.bat Z:\Tetra\Pgm\Tr\*. * /Y
rem net use Z: /DELETE

rem @echo ***** Copy files to TR421-3 *****
rem net use Z: \\172.16.1.13\CF-Card tetra /USER:tetra /PERSISTENT:NO
rem copy TR421.dll Z:\Tetra\Pgm\Tr\*. * /Y
rem copy TR421.bat Z:\Tetra\Pgm\Tr\*. * /Y
rem net use Z: /DELETE


rem @echo ***** Copy files to TR421-4 *****
rem net use Z: \\172.16.1.14\CF-Card tetra /USER:tetra /PERSISTENT:NO
rem copy TR421.dll Z:\Tetra\Pgm\Tr\*. * /Y
rem copy TR421.bat Z:\Tetra\Pgm\Tr\*. * /Y
rem net use Z: /DELETE

@echo Please restart all TR421 services afterwards
@echo by executing B/99/RESTART from BSC
pause
```

On the local BSC execute “BS421Download.bat” file (Path “C:\Tetra\Active\Pgm\TR421”):

Restart all TR's by using the TetraOM commands:

99/RESTART

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NB: Only update NK.BIN and Boot.ini if you are advised to do so (in case they are damaged or need to be updated).

Installation of NK.bin file (Windows CE): Refer to section 2.6.2.1

Installation of the Boot.bin file:

- Copy the Boot.bin file to the root of the TR421 CF-Card.
- Restart the TR421 with the command

99/RESTART

- Reboot the TR421 with command to the PS421, commands

AP (Address the Power supply)  
11- (power off for TR1 and TR3)  
11+ (power on for TR1 and TR3)  
12- (power off for TR2 and TR4)  
12+ (power on for TR2 and TR4)

## 2.6.2 Installing Windows CE on BS421

The operating system on BS421 is Windows CE that is contained in one file - NK.bin this chapter describes how to install it.

### **IMPORTANT:**

**Do not copy NK.bin (WinCE) to the BS421 unless instructed to do so, or forced to do so due to breakdown.**

### 2.6.2.1 Copy NK.bin (WinCE) to BS421


If the BS421 is connected with VNC, the BS application (TR421) MUST be stopped before copying files. Enter 99/STOP <Enter> in the OM Command Interpreter and the application stops and shows the normal WinCE desktop

**WARNING:** If the BS application is not stopped before copying, the connection to the BS421 may be lost. In this case proceed as follows:

- Disassemble the BS421
- Take out the CF-Card
- Put the CF-card into an compatible card reader
- Manually copy the NK.bin file to the CF card
- Put the CF-card back in the BS421
- Reassemble the BS421 and proceed as described in section 2.6.2.2

**If communication with BS421 is present, proceed as follows**



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- Search for BS421 using Start -> Search -> Files or Folders -> Computer
- Enter the IP address of the BS421 e.g. 172.16.1.11 or 172.16.1.12
- Select Search
- Select the search result
- Select CF-Card
- Create a new directory called CF-Card\TMP on the BS421
- Copy the file NK.bin from SB421 C:\tetra\PGM\TR to the CF-Card\TMP on BS421
- Open VNC for TR1 or TR2 from the desktop
- Open My Device
- Copy NK.bin from CF-Card\TEM to CF-Card
- Accept overwrite of old NK.bin file

The copy function takes app. 15 min.

**Note:** If for some reason the connection to the system is broken, the copying of the file will continue locally. Just wait until the copying has finished (minimum 15-20 minutes) before restart.

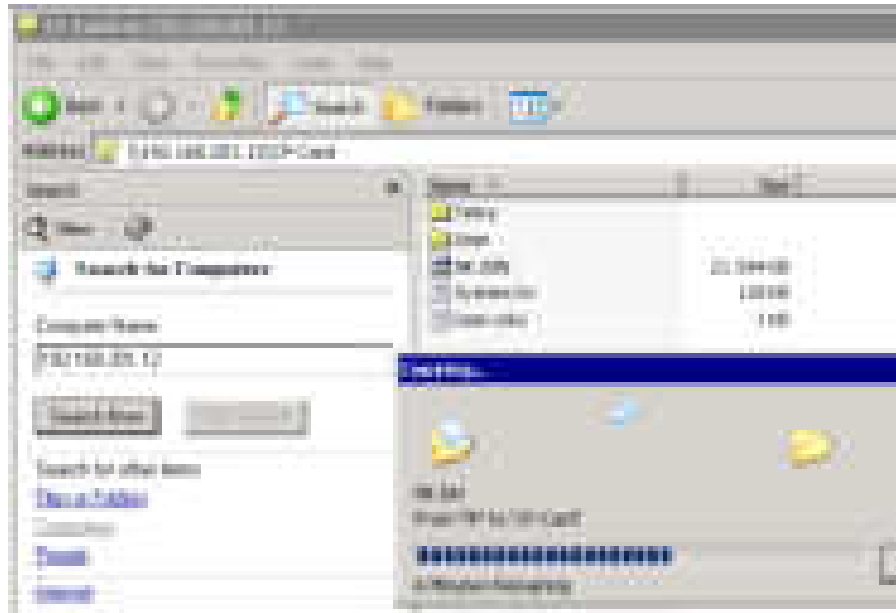


Figure 2-13: NK.BIN copy

- After successful copy, delete the CF-Card\TMP directory
- Restart BS421 using switch in SB421

#### 2.6.2.2 Configure admin user

When a new NK.bin file has been copied to the BS421, the BS421 Admin and User settings are lost. To reestablish, follow the procedure:

- Start the Internet Explorer from SB421 Start -> Programs -> Internet Explorer
- Connect to the file-server web client on BS421 using:

`http://TRx IP address/remoteadmin`  
 ("TRx IP address" = 172.16.1.11 for TR1 or 172.16.1.12 for TR2)

- Password = tetra
- Verification = tetra
- Select Apply



Figure 2-14: Configure Admin and User

The gateway will restart and prompt for username and password

- Enter username = admin
- Enter password = tetra

#### 2.6.2.3 Configure host name

- Insert BS421-“BS421 serial number”
- Press Apply. **To move on, it might be necessary to temporarily make a change to the Device Name and press <Apply>. Immediately change it back to the original name and press <Apply>, then move to on to the next point**

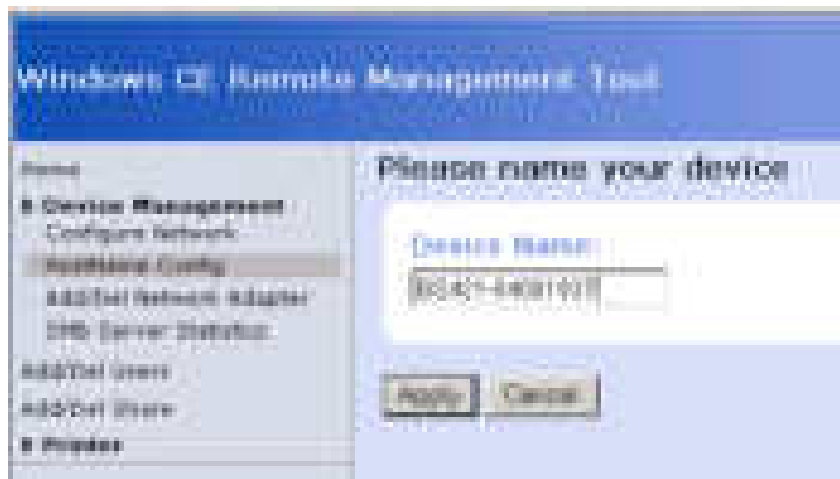
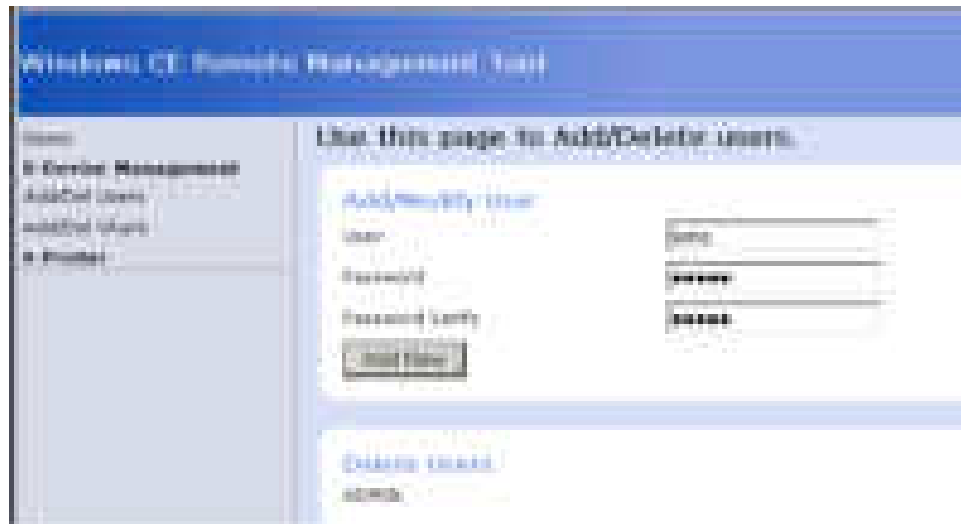


Figure 2-15: Configure Host Name

#### 2.6.2.4 Configure file-server user

- Select add/del User
- Enter username = tetra
- Enter password = tetra
- Enter confirm = tetra
- Press Add New or <Enter>
- Check user tetra has been added and exit the browser



**Figure 2-16: Configure user and password**

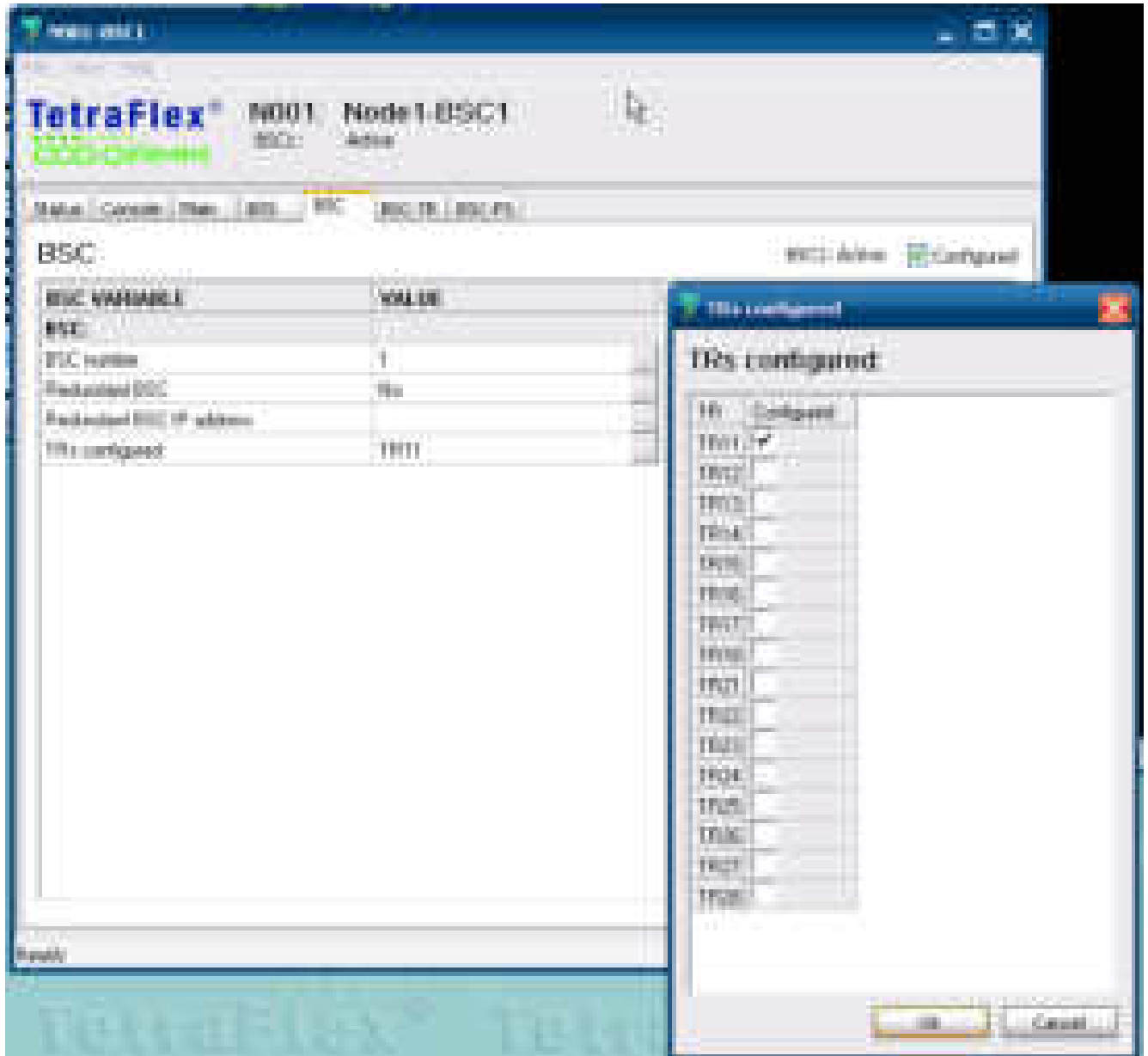
### 2.6.3 Copy to and from Compact Flash Card (CF Card) on BS421

- Use Explorer to connect to BS421
- Start -> Search -> For files or folders -> Computers
- Enter TRx IP address 172.16. 1.11 for TR1, 172.16.1.12 for TR2 and so on
- Check that the S/N is correct
- When connected, update the CF card as required

## 2.6.4 Add a transceiver

Adding a transceiver to a SB421 can be done either from the BSC-GUI or using OM command:

BSC-GUI:




Select the BSC tab and click on the TR's configured menu and then add the TR. When clicking Ok the setting is saved.

TetraOM: connect to the BSC Perform the following commands:

F75 <Enter>

This shows the configuration for TR 11-28

If the displayed message does not correspond to the actual number of TR, perform the command: F75/xx/ADD (F75/xx/REMOVE removes the TR again). xx =TR number e.g. 11.

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#### 2.6.4.1 Diversity configuration

Two TR421 may be used without the RF coaxial connection between them. In this case the system will behave normally as a 2 carrier system, but will NOT support diversity.

When using diversity set-up (Standard configuration), the RF coaxial connection must be installed and RX-B input (6dB pre gain) must be set

This configuration also applies to the 4 carrier configuration, where the carriers are defined as two 2 carrier systems.

#### 2.6.4.2 RX-B setting (Diversity) in TetraOM:

- 24 Display setting
- 24+ Select RX-B input Cascaded (Standard setting)
- 24- Deselect RX-B input Cascaded

**NOTE:** This must be configured in both BS421

#### 2.6.4.3 3 And 4 carrier operation

NOTE: Operation with 3 and 4 carriers with redundant BSC require a change to the HW of the BS421 and the SB421 (See the SB421 section for details) if the HW version stipulated on the serial number label is v1.

HW version v2 and forth has the possibility to change the setting via the TetraOM program. This change is required to ensure correct BSC handover and synchronization of the carriers. The change cannot be made in the field. The system must be ordered for 4 carrier operation or the units may be returned to DAMM for modifications.



**NOTE:** For change in the field (trained staff only), please order a change kit from DAMM. This kit includes a manual dealing with this issue and the necessary hardware, jumpers, screws, markings etc.

For a 4 carrier system, 2 of the BS421 is marked "MASTER" and 2 are marked "SLAVE". One master and one slave are to be connected to each SB421, the master being TR1/TR3 and the slave TR2/TR4.


**NOTE:** A GPS antenna should at least be connected to TR1 and TR3

#### 2.6.4.4 Synchronization

The TETRA Base Station TR's need to be time synchronized to operate correctly.

Most important, all TR's in a radio cell shall be time synchronized to ensure correct timing for the mobiles, when switching from the control channel to a traffic channel on another TR.

For a multi-cell systems, all radio cells are also recommended to be time synchronized to enable use of seamless handover (cell re-selection).

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The Damm BS system has a flexible system to provide synchronization between individual Transceivers. Built-in GPS Receivers give absolute time synchronization to the radio cells. External Inputs can also be marked as Primary Sync. References.

When a BS is Network locked, automatic frequency correction of the Master Oscillator (RX and TX carrier frequencies) is provided, and Seamless Handover to other Network Synchronized Cells is activated.

The BS can be setup to run as either Sync Master 0 to 4 or Slave. The Masters shall preferably be provided with GPS antennas or an External Primary Sync source. The remaining BS's shall be setup as Slave and does not need a GPS antenna.

The BS421 is provided with one External 1PPS (1 Pulse Per Second) output and two external 1PPS inputs. The Slaves shall receive external 1PPS inputs connected to Masters.

In addition to the hardware 1PPS, sync messages are send every second on IP from the Masters to attached BS's.

A Master will indicate Master Mode, if:

- 1) Synchronized to the internal GPS RX or
- 2) Synchronized to an External Input marked as Primary and indicating Master Mode

The priority can be changed with OM command 72/MASTER/c  
(c = 0-4 or S)

Master **0** priority:

- 1) Int. GPS RX
- 2) Ext. Master 1, Master Mode
- 3) Ext. Master 2, Master Mode
- 4) Ext. Master 3, Master Mode
- 5) Ext. Master 4, Master Mode
- 6) Ext. Master 1, Resync-only
- 7) Ext. Master 2, Resync-only
- 8) Ext. Master 3, Resync-only
- 9) Ext. Master 4, Resync-only
- 10) Int. Free-Run

Master **1** priority:

- 1) Ext. Master 0, Master Mode
- 2) Int. GPS RX
- 3) Ext. Master 2, Master Mode
- 4) Ext. Master 3, Master Mode
- 5) Ext. Master 4, Master Mode
- 6) Ext. Master 0
- 7) Ext. Master 2, Resync-only
- 8) Ext. Master 3, Resync-only
- 9) Ext. Master 4, Resync-only
- 10) Int. Free-Run

### Master 2 priority:

- 1) Ext. Master 0, Master Mode
- 2) Ext. Master 1, Master Mode
- 3) Int. GPS RX
- 4) Ext. Master 3, Master Mode
- 5) Ext. Master 4, Master Mode
- 6) Ext. Master 0
- 7) Ext. Master 1
- 8) Ext. Master 3, Resync-only
- 9) Ext. Master 4, Resync-only
- 10) Int. Free-Run

### Master 3 priority:

- 1) Ext. Master 0, Master Mode
- 2) Ext. Master 1, Master Mode
- 3) Ext. Master 2, Master Mode
- 4) Int. GPS RX
- 5) Ext. Master 4, Master Mode
- 6) Ext. Master 0
- 7) Ext. Master 1
- 8) Ext. Master 2
- 9) Ext. Master 4, Resync-only
- 10) Int. Free-Run


### Master 4 priority:

- 1) Ext. Master 0, Master Mode
- 2) Ext. Master 1, Master Mode
- 3) Ext. Master 2, Master Mode
- 4) Ext. Master 3, Master Mode
- 5) Int. GPS RX
- 6) Ext. Master 0
- 7) Ext. Master 1
- 8) Ext. Master 2
- 9) Ext. Master 3
- 10) Int. Free-Run

### Slave priority:

- 1) Ext. Master 0, Master Mode
- 2) Ext. Master 1, Master Mode
- 3) Ext. Master 2, Master Mode
- 4) Ext. Master 3, Master Mode
- 5) Ext. Master 4, Master Mode
- 6) Ext. Master 0
- 7) Ext. Master 1
- 8) Ext. Master 2
- 9) Ext. Master 3
- 10) Ext. Master 4
- 11) Int. GPS RX
- 12) Int. Free-Run



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If no GPS synchronized Master or higher prioritized free-running Master is available at re-start, Masters will try initially to synchronize to lower prioritized free-running Masters.

A BS will resync automatically after a short time if Century Second and Phase Detector are out of sync with a valid sync source.

Masters shall be setup even if GPS antennas are not used and internal GPS RX is deselected, to ensure proper synchronization between all TR's.

#### **Typical 1-carrier BS421 configuration:**

- TR11: Master 1

OM command: 72/MASTER/1

#### **Typical 2-carrier BS421 configuration with GPS on both carriers:**

- TR11: Master 1
- TR12: Master 2
- TR11-OUT connected to TR12-IN1
- TR12-OUT connected to TR11-IN1

OM command:

TR11

```
72/MASTER/1
72/IN/G/+
72/IN/1/+
72/IN/1/-/172.016.001.012/000.0
72/OUT/172.016.001.012/+
```

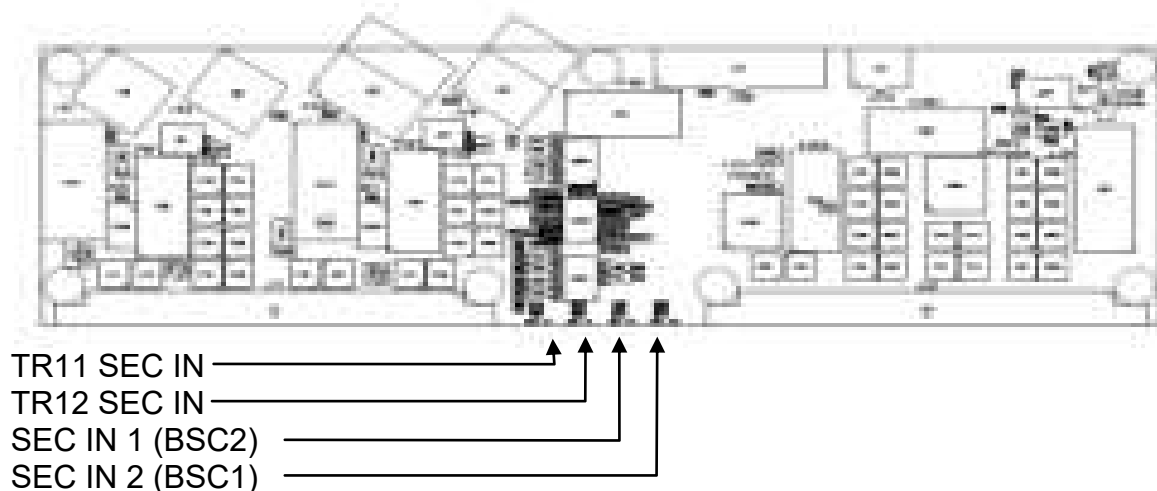
TR12

```
72/MASTER/2
72/IN/G/+
72/IN/1/+
72/IN/1/-/172.016.001.011/000.0
72/OUT/172.016.001.011/+
```

#### **Typical 3 or 4-carrier BS421 configuration:**

- TR11: Master 1 (Powered of SB421-1)
- TR12: Slave (Powered of SB421-1)
- TR13: Master 2 (Powered of SB421-2)
- TR14: Slave (Powered of SB421-2)
- TR11-OUT connected to TR12-IN2, TR13-IN1 and TR14-IN1
- TR13-OUT connected to TR11-IN1, TR12-IN1 and TR14-IN2

Interconnection board 1 second pulse sync indicators flashes synchronous when in sync



**Figure 2-17: 1 second Sync indicators**

**NOTE:** HW changes to SB421 interconnection board and TE2 and TR4 required

#### 2.6.4.4.1 GPS setup commands

To enable GPS synchronization execute the following TetraOM commands: 72/IN/G/+

#### 2.6.4.5 BS421 manual frequency adjustment procedure

If the BS is operating without GPS sync. (Free run) the reference oscillator has to be checked and adjusted one time a year.

Measure the BS421 transmitter frequency, the transmitter can be switch to CW mode for easier measurement.


Commands :

01+ ;Local blocking  
02/- ;Test mode  
15/CW ;CW modulation  
10+ ;Start transmitter

Commands to adjust the reference oscillator:

31 ;Display Sync status, note the DAC output value (OCXO Free Run value)  
31/SET/nn.nnn ;Set the OCXO Free Run value, range from 00.000% to 99.999%  
31/SAVE ;Save the OCXO Free Run value to flash

A change of 1% will give a frequency change about 0.1PPM

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## 2.7 BS41x CONFIGURATION

### 2.7.1 Turn on Base Station power

Turn on the BS Power by turning on the switches on the front of the PS411 Power Supplies and the Mains outlet.

Power-up will take 2-3 minutes, mainly determined by the start-up time of Windows operating system on the BSC. After Windows re-boot and BSC start-up, all TR41x will re-boot, and the BSC red alarm LED turns off and the green Active LED turns on.

If a TR41x is not configured in the BSC, the yellow Power LED on the TR41x will proceed to flash.

During power-up the Power LED of the PS411 Power Supplies will flash until they receives configuration from the BSC.

### 2.7.2 Special precautions

**NOTE:** Batch commands (B/....) are not supported on TR411 and TR412 using the HDLC bus

### 2.7.3 Set-up of IP address

The IP address and net-mask shall be set-up in BSC412 Windows settings as the first configuration step. This is done either with:

- Connect a monitor and USB keyboard / mouse directly to the BSC or
- Connect your PC to the BSC via an Ethernet cable (crossed or straight rough) or
- Start-up Remote Desktop and connect to the IP address of the WAN Ethernet port

And then:

- Configure IP number, net-mask etc. to the required configuration for the LAN and WAN

Default factory settings (can be ordered to specific settings):

BSC1 LAN: 172.16.1\*.10  
BSC2 LAN (red.): 172.16.1\*.19  
BSC1 WAN: DHCP  
BSC2 WAN: DHCP

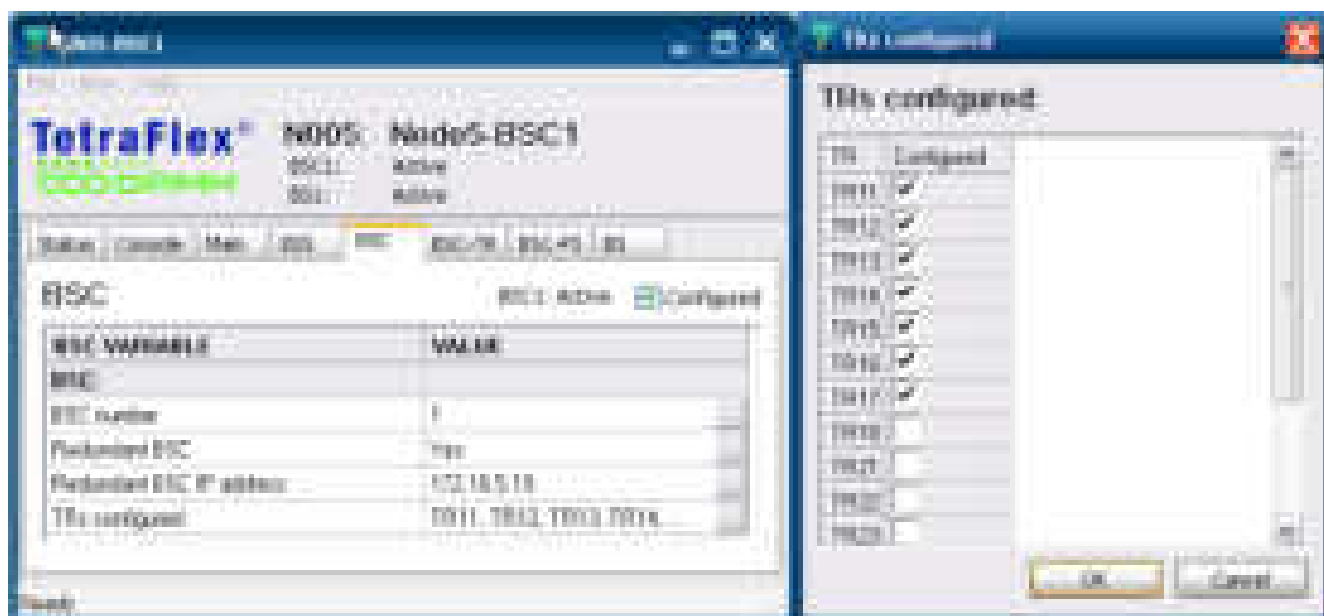
\* 1 for single node, or node1 in multinode. This will be 2 for node2 etc.

## 2.7.4 Add a Transceiver

A new TR412 Transceiver can be inserted “live” into the Rack. If already configured in the BSC, the TR412 will automatically start-up. Before removing a TR412 it should be blocked and the TX stopped.

The settings can be set and changed from the BSC GUI or with OM commands. Both are described in this chapter.

The BSC-GUI can be started from the Start menu – TetraFlex – BSC - BSCGUI :



The Transceivers can be added and deleted from the BSC tab. OM command

F75 - to view configured TR's


F75/nn/ ADD - To add new transceiver, where nn reflects the TR position 11 to 18

All TR412's should be configured in the BSC.

The current TR configuration can be displayed from the BSC-TR and BS tab and OM command:

- 05 - Display Config /Status from BSC
- 13 - Display TX output power selection
- 22 - Display RX diversity selection
- 30 - Display RX-TX channel numbers
- 72- Display RX settings



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### 2.7.6 Diversity

Setting-up the diversity and TMA/TMD pre-gain can be done from the BSC-GUI, BS tab.  
Select RX pre-gain and RX diversity:

OM Command:

F73/RXDIV/n      Where n reflects the diversity type  
                          D = Diversity  
                          A = RX-A antenna only  
                          B = RX-B antenna only

F73/RXPREGAIN/n.n    Where n reflects the dB value 0.0 to 9.9 (nominal 6.0)

### 2.7.7 Add a Power Supply

A PS411 Power Supply can be inserted into and removed from the rack during normal BS operation. Before it is inserted or removed, be sure, that both switches on the front plate are in OFF position.

The PS411 automatically receives the configuration from the BSC at start-up. The configuration can be checked from the BSC-GUI - BS Tab

or with the command:


H76/nn/ADD

Where nn reflects the PS411 cassette position 11 to 47

### 2.7.8 Combiner adjustment

The combiner can be adjusted with this OM command:

A11	Address TR1
10	Check that Tx is on else Turn on TX with 10+
AT11	Address select combiner 1A (AT12 = combiner 1B)
01+	Local blocking on
12	Display TC test points (should be as close to 0 VDC as possible)
13/1/+	Increment fine adjust setting (TC1 in combiner 1A)
13/1/-	Decrement fine adjust setting (TC1 in combinder 1A)

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Use 13/X/+ and - to adjust until you get the lowest possible VDC, check with OM 12 for each adjustment. X is TC number (1-4), Change to TC that needs adjustment

13/1/EE++++ Save setting for TC1 (not automatically saved without this command)

01 - Set local blocking to off again

## 2.7.9 Antenna measurement

Use the following OM command to check the antenna and cable conditions:

AU+ (AU/FORCED if there are no connection)

A12 – Shift to TR2

01+ local blocking conditional request

10/AUTO/D disable auto Tx

10+ Turn on Tx

32+ Turn on RFTL high

23+ Rx antenna measurement command

The measurement must show a value around -20dBr (+/- 3dBr) a lower value may indicate a bad receiver antenna (or cable)

Set local blocking to off again

01- Local blocking off

## 2.7.10 Save BSC and TR configuration

The various settings are from TetraFlex® version 7.5 on saved automatically when making changes from BSC-GUI or OM-commands.

## 2.7.11 TMA/TMD installation adjustment

### 2.7.11.1 Introduction

This guide describes how to adjust the BS41x Tetra Base Station after installation of the TMA412 RX Tower Mounted Amplifier. The instruction is also valid if only the TMD412 is provided, as the TMD412 is identical to the TMA412 except for the additional Duplexer.

The TMA is to be connected with the BS using 3 shielded cables with a maximum insertion loss of 8dB. The adjustment procedure requires the loss of all 3 feeders to be identical.

The adjustment is done to adapt the TMA to the selected output power of the TR and to compensate the actual loss of the 3 feeders.

The TMA including feeder loss and AI411 input attenuation is recommended to run with a pre-gain of 6dB. This has been chosen as a compromise between sensitivity and dynamic range. It is not recommended to operate a higher gain.

Output power in analogue NMT/MPT mode is fixed to be twice the output power in Tetra mode. The following equivalent input levels at the TMA input from the RFTL are recommended:

Mode	RFTL level	TMA input (+6dB)	TR input
Analogue	High	-105dBm	-99dBm
Tetra	High	-108dBm	-102dBm
Analogue	Low (-10dB)	-115dBm	-109dBm
Tetra	Low (-10dB)	-118dBm	-112dBm

Note that RFTL low level (-10dB) is not supported in the first versions of the TR411.

#### 2.7.11.2 Tools and Equipment

Operating the TetraOM System requires a PC to be connected to the BS, a screwdriver, and a short test cable.

The test cable must be a 50 cm long RG214 cable with two N-male connectors.

#### 2.7.11.3 Adjustment Procedure

##### Step 1: Prepare the adjustment:

- Connect the PC to the BS, log-on and address a TR to be used for the adjustment. Any TR connected to the node can be used.
- Make Local Blocking (01+)
- Select test mode CW (02/- and 15/CW)
- Check the TX output power to be set to the required value (13).
- Check, the TMA pre-gain to be 6.0dB (72)
- Key the transmitter (10+) and activate the RFTL (32+)
- Display RSSI (R/21/0)
- Turn the 3 attenuators on AI411 "GAIN A", "GAIN-B" and RFTL "OUT" to maximum RSSI (minimum attenuation).


##### Step 2: RFTL input level adjust

This step adjusts the RFTL input attenuator to give a fixed level on the RFTL mixer independent of the selected output power:

The attenuation shall be adjusted to the following:

TR power (Tetra)	TR power (Analogue)	Attenuator
25W	50W	15dB
12W	25W	12dB
6W	12W	9dB
3W	6W	6dB
1.5W	3W	3dB



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- Turn RFTL input attenuator to minimum attenuation
- Register the RSSI
- Increase attenuation until the RSSI has decreased to the value from the table

### Step 3: RFTL output level adjust

This step adjusts the RFTL output level at the BS TMA Test Connector to be correct, if the feeder loss is 8dB.

- Remove the feeder on the Test connector on top of the rack.
- Remove the feeder on the RX-A connector on top of the rack
- Connect the test cable between the Test connector and the RX-A connector.
- Adjust the RFTL out attenuator to give an RSSI of –47dBm on TR41x input.
- Remove the test cable and re-connect the feeders again

The –47dBm is related to the nominal test signal level of –105dBm at the TMA, with a coupling loss in the TMA in forward direction of 50dB and a feeder loss of 8dB.

### Step 4: Feeder loss compensation adjust

This step adjusts the RFTL output attenuator and the RM input attenuators to compensate the feeder loss.

- Register the RSSI on the TMA input. If step 1 and 2 has been done correctly, the reading should be –105dBm, if the cable losses are 8dB. If the cable losses are less than 8dB, the input levels will be higher than –105dBm. The feeder loss will be:  
Feeder loss =  $8 - (105\text{dBm} + \text{RSSI}) / 2$  dB.
- Adjust with AI411 RFTL “OUT” the RSSI TMA input reading exactly half the way down to –105dBm. For example if reading –100dBm then adjust to –102.5dBm.
- Adjust the AI411 “GAIN A” to an RSSI input level on TMA-A input of –105dBm.
- Adjust the AI411 “GAIN B” to an RSSI input level on TMA-B input of –105dBm.

### Step 5: Restarting the Base Station

It is recommended to make a complete restart of the BS after the installation procedure has finished ensuring, that a correct automatic start-up after power-down will take place.


- Turn off all the Output switches on the PS411 front plates
- Turn on all switches again

### Step 6: Before the Base Station is left, always check that:

- All TR units are un-blocked (01-)
- Line by-pass switch is OFF
- No RED alarm indicators are illuminated
- Door is locked

#### 2.7.11.4 BS41x manual frequency adjustment procedure

If the BS is operating without GPS sync. (Free run) the reference oscillator has to be checked and adjusted one time a year.

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Measure the BS41x transmitter frequency, the transmitter can be switch to CW mode for easier measurement.

Commands to TR412

01+ ;Local blocking  
02/- ;Test mode  
15/CW ;CW modulation  
10+ ;Start transmitter

Commands to adjust the reference oscillator:

H31 ;Display Sync status, note the DAC output value (OCXO Free Run value)  
H31/SET/nn.nnn ;Set the OCXO Free Run value, range from 00.000% to 99.999%  
H31/SAVE ;Save the OCXO Free Run value to flash

A change of 1% will give a frequency change about 0.1PPM

## 2.8 COMMON SETTINGS FOR BS41x AND SB421

### 2.8.1 Setting the main parameters

The settings can be set and changed from the BSC GUI or with OM commands. Both are described in this chapter.

The BSC-GUI can be started from the Start menu – TetraFlex – BSC - BSCGUI:

(on SB421 the BS tab is not present)



First set the Main parameters from the Main tab

**Description:** e.g. Node5-BSC1 OM command M71/DESCR/NODE5-BSC1

The string should contain a description of the node or the geographical position of the BS site. If it is a single-carrier BS with directional antenna, the direction can also be included.

**LAN IP address:** Use the drop down box to select the LAN address setup from the Windows IP setting as described in 2.7.3. OM Command M71/IPADDR/LAN/172.016.005.010. The IP address must match the Windows LAN IP setting.

The example shows BSC1 in a multinode configured to Node 5.

**WAN IP address:** Use the drop down box to select the WAN address setup from the Windows IP setting as described in 2.7.3.

OM Command M71/IPADDR/WAN/010.239.024.125. The IP address must match the Windows WAN IP setting.

The example shows the WAN address set to match the company WAN IP address range.

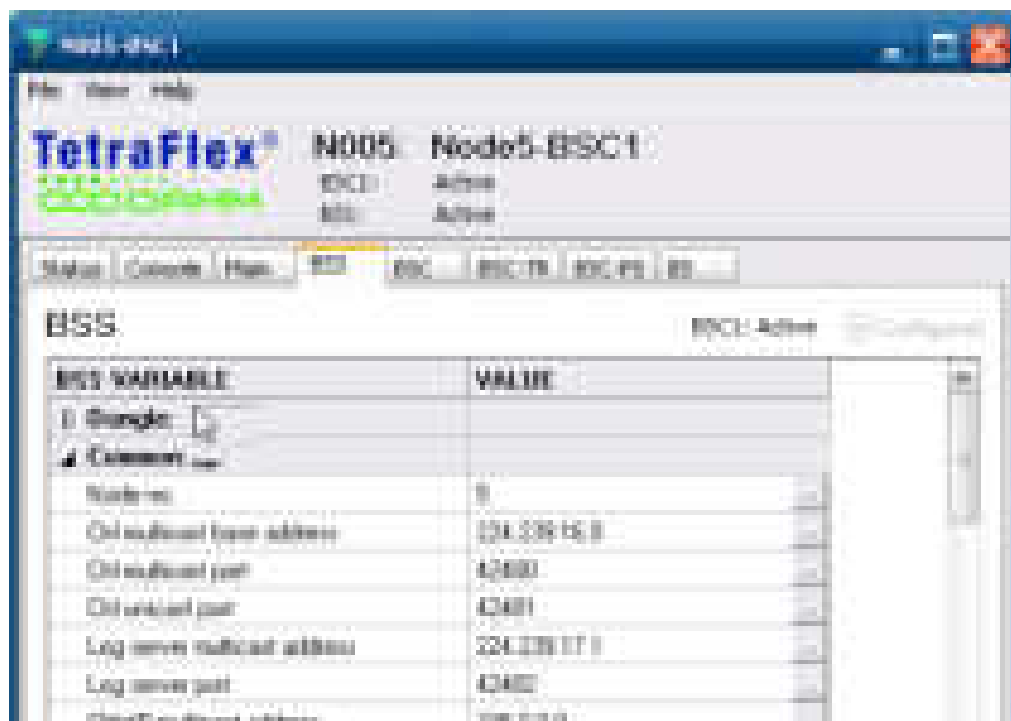
**Position change from GPS allowed:** If set to “Yes” the Latitude and Longitude GPS coordinates are received from the GPS antenna and overwrites the settings in the *Latitude* and *Longitude* fields. Set to “No” the Latitude and Longitude settings can be set manual. OM command M71/POS/GPS/+ for “Yes” and M71/POS/GPS/- for “No”

**Latitude and Longitude:** Manual setting of the Latitude and Longitude coordinates of the Node, This will be overwritten with the actual GPS position if *Position change from GPS allowed* is set to Yes. OM command H71/POS/54:54:55:54N/009:48:23:69E

All settings are saved immediately in the configuration file *CnfgMain.txt* when pressing the Ok button in the different settings and when executing the OM commands.

The rest of the fields on the Main tab are for information only and cannot be changed from the BSC-GUI.

Next step is to set the BSS settings- Select the BSS tab:



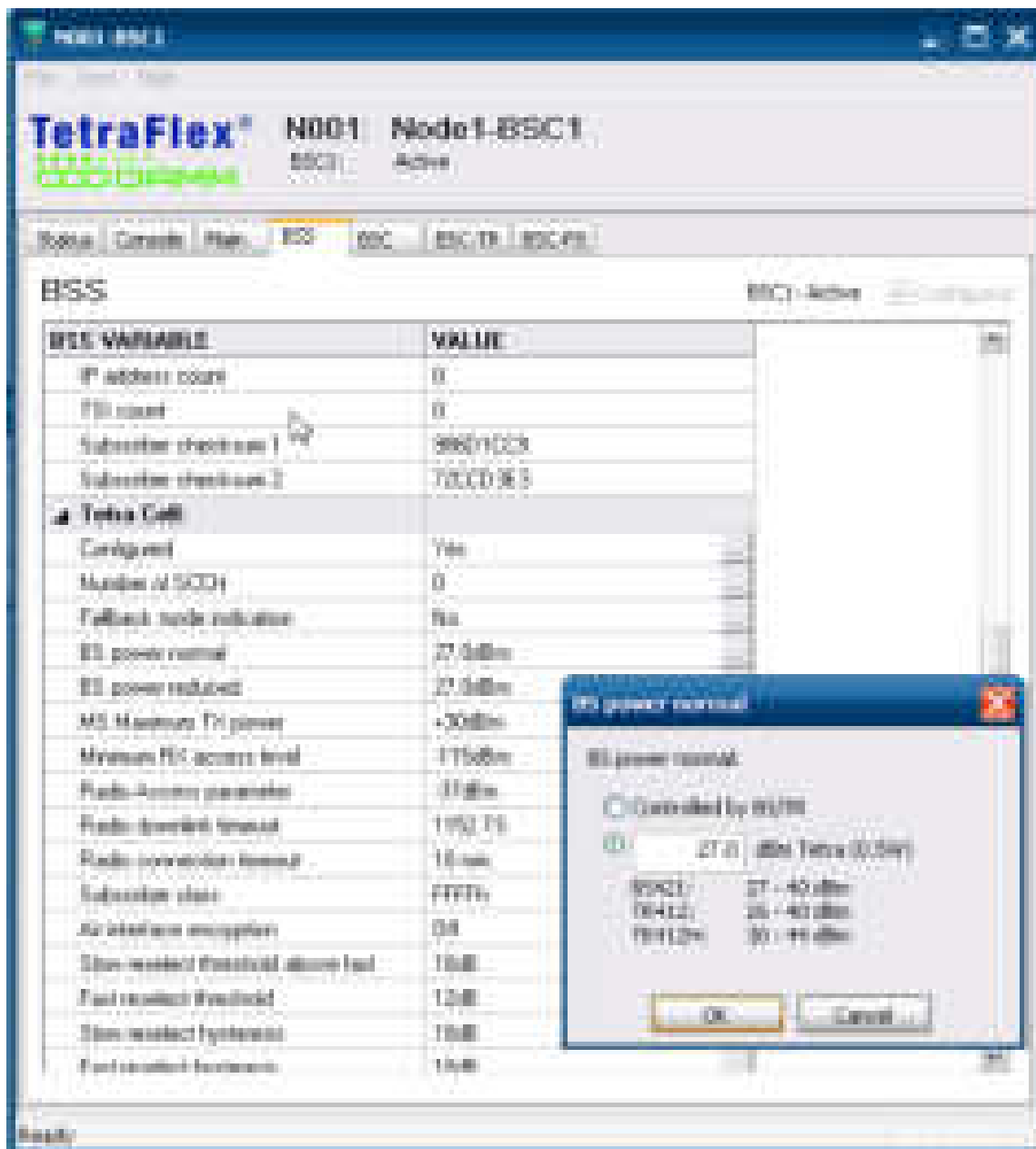
Most important is to set the **Node no**. This must be set to chosen node number. This example shows Node 5. OM command S71/NODENO/005

The remaining parameters can be set from NM too.

For setting up redundant BSC see ref. 5 “TetraFlex 7.6 BS41x redundant setup.pdf” and see ref. 6 “TetraFlex 7.6 SB421 redundant setup.pdf”

## 2.8.2 TX Power

Setting the desired TX power level for all Transceivers use the BSC-GUI, BSS-Tab select the TX BS power normal:



For the BS41x the setting is Tetra Mode output power at Rack TX Antenna connector. An insertion loss of the combiner system of 4.0dB is assumed. If the value is lower or higher than the TR412 limits, the TR412 will set the power to the minimum or maximum power respectively.

For the BS421 it is the output power on Tx antenna connector.

If set to Controlled by BS/TR, the output is controlled by the setting in the BS421/TR412.

### 2.8.3 BS Power reduced

The Tx output can automatically be set to reduced power value as set in BS power reduced:



The reduced level is activated when Digital input 8 (Power red.) in BS41x or SB421 is set to active. See also OM command `S72/BSPWR/RED/+xx.xx`

## 2.9 NETWORK MANAGEMENT INSTALLATION

### 2.9.1 The DAMM Network management Application

The Network Management software (NM) is preinstalled on every SB421/ BS41x delivered with TetraFlex® and need no installation to run.

NM may be executed on any node from a remote desktop connection to the node or with a keyboard/mouse and a monitor connected direct to a SB421 or a BSC412.

You can also use a PC which has an IP connection to the infrastructure. The NM is able to listen to the multicast which means, when using a PC the PC must be connected to the LAN.



Figure 2-18: Network management main screen

### 2.9.2 NM Installation on an external PC

- If not already done, copy the Tetra directory from a BSC to a PC
- Execute the NM.vbs file. This will copy the NM program to the user profile and start up the NM application. There must be a dongle (at least an empty dongle) in the PC before NM will start
- Create a shortcut on the desktop to the NM.vbs file

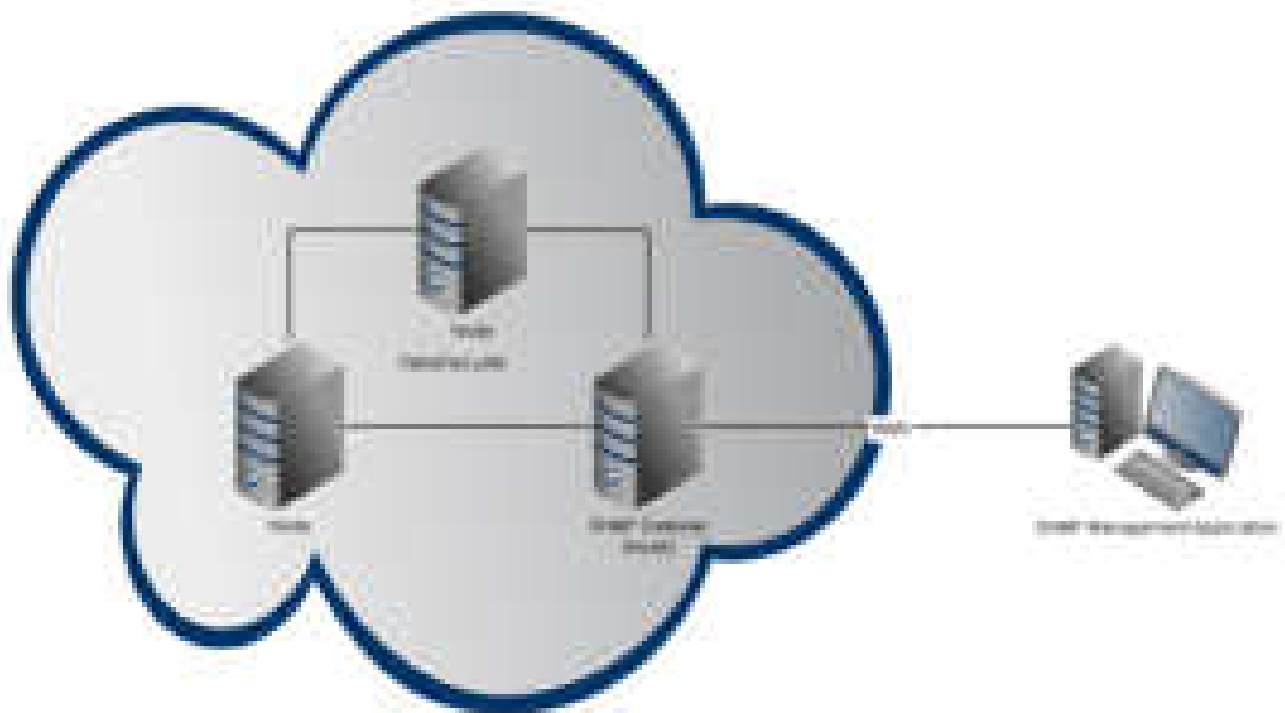
Refer to section 3.3.2 for NM User Manual

### 2.9.3 SNMP gateway

The SNMP gateway operates together with NM. To utilize SNMP you will need an SNMP Management Application. This application will gain access to the status of the TetraFlex network through the “SNMP Gateway”. This gateway could be a node in the TetraFlex network. In that case the PC which runs the SNMP Management Application will need to connect to this “SNMP gateway node” via the WAN connection.

The SNMP gateway must have the SNMP extension agent installed and will need to have NM running. NM is responsible for updating all of the node status variables, whilst the SNMP agent will service the SNMP requests.

The SNMP Management Application polls for the node status. Traps are not generated by the TetraFlex network. This is in accordance with recommendations found in the rfc1157.



The SNMP agent packets is default in the c:\tetra\active\pgm\nm directory or can be downloaded from [www.damm.dk](http://www.damm.dk) extranet software download site.

The SNMP agent packet consists of:

SNMPAgent.dll	This file is the actual SNMP extension agent. It works in correlation with the Windows SNMP service, which is already installed on the SB421 and BSC412. This extension agent is responsible for servicing SNMP requests.
SNMP_install.vbs	Script-file which will: <ul style="list-style-type: none"> <li>• Stop the Windows SNMP Service.</li> <li>• Copy SNMPAgent.dll to SNMPAgent_.dll</li> <li>• Import registry settings required to install SNMPAgent_.dll.</li> <li>• Modify registry settings to make the SNMP Gateway node auto logon with the “tetra” user.</li> </ul>



	<ul style="list-style-type: none"> <li>• Copy shortcut to NM.bat file into startup folder.</li> <li>• Start Windows SNMP Service.</li> </ul>
SNMPInstall.reg	Registry file containing registry settings necessary to install the SNMP extension dll. The settings in this file will be imported by the SNMP_Install.vbs file.
NM.exe	Network Management application. NM is regularly updating the BSC variables, so that the extension agent is able to service the SNMP request with the latest info.
Network Management.lnk	Shortcut to the NM.bat file located under C:\Tetra\Active\Pgm\NM.
DAMM-GLOBALMIB.Mib	Damm MIB tree

### 2.9.3.1 SNMP installation

To install the SNMP agent on the SB421 or BSC412 complete the following steps:

1. Copy "DAMM-GLOBAL-MIB.mib" into the documentation folder of the BSC "C:\Tetra\Active\Doc".
2. Copy SNMPAgent.dll, SNMP\_install.vbs, SNMPInstall.reg, NM.exe and Network Management.lnk to the SNMP gateway node. The files should be placed in C:\Tetra\Active\Pgm\NM.
3. Run the SNMP\_install.vbs file to install the SNMP extension dll and registry settings.
4. Start-up the Network Management application (NM). NM should be set to auto start to start-up automatically when the computer is restarted. The SNMP gateway will not operate without the NM.

### 2.9.3.2 SNMP Manually PC installation

If the Damm SNMP agent is to be installed on a PC instead of a SB421 or BSC412, you will have to install the agent manually. To manually install the Damm SNMP agent do the following:

1. Make sure the Windows SNMP Service is installed on the PC. It can be installed via: "Control Panel" – "Add or remove programs" – "Add/Remove Windows components" – "Management and monitoring tools" – "Simple Network Management Protocol".
2. Copy SNMPAgent.dll, NM.exe and Network Management.lnk to the PC. The files should be placed at C:\Tetra\Active\Pgm\NM.
3. Copy the SNMPAgent.dll, and rename the copy "SNMPAgent\_.dll".
4. Install the SNMPAgent\_.dll by entering the following settings into the registry:

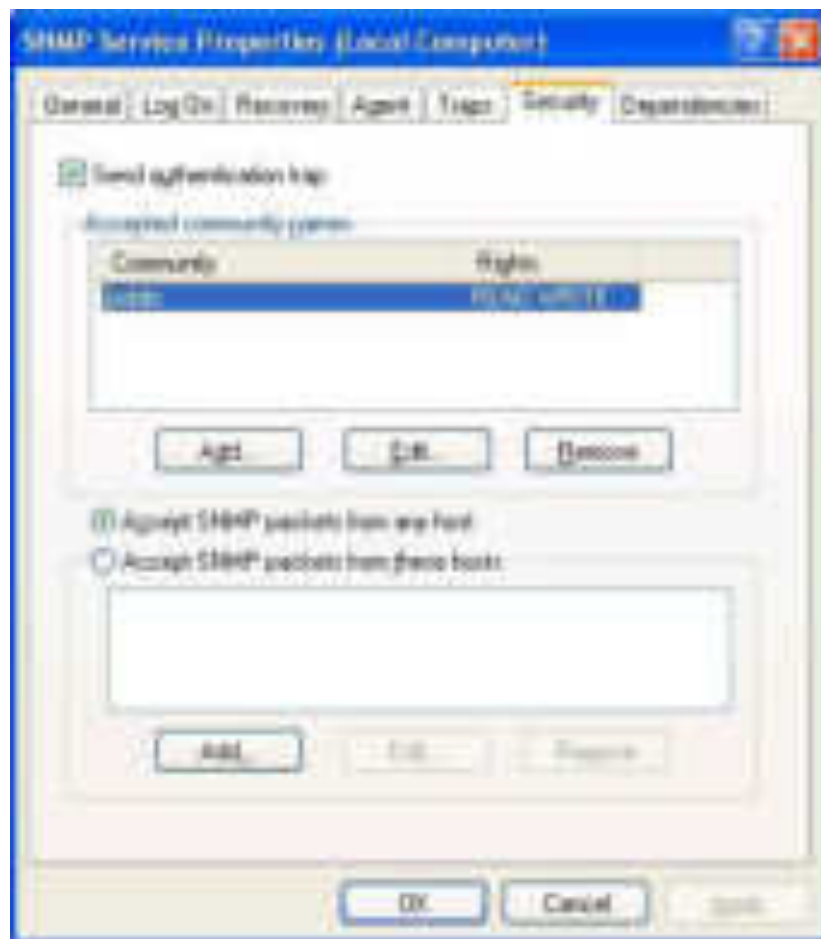
```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\SNMP\Parameters\ExtensionAgents]
"TetraFlexSNMP"="SOFTWARE\\SNMP\\CurrentVersion"

[HKEY_LOCAL_MACHINE\SOFTWARE\SNMP\CurrentVersion]
"Pathname"="C:\\Tetra\\Active\\Pgm\\NM\\SNMPAgent_.dll"
```

- Make the PC login automatically upon boot, by entering the following settings into the registry (exchange DefaultUserName and DefaultPassword with the correct username and password):

```
[HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon]
"AutoAdminLogon"="1"
"DefaultUserName"="tetra"
"DefaultPassword"="tetra"
```

- Place the Network Management.lnk file in the startup folder to make the Network Management application startup automatically upon boot..
- Check the SNMP Security settings (start -> right click on "my computer" -> manage -> Services and Applications -> Services -> SNMP Service -> Properties -> Security). These settings could be as shown in the example on the following figure:



A more safe solution is to restrict the SNMP access by ticking "Accept SNMP packets from the hosts" and add the Host name, IP or IPX address of the specific known hosts.

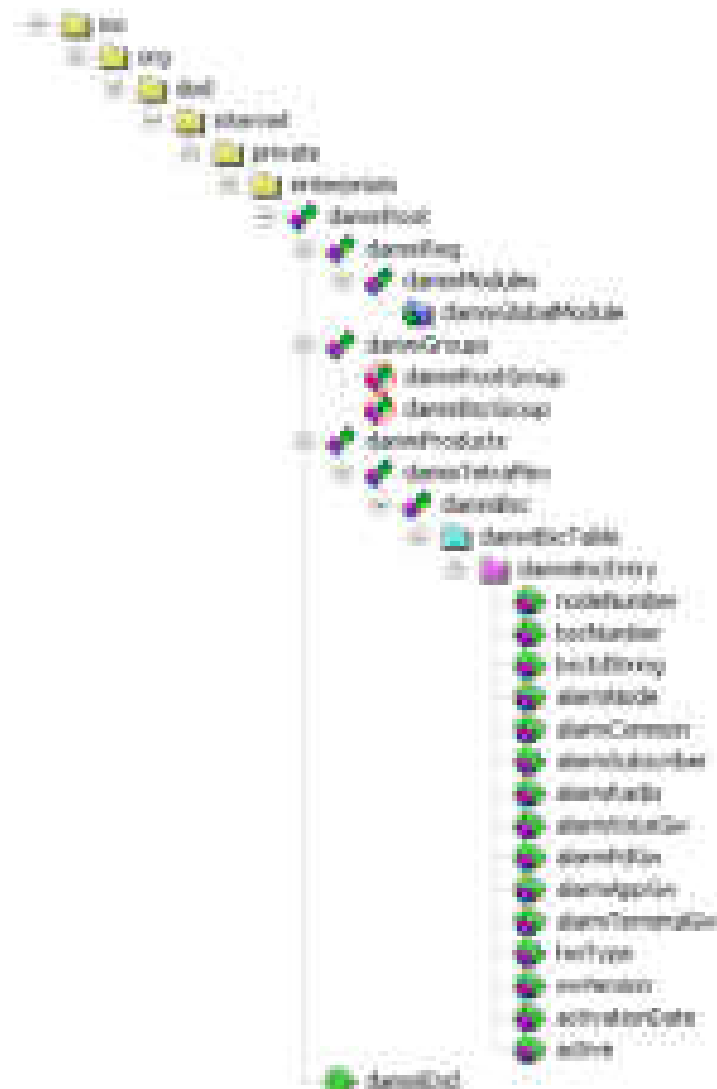
- Restart the Windows SNMP Service.
- Start the Network Management application. NM should be set to auto start-up to make it start-up automatically when the computer is restarted. The SNMP gateway will not work without the NM.

### 2.9.3.3 SNMP MIB Tree

A SNMP Management Application uses the information in the DAMM-GLOBAL-MIB.MIB file for configuration and setup, please refer to the user guide for your SNMP Management Application to set it up.

SNMP gateway has been tested to work with WatchUp Gold 14.2


The following figure is a graphical representation of the DAMM-GLOBAL-MIB module (The Damm MIB tree).



**Figure 19: The DAMM-GLOBAL-MODULE**


The most important variables are explained in detail in the following table.

Name	OID	Description
dammRoot	1.3.6.1.4.1.15228	The root of the Damm MIB tree.
dammGlobalModule	dammRoot.1.1.1	Contains info on when the MIB file was updated. This is not a scalar variable, which means the data is located in the mib file and isn't polled from the BSC.
dammBscTable	dammRoot.3.1.1.2	Contains a dammBscEntry for each BSC

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		running in the system.
dammBscEntry	dammRoot.3.1.1.2.1	Contains each variable in a given BSC, which is going to be monitored.
nodeNumber	dammRoot.3.1.1.2.1.1	The node number of the BSC which is monitored. Values range from 1 to 999.
bscNumber	dammRoot.3.1.1.2.1.2	The BSC number of the polled BSC. Values range from 1-2. (Used for redundant BSCs).
bscIdString	dammRoot.3.1.1.2.1.3	The description for the given BSC.
alarmNode	dammRoot.3.1.1.2.1.4	Node alarm (0=OK, 1=Warning, 2=Alarm, 3=Blocked, 255=Not configured).
alarmCommon	dammRoot.3.1.1.2.1.5	Common alarm (0=OK, 1=Warning, 2=Alarm, 3=Blocked, 255=Not configured).
alarmSubscriber	dammRoot.3.1.1.2.1.6	Subscriber alarm (0=OK, 1=Warning, 2=Alarm, 3=Blocked, 255=Not configured).
alarmRadio	dammRoot.3.1.1.2.1.7	Radio alarm (0=OK, 1=Warning, 2=Alarm, 3=Blocked, 255=Not configured).
alarmVoiceGw	dammRoot.3.1.1.2.1.8	Voice Gateway alarm (0=OK, 1=Warning, 2=Alarm, 3=Blocked, 255=Not configured).
alarmPdGw	dammRoot.3.1.1.2.1.9	Packet Data Gateway alarm (0=OK, 1=Warning, 2=Alarm, 3=Blocked, 255=Not configured).
alarmAppGw	dammRoot.3.1.1.2.1.10	Application Gateway alarm (0=OK, 1=Warning, 2=Alarm, 3=Blocked, 255=Not configured).
alarmTerminalGw	dammRoot.3.1.1.2.1.11	Terminal Gateway alarm (0=OK, 1=Warning, 2=Alarm, 3=Blocked, 255=Not configured).
hwType	dammRoot.3.1.1.2.1.12	Hardware type (0=PC, 1=BSC421, 2=BSC412).
swVersion	dammRoot.3.1.1.2.1.13	Software version string.
activationDate	dammRoot.3.1.1.2.1.14	Activation date.
Active	dammRoot.3.1.1.2.1.15	BSC active status (1=active, 0=not active).

The DAMM-GLOBAL-MIB.MIB file can be found in c:\tetra\active\doc folder.

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## 2.10 DISPATCHER INSTALLATION

### 2.10.1 The DAMM Dispatcher Application

The DAMM TetraFlex® Dispatcher is a Windows application consisting of the core TetraFlexApi.dll and the associated Graphical User Interface.

The DAMM TetraFlexApi.dll contains all the functionality to connect to the TetraFlex® Network and has a fully documented API to interface with the GUI.

The dispatcher is delivered with a Multi Lingual Graphical User Interface. The DAMM dispatcher is generic and intended for standard use. In case the user wants additional features, this may be accomplished by programming their own application or obtaining a third party application using the delivered TetraFlexApi.dll and the TetraFlexApi.h file

The TetraFlexApi.dll connects to an Application Gateway on a TetraFlex® node via a standard WAN IP connection.

For API installation, please refer to the Application Gateway installation section.

### 2.10.2 Dispatcher Installation:

The Dispatcher can only be installed outside the BSC, on a separate PC. It connects to the Application Gateway of the TetraFlex® through the WAN port.

Prerequisite for this connection to be successful is that the WAN port of an Application GW node is physically connected to a network - and that the WAN port of the BSC/ Windows is configured with an IP address inside the same subnet as the PC on which the Dispatcher is going to reside.

The dongle marked "API" must be inserted in the USB port of the Dispatcher PC before installing the Dispatcher. For the DAMM Dispatcher a dispatcher entry in the dongle must be present to allow the DAMM Dispatcher to start up. For a third party dispatcher, this entry is not relevant.

When the BSC.exe is started, the Dispatcher installation files are automatically placed in the C:\Tetra\Share\Dispatcher directory on the nodes:



File Name	Size	Type	Date
Dispatcher_766.exe	8,442 KB	Windows Installer Package	30-09-2011 14:59
Setup.exe	26 KB	Application	30-09-2011 14:59
TFC2FlexApi_v48-076-1.exe	3,368 KB	Windows Installer Package	07-09-2011 14:46
TFC2FlexApi_v48-076-1.exe	3,390 KB	Windows Installer Package	07-09-2011 14:46

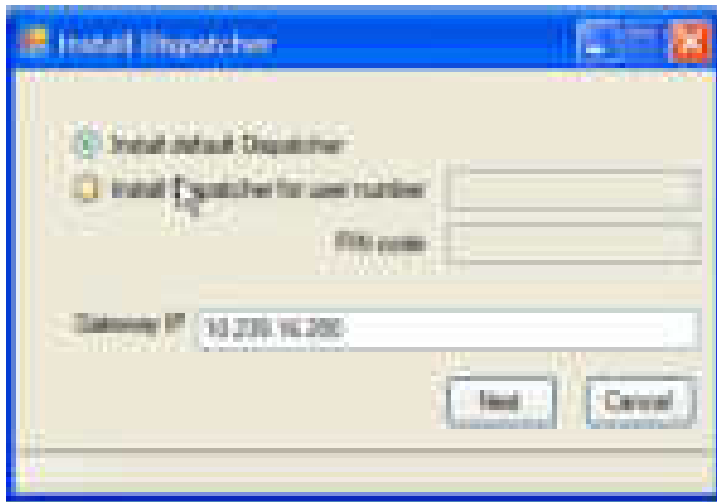
By accessing the share on the node where the Application Gateway is setup from an external PC, the Dispatcher Setup.exe can be executed and the Dispatcher installation starts.

The share looks like this seen from an external PC:

\\< IP address or node name >\TetraFlex\Dispatcher

< IP address or node name > is either the IP address or the DNS name of the node where you install the Dispatcher from and where the Application Gateway is defined.

When the setup.exe program is executed this dialog comes up:



The dispatcher can be installed as default; this means that the dispatcher is installed in the directory c:\tetra\applications\dispatcher\default and the user number and PIN code has to be setup in dispatcher after the installation.

If using “Install dispatcher for user number” the user Application SSI number and PIN code that has been setup in the subscriber register must be typed in, in this case the Dispatcher is installed in the directory:

c:\tetra\applications\dispatcher\<user number> where the “user number” is the number you typed.

The installation process makes a shortcut to the dispatcher in the start menu on your PC:


Ex. “Tetraflex – Dispatcher 7.60 2012-11-19 – Default” where “date” is the date you made the installation followed by “Default” or the user number if the user number was used for the installation.

Please see also chapter 3 “Dispatcher” for setting up the dispatcher.

### 2.10.3 Dispatcher Installation on a PC with Windows 7

If problems occur with finding the node from where the dispatcher shall be installed, this setting in Windows 7 can help:

- click the start button and type secpol.msc in the search function.

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- Browse to "Local Policies" -> "Security Options". Now look for the entry "Network Security: LAN Manager authentication level" and open it. Click on the dropdown menu and select "Send LM & NTLM - use NTLMv2 session security if negotiated". Apply the settings.
- In the Advanced sharing settings page of Network and sharing center, you need to set it as Work/Home profile. How to do it:
  - Enable network discovery
  - Turn on file and print sharing
  - Turn off password protected sharing
  - Use user accounts and passwords to connect to other computers

#### 2.10.4 Configurations to be done on the node

The Application gateway must be enabled on the node where the Dispatcher has to be connected to, and the Application SSI must be defined in the subscriber register.

This can be done from the Network Management (please see the relevant chapter in Network manager).

The following OM command can also be used to check the settings:

- M71 to verify the correct IP address of the BSC WAN.
- S75 and S75/CNFG/+ to check and enable the application gateway in the BSC.

## 2.11 LOG SERVER



**Warning:** When installing the Log Server on a system with a former database version, the log server backs up the old database and Log Client and starts up with a blank database. To view the content of the old database, use the back'ed up version of the Log Client.

### 2.11.1 General Description

The TetraFlex® Log Server software is delivered in 3 versions: Internal log server on the BS41x and SB421, external Log Workstation and external Log Server.

The TetraFlex® Log Server software is installed as a service named “LogServer”, which automatically starts when the windows system is powered up. The internal log server is factory set to be disabled and has to be enabled and started from the TetraFlex menu – Logserver install.

### 2.11.2 LogServer License

The TetraFlex® Log Server requires a USB License dongle to run. The dongle has two purposes, to protect the TetraFlex® Log Server software from being illegally used without any software license, and to store essential configuration and licensing values.

The dongle has a selection of settings, some of which are payable

The dongle must be present on the unit (BS41x, SB421, Log Workstation, and Log Server) where the TetraFlex® Log Server application is installed else it will not be able to run.

The log server is capable of logging statistics data if only a valid DAMM dongle is installed, but if CDR, Voice logging, MS registration and SDS logging are needed, this must be set in the dongle.

From the log server tray – *LogServer License tab*, the following configuration values read from the dongle are shown:





Dongle Configuration Values	
Name	Description
Dongle serial number	DAMM serial number of the dongle programming.
Dongle Date Limit	The date the dongle will cease to operate
Application Date Limit	If the application date (date compiled in the software) is newer than the Application date limit the application will no longer start. This means that it is not possible to upgrade the software with a newer one as the application date limit.
Logging to Database	Logging to the MySQL database (default)
Logging to API	Streaming to external application through the Log API
CDR and MS location logging	CDR and Voice logging allowed or not allowed. MS registration and RSSI measurement allowed or not allowed
SDS Content Log	Logging of SDS content allowed or not. This is also the case GPS coordinate logging.
Max. number of concurrent voice logging channels	Number of simultaneous voice channels which can be logged at a given time (0-255)

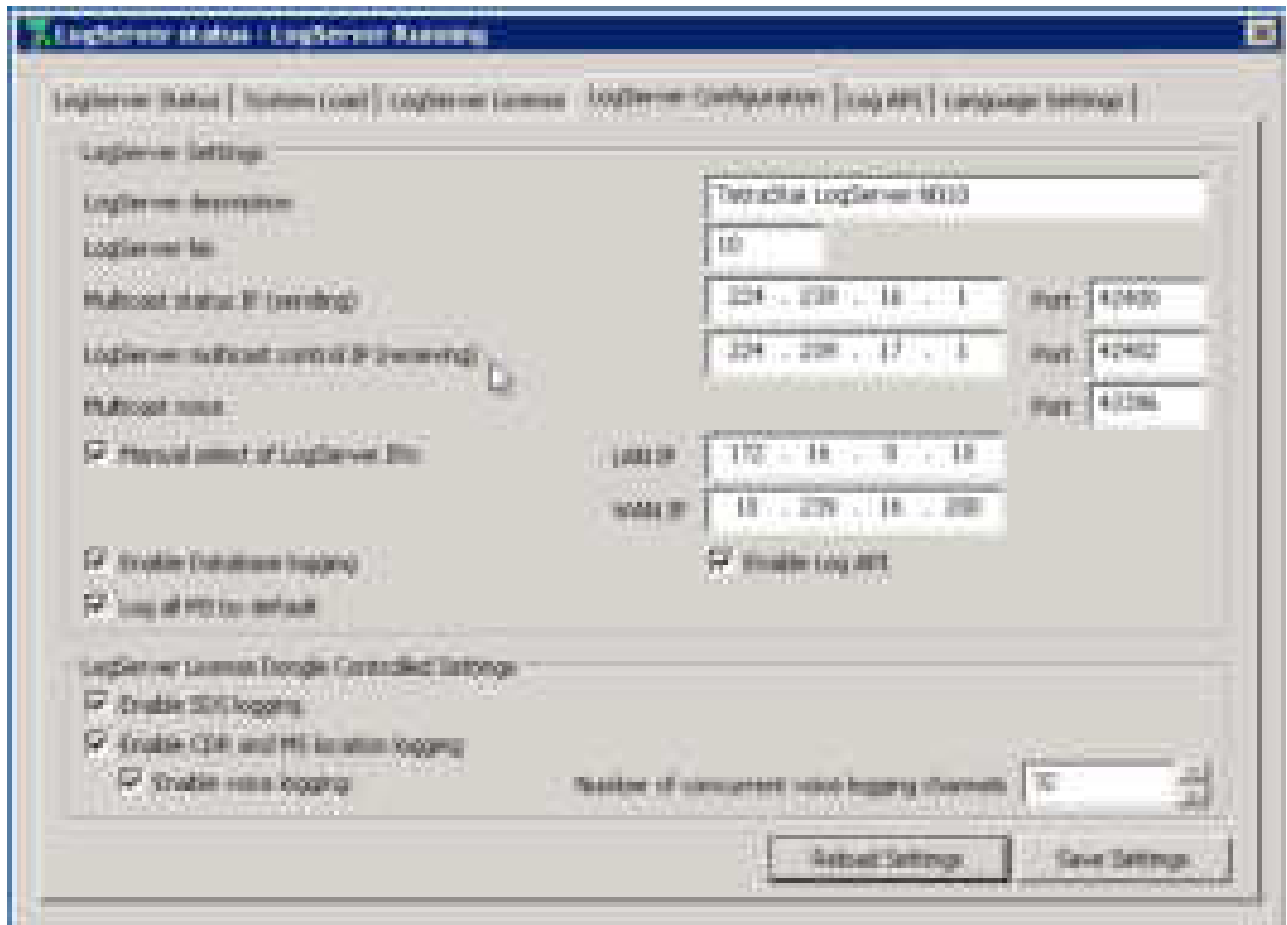
### 2.11.3 Logserver Tray Configuration

The TetraFlex® Log Server's configuration is located in an ini file within the same folder as the executable one (C:\Tetra\Applications\LogServer\LogServer.ini).

The configuration is loaded during start up by the LogServer Service. The LogServer keeps the configuration in memory, it can be changed on the fly via the LogServer Tray user interface without restarting. When the LogServer service is running it owns the .ini file and changes in the configuration should always be made via the LogServerTray, since the LogServer service will overwrite the ini file if it detects any configuration differences.

First time the TetraFlex® Log Server is launched, it will automatically generate the LogServer.ini file with the default parameters mentioned bellow. In most cases, it will only be necessary to change the "Manual select of logServer IP's" if the TetraFlex® Log Workstation or Log Server machine has more than one network interface card.

## LogServer Tray:



**LogServer description:** This is a textual description of a maximum of 32 characters describing this instance of the LogServer. This info is sent to NM, and is visible there along with other LogServer settings as well (default: LogSrv Description)

**LogServer No:** Log server number (default: 25)


**Multicast status IP(sending):** This is the multicast IP address of the multicast group where the control messages flow (default : 224.239.16.1) and **Port** (default 42400).

**LogServer multicast control IP (receiving):** This is the multicast IP address of the multicast group and **Port** (default 42402)

**Multicast Port:** This is the multicast port number for Voice.

**Manual select of logServer IP's:** This setting enables or disables automatic detection of which network interface is LAN and WAN.

The LogServer needs to know which network interface is the "LAN" when joining multicast groups. It auto-detects this in the following way: 1<sup>st</sup> if a NIC is named "LAN" use this. 2<sup>nd</sup> if no "LAN" NIC found, use the logical interface which has an IP starting with the default LAN segment: 172.16.x.y

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3<sup>rd</sup> if none of the above criteria is met, the use the first interface found. NIC=Network Interface Card.

**LAN IP:** This is used only when Manual select of log server IP” is off .The LogServer will join its multicast groups via the network interface with this IP. It is needed only to specify this value in case of two or more network adapters.

It is the IP towards the Tetra nodes that needs to be specified here.

**WAN IP:** This is only displayed as info.

**Enable Database logging:** The log server logs to the database (Default)

**Enable log API:** Enables streaming of log data to and external device (dongle controlled)

**Log all MS by default:** This setting allows logging of voice of non-configured MS (subscribers) in the LogServer when enabled. If a MS has been configured in the LogServer, it will use these values regardless of this setting.

When this setting is disabled, the MS (subscriber) must be configured to be able to log voice by the LogServer

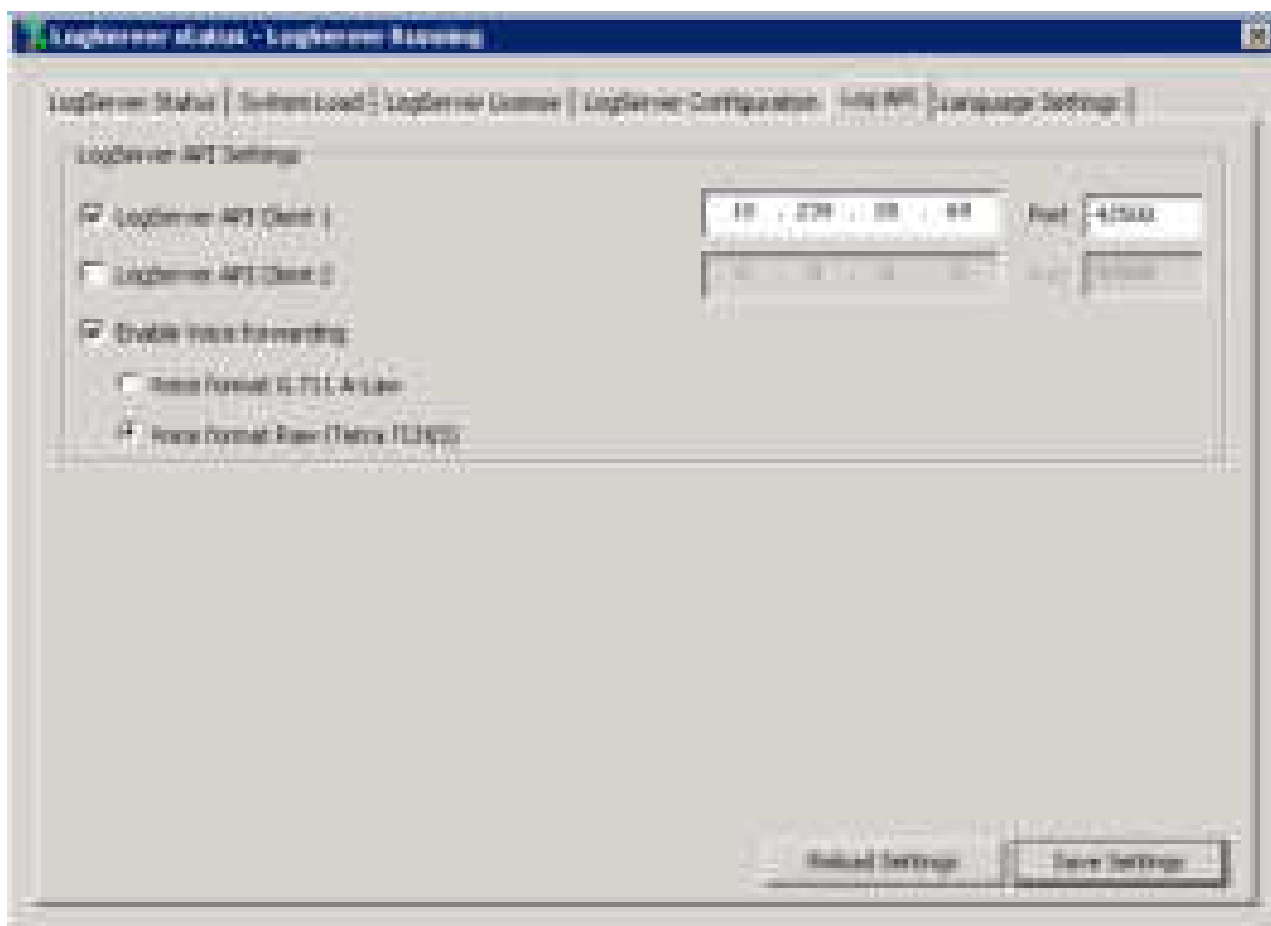
**Enable SDS logging:** This setting can enable/disable SDS logging. This setting only has effect when using a License dongle where SDS logging is allowed.

**Enable CDR and MS location logging:** This setting can enable/disable CDR- and MS Registration logging. This setting only has effect when using a License dongle where Call Info Logging is allowed.

**Enable Voice logging:** Enable or disable Voice logging – only possible with CDR and MS location logging enabled.

**Number of concurrent voice logging channels:** This setting defines how many concurrent calls can be voice logged. This setting only has effect when using a License dongle where voice logging is allowed.

## 2.11.4 Log API



The Log server can redirect the log server data to an external program instead of, or together with logging to the database. The log API requires a dongle with the log API flag set.

The Log API interface is described in a header file that can be requested from DAMM support.


DAMM has made a test application which can be used for testing the Log API. This can be requested from DAMM support. Every UDP message contains a common message header. The byte order is Little Endian.

Supported features:

- Status messages, SDS-Type4 (without TL), SDS-TL TRANSFER
- Individual calls (Duplex/Simplex)
- Group calls (Normal/Broadcast)
- Streams of active voice calls either as G.711 A-LAW or Tetra encoded TCH/S streams

The LogApi is an UDP-interface, which outputs CDR-, voice and SDS data. A maximum of 2 receiving LogServer API Client IP addresses can be setup:

**LogServer API Client 1 and 2 :** The IP address and Port number of the Application(s) that should receive the log stream can be setup.

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**Enable Voice forwarding:** If this flag is set the voice streams from the log server can be streamed to the receiving application(s) in either **G.711 A law** format of **Tetra** codec format.

## 2.11.5 Log server Installation

### 2.11.5.1 Internal Log Server:

The Log Server is preinstalled on all 8GB CF cards (delivered with all BS41x and SB421 today).

NOTE: The internal Log Server needs to have 1GB RAM or more to function properly (delivered with all SB421 today).

The log server is as default stopped from factory and need to be started when applicable. This can be done from the *Start menu – TetraFlex – LogServer- LogServer Restart*. This only works if the log server has been started once before.

If the Logserver never has been started you must use the install function from: *Start menu – TetraFlex – LogServer- LogServer Install*.

This will start the MySQL service, Log server application and the log server tray. This also will create a new empty database if not already created.

### 2.11.5.2 External Log Workstation and Log Server

The external Log Workstation and Log Server are pre-installed and preconfigured from DAMM at delivery.

If for any reason it has to be reinstalled this procedure must be followed:

This description is based on a Windows 7 platform installation, but it also applies to Windows Server 2008 platforms.

The installation procedure has been tested on a Dell Precision T3500 and on a Dell PowerEdge R710 that are the hardware used for the Log Workstation and the Log Server delivered from DAMM.

To install the Log Server, you have to follow these steps:

1. Rename NIC's to "LAN" and "WAN"
2. Disable "Automatic updates"
3. Change "Power Options" to high performance
4. Install "MySql ODBC 3.51 Driver" or later version
5. Install "MySql Community Server"
6. Install the MySQL GUI Tools
7. Create Tetra user
8. Copy Tetra apps
9. Install the Log Server
10. Add rule for firewall

## 1. Rename NIC's to "LAN" and "WAN"

Go to "Control Panel\Network and Internet\Network Connections"

Select the "LAN" Network interface card which should be the internal NIC on a Workstation. Look for the white "LAN" label on machine by the network card plug to identify it. Right click and select "Rename" from menu, name it "LAN".



If the machine has 2 NIC's:

Select the "WAN" Network interface card which should be the external NIC on a Workstation. Look for the white "LAN" label on machine by the network card plug to identify it. Right click and select "Rename" from menu, name it "WAN".

Set the Connection type to "Home or Work (private) networks"

## 2. Disable "Automatic updates"

Go to "Control Panel\System and Security\Windows Update\Change settings"

In the drop down options under "Important updates", select "Never check for updates (not recommended)"


## 3. Change "Power Options" to high performance

For Windows 7:

Right click on desktop and select "Personalize" from menu. In the lower right corner select "Screen saver". In the "Screen saver Settings" dialog select "Change Power Settings". In the "Control Panel\Hardware and Sound\Power Options" dialog select the predefined "High Performance", which never puts the machine to sleep.

For windows Server 2008:

Go to "Control Panel\System and Security" and select "Power options". Select "High Performance" as preferred plan.

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#### 4. Install "MySQL ODBC 3.51 Driver"

ODBC driver Version 3.51 can be found on the internet searching for "MySQL ODBC 3.51". Run the msi file, use default settings.

NOTE: The LogClient and LogServer specifies that this driver version must be used, when using later versions they will fail.

#### 5. Install " MySQL 5.1.52-community via TCP/IP"

The MySQL Community Server can be found at <http://dev.mysql.com/downloads/>

There are 2 versions, a 32bit and a 64bit version, select the one that matches your hardware.

Right click Setup.exe and select "Run as administrator" and select the following:


Setup Type: Typical

- click next
- click Install
- Click next until Wizard Completed page
- Keep the Check mark in "Configure the MySQL Server now", click finish.
  
- Now the "MySQL Server Instance Configuration Wizard Ver 1.0.17" is launched, click next
- Keep the Check mark in "Detailed configuration", click next.
- Depending on the machine select either "Server Machine"(this is for a BSC) or "Dedicated MySQL Server Machine"
- (this is for LogServer running on PC without any other server applications)
- click Next
- On "Database Usage" select the "Multifunctional database", Click next
- Select the installation path. If possible select another partition than the c: drive.
- For Bsc: Select datadir d:\MySQL Datafiles, click next
- Select the "Decision support" number of concurrent connections (20 assumed), click next
- Enable TCP/IP Network option, disable Strict mode, click next
- Select the default language to "Standard Character set", click next
- Select "Install as Windows Service", launch the MySQL Server,
- deselect "Launch the MySQL service automatically" only if data partition (d:) is present, click next
- Enter "tetra" as root password, Check "Enable root access from remote machines",
- click next and finally Execute

Please note that the first couple of Connection tries might fail, in that case simply press the retry button and you should get a connection.

The "MySQL" service is now installed.

#### 6. Install the MySQL GUI Tools

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The latest MySQL Gui Tools can be found at <http://dev.mysql.com/downloads/> use mysql-gui-tools-5.0-r12-win32.msi or later versions.

The package includes:

- MySQL Administrator
- MySQL Query Browser
- MySQL Migration tool

Install the complete package

## 7. Create Tetra user

Create the user 'tetra' with the password 'tetra'.

The 'Local Security Policy' setting: 'Password must meet complexity requirements' must be disabled, to allow the short 'tetra' password.

Find the setting here:

Open "Start->Administrative tools->Local Security Policy" window

In left pane: 'Security Settings->Account Policies->Password Policy'

To the right disable: 'Password must meet complexity requirements'

The 'tetra' user must have "Administrator rights".

## 8. Copy Tetra programs

The Log Server programs can be downloaded from [www.damm.dk](http://www.damm.dk) extranet by downloading the latest Tetraflex 7.6 version. Please read the release notes before installing.

## 9. Install the Log Server

Ensure that the IP settings are correct for LAN and WAN connectors. You should be able to get ping responses from the BSCs on the LAN segment. It might be necessary to add a persistent route, this is done by executing the following in a command shell:

```
route add 172.16.0.0 mask 255.255.0.0 172.16.0.1 -p
```

Insert License dongle, and wait till Windows has installed windows drivers.

Run "Start->All Programs->TetraFlex->LogServer->LogServer Install"


This will create the Tetra folder structure and copy the Log Server files and finally install the service.

Run the "LogServer Restart" shortcut. If running "LogServer Restart" for the first time a "User Account Control" dialog pops up with the following message:

"Do you want to allow the following program to make changes to this computer?"

Click the "Change when these notifications appear" link. In the new dialog set the slider control to "Never notify". Click OK, and Yes till all warning dialogs are closed.



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The machine needs to be restarted before this new setting takes effect. Restart the machine and start the LogServer service using the "LogServer Restart" shortcut.

The "LogServer Restart" shortcut also starts the service and sets the LogServer startup type to "Automatic (Delayed start)".

This causes a delay of approx 2 minutes after power on before startup of the service. This is necessary because the dongle might not be ready when Log Server Service is started (only seen on machines with SSD disks and very short reboot times).

Executing the "LogServer Restart" will copy and generate the necessary LogClient install files.

Finally set the Notification level on the LogServerTray: right click on "Start" and select "Properties".

In the "Taskbar and Start Menu Properties" dialog go to tab "Taskbar" and select "Customize...".

In the Icon list change behavior for "Log Server Tray Application" to "Show icon and notifications".

## 10. Add rule for firewall

Go to "Control Panel\System and Security\Allow a program through Windows Firewall"  
Select "Allow another program".

Browse to C:\Tetra\Applications\LogServer\LogServer.exe

Allow this for both Home (Private) and Public Network.

Allow also for LogClient.exe and MySql.exe.

### 2.11.5.3 Log Client:

The log client can be started either from the log server or an external PC. Before you can use the log client from an external PC it must be installed on this PC using this procedure:

Use a Explorer to connect to the "TetraFlex" share on the LogServer, right click the "\\<LogServer>\TetraFlex\LogClient\LogClientInstall.vbs" and select "Run as administrator" and follow the instructions on the screen.


A log Client link icon will appear on the desktop.

The Log Client may be started using any valid DAMM dongle for statistics display only.

### 2.11.5.4 Log Client installation on a PC with Windows 7:

If you can't find the node from where the dispatcher shall be installed, this setting in Windows 7 can help:

- click the start button and type secpol.msc in the search function.
- Browse to "Local Policies" -> "Security Options". Now look for the entry "Network Security: LAN Manager authentication level" and open it. Click on the dropdown

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menu and select "Send LM & NTLM - use NTLMv2 session security if negotiated". Apply the settings.

- In the "Advanced sharing settings" page of "Network and sharing center", you need to have it set as "Work/Home profile".
- Try :
  - Enable network discovery
  - Turn on file and print sharing
  - Turn off password protected sharing
  - Use user accounts and passwords to connect to other computers

#### 2.11.5.5 SQL Server

##### 2.11.5.5.1 General Description

The SQL Server used is a MySql server. The MySQL Community Edition is a free downloadable version of the world's most popular open source database that is supported by an active community of open source developers.

The TetraFlex® Log Server stores all data in the TetraFlexLogDB database. Some limitations for the MySql Community Server 5.0 are listed below:

- 256 TB of database disk space.
- 20 database connections at a time. The Log Server and the Log Client each uses 1 connection pr instance.

##### 2.11.5.5.2 ODBC Access to SQL Server

Access to the MySql Server from database clients can be obtained via an ODBC driver. The latest MySql ODBC driver can be found at <http://www.MySql.com>.

#### 2.11.5.6 Log server maintenance

This is described in chapter 3 Log client.

## 2.12 VOICE GATEWAY

Voice gateways can be activated on any node using the SIP protocol with Voice-over-IP (VoIP). The gateway is able to handle up to 31 simultaneous speech connections including conversion of speech from TETRA to A-law and vice versa, when running on the standard BSC412 platform and up to 15 simultaneous speech connections when running on a standard BSC421 platform. Up to 32 simultaneous speech connections are possible when a voice gateway is installed on a PC node.

The gateway does not provide any PABX features but has the capability to connect via the SIP protocol to an external PABX/gateway where routing, number modification, and protocol conversion (to e.g. ISDN or H.323) are handled. The gateway is tested to support the recommended Innovaphone V6 software, running on an IP400 (No PABX feature), IP800 or IP2000. Products from other manufacturers like Cisco and Avaya has also been tested and can be applied as well.

Each voice gateway is related to a node number. The SSI provided from the mobile station when making a call is not used in the system. Instead the system will always look in the calling mobiles profile and forward the call to the specified primary or alternate gateway node. This ensures predicted functionality independent of mobile programming.

The TetraFlex® System supports the unique feature of adding a fixed prefix to all PSTN calls made of mobiles

with a specific profile. This prefix can be used in the interconnected PABX for routing analyses, allowing a single TetraFlex® gateway to route calls to different organizations.

Let us assume two organizations, one with the prefix 101 and the other with prefix 102, both have fixed phones with local numbers 301 and 302 and TETRA mobiles with local numbers 401 and 402. The user numbers in the subscriber register for the mobiles will for organization 1 be set to 101401 and 101402 and for the second organization 102401 and 102402. When making any call from 101401 the base station will add the prefix 101 from the profile to the called number. When dialing 402 the complete number will then be 101402. This is positively checked for existence in the subscriber register after which the base station will initiate a call to the SSI for that particular mobile.

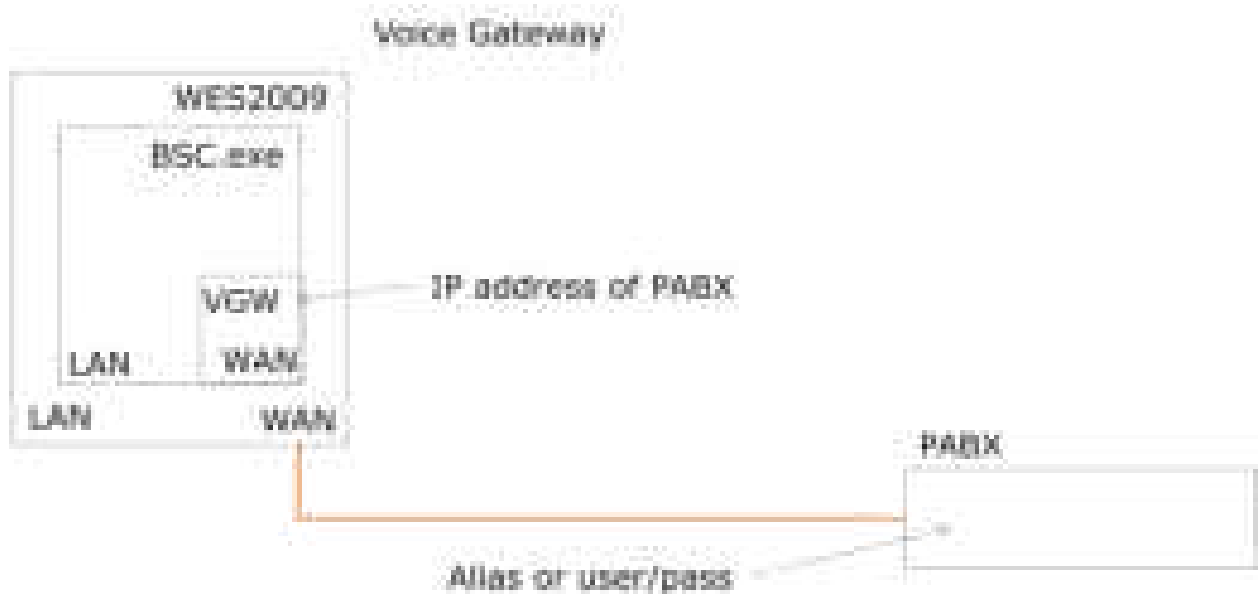
When making a call from mobile 101401 to the number 301 the base station will add the prefix and get the number 101301. This does not exist in the subscriber register so instead the base station will make a call to the voice gateway indicated in the profile. When the system PABX receives the number 101301 it recognizes the prefix 101 as belonging to organization 1 and will route the call from the PABX with the prefix removed, effectively calling organizations 1's phone 301.

When a fixed phone in organization 1 calls the number 401 their PABX will recognize the number as a TETRA mobile and route it to the TETRA system PABX. The TETRA system PABX will add their prefix 101 to get the full number 101401 and call the TETRA gateway. The TETRA gateway will find the user number in the subscriber register and then create a call to the associated SSI.

The TetraFlex® voice gateway supports incoming and outgoing duplex calls. It also provides full support to allow any PSTN phone (fixed, IP, GSM, etc.) to establish call in connection to group calls. The caller will initially be prompted for ID and pin code before the group attachment. All group communication can then be monitored in the phone. PTT activation can be done by a combination of key pressure and VOX (Voice Operated Transmit). The voice gateway automatically makes SIP registration to the PABX. In case the redundant BSC takes over it will automatically re-register with the same name and its new IP Address giving full gateway hardware redundancy. In addition an alternate voice gateway can be established and defined in the subscriber register.

## 2.12.1 Voice Gateway configuration

This section describes the configuration needed to setup the system for SIP operation.



To configure a Voice Gateway, use the TetraFlex NM application, BSC-GUI or the TetraFlex OM as described here (see also this manual in part 3 - Network Management – Voice GW):

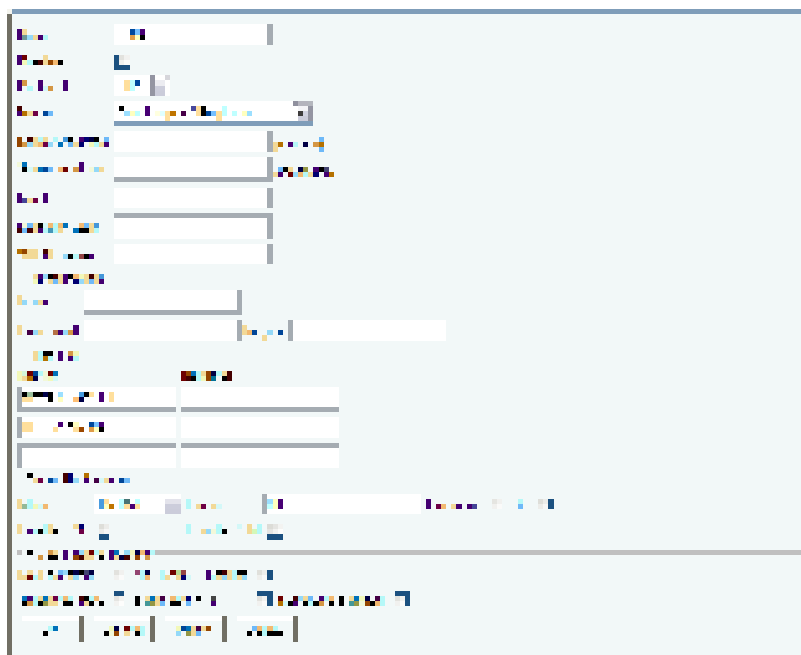


- The SIP registration name (Alias) must be unique and can only be generated by the BSC\_GUI or OM command “S73/NAME/<SIP registration name>”. e.g. “**S73/NAME/TETRA-16024-2**”. The name must be entered as the SIP Alias name into the PABX as well SIP registration name and password cannot be generated by NM, only by BSC-GUI or OM commands
- The SIP registration password is optional and can be generated only by BSC-GUI or the OM command “S73/PASSWORD/<password>”. e.g. “**S73/PASSWORD/TETRA**” (blank means no password). The password must be entered into the PABX as well.
- The Voice GW must be assigned to a node number to attach. This can be setup in the subscriber register in the different profiles where PABX access is desired or by using the TetraOM command **S21/”Profile No”/VGNODE/”x”/”Node Number”**, where x is 1 for primary GW and x is 2 for alternate GW.
- Organization – can be set from the Voice GW setting in NM to allow all or some organization to make call to trough the Voice GW.



- All – all organizations are allowed
  - If you specifies an organization ex. 1 only this is allowed
  - B- number prefix, The Org. number for the subscriber is set in front of the dialing number so that the PABX can route this according the org. number.
- SIP registration must be set to YES, use NM, BSC-GUI or TetraOM command **S73/REG/+** (default)
- Remote IP address is the IP of the Voice GW (e.g. IP800). Use NM, BSC-GUI or TetraOM command **S73/IPADDR/xxx.xxx.xxx.xxx**
- Voice GW must be activated. Use NM, BSC-GUI or TetraOM command **S73/CNFG/+**
- The SIP registration name and password (if used) must be unique and entered into the Voice GW as well
- Use SIP registration must be set to YES.
- Remote IP address is the IP of the Voice GW (e.g. IP800)





**Figure 2-22: Gatekeeper registration**

The Alias name and password (if used) must be consistent with the name defined in the BSC Voice GW

**NOTE:** To be able to enter registration mode “Gatekeeper / Registrar”, a “Gateway, Gatekeeper” license must be present in the IP800 unit. If this license is not present, the selection “Gatekeeper / Registrar” will not be shown

If IP800 GW license is not present, it is possible to connect without registration. In this case the WAN port IP address must be entered in the IP800 “Server Address” field and the Voice GW selection in Network Management Reg. field must be changed to NO. Observe that this solution is not recommended and also this solution will NOT provide Voice GW alarms if connection is interrupted or broken. This solution also may prevent the use of a second voice gateway (dependent on SIP and subscriber timeouts - standard 32 sec).

### 2.12.2.1 Example of the IP800 objects.

Notice that the route table must be defined too.



Figure 2-23: Objects in PABX mode (example)

### 2.12.2.2 IP 800 Route table example

Please note that this example shows an IP800 which serves as gateway for several TetraFlex® systems

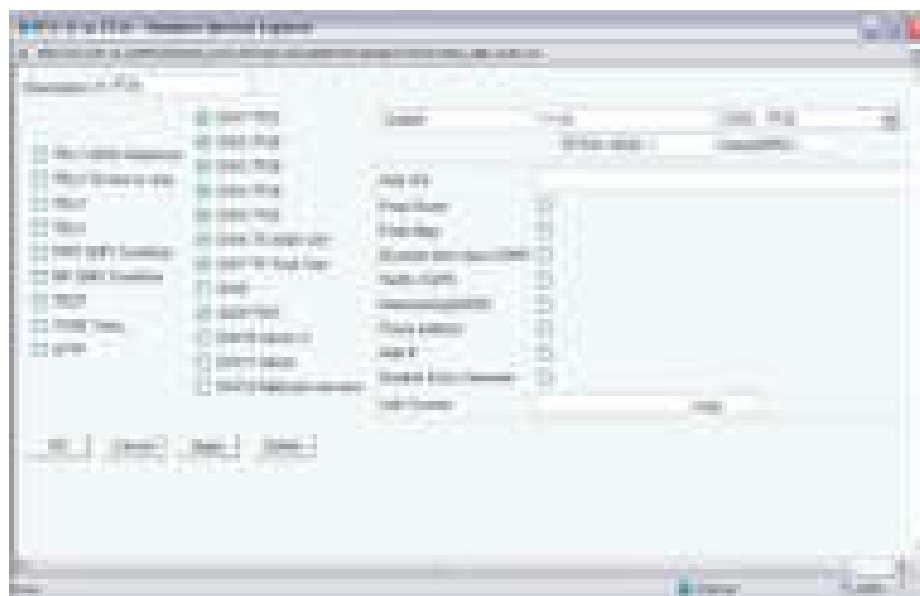


Figure 2-24: Route table example

Dialing 724000 will be transformed into 01.

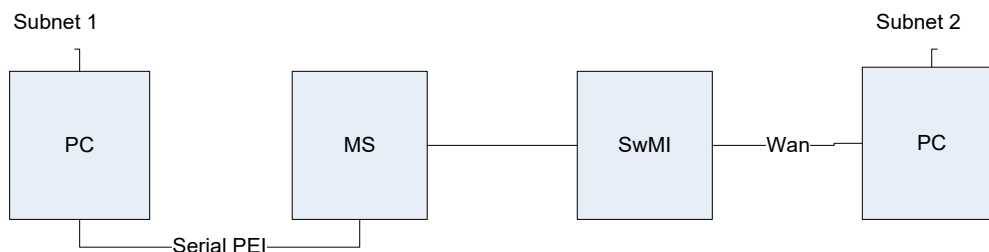
- 0 is the number presented to the TetraFlex and is then routed to the speech message
- 1 is the prefix chosen to distinguish different organizations on one GW

In this example several TetraFlex systems use the same GW i.e. TF24 to TF28 and more



## 2.13 PACKET DATA GATEWAY

The Packet Data Gateway can be used as a Gateway between two networks; in this case Subnet 2 connected to the Wan and another network Subnet 1 connected to a MS device.



The TetraFlex® System supports dynamic multi slot packet mode where Packet Data gateway/servers can be activated at any node supporting standard IP communication between TETRA Mobiles and attached units like laptops, application servers, workstations, FTP servers, WAP servers, etc. anywhere within the IP network/Internet.

Fixed IP addresses are allocated for the mobiles in the subscriber register allowing direct access to mobiles from different applications. Computers connected to the mobile have to be set to DHCP and automatically the system will provide them with an IP address, mask, DNS server, etc. The DNS server address is configured in the profile for the mobiles allowing mobiles to use their company DNS Server.

By default the TetraFlex® Packet Data gateway automatically announces itself to the connected IP segment with the RIPv2 protocol. The main router/default IP gateway therefore has to have RIPv2 activated as it ensures automatic rerouting to the redundant BSC when it takes over.

It is possible to set up two redundant PD gateways/servers in the mobiles profile. Note that the access to a packet data gateway is not needed for making IP communication between two mobiles as mobile to mobile packet data service always will be available.

The TetraFlex® System has full support for multi slot PD giving an approximate throughputs from 3.5 to 14 Kbit/sec depending on the number of slots used. If possible the system will automatically assign 4 data slots (system with 2 carriers or more) at startup and then preempt data slots when necessary to assign slots for speech. Each data slot can be shared by two users making it possible to have a maximum of 8 packet data sessions running simultaneous. In case slots assigned for speech is available the packet data gateway will monitor timeslots every 5 seconds and reassign these for data transfer.

### 2.13.1 PD GW configuration

To configure the Packet Data gateway use the Network Management program (NM), BSC-GUI or the TetraOM application (OM)

NOTE: Packet Data GW configuration is only needed for Packet Data access from TetraFlex to the public world. PD access Tetra to Tetra is always available and need no configuration.

- BSC-GUI:



Right mouse click on the following items allows change of the configurations.

- Configured: Yes or No is PD GW active
- RIPv2: If Yes RIPv2 is used – If No Static routing is used.
- Active mobiles count: Numbers of active mobile connections
- TetraOM:
  - Activate the packet data gateway using **S74/CNFG/+**.
  - **S74/RIP/+** Activated RIP  
Use the OM command **S71/SUBIPADD/"IP address range"/"MASK"** to configure an IP address range defined by the MASK.
  - Configure the packet data gateway Node using the OM command **S21/"Profile number"/PGNODE/x/"Node Number"**. Where x is 1 for primary GW and x is 2 for alternate GW
- Network Management:  
These parameters can also be set from NM please see chapter 3 Network Manager

The following is information only

- Status

The drop down box "All Nodes" / "Active GWs" changes between display of active nodes only, or both active and not active nodes



The screenshot shows the "Change Profile" dialog box with the following settings:

- Profile:** 0
- Description:** [Empty]
- Name Organization:** 0 [All Organizations]
- Accounting On:** No [Setup]
- Service Restrictions:** No [Setup]
- Group Restrictions:** None [Setup]
- Radio Call Restrictions:** No [Setup]
- Subscriber Class:** HQ controlled [Setup]
- Call routing:** User No. only
- Group Value ID:** User No. [Default]
- Security mode:** N None
- Net Interface Desc.:** Net 18A.
- Short No. Format:** [Empty] [Setup]
- Dispositive No.:** [Empty]
- Call transfer:** None permitted
- Per. PTT Answer (sec):** Disabled
- Group Transfer (sec):** 3
- Has call transfer (sec):** priority
- Has PTT transfer (sec):** None permitted
- Late entry time (sec):** Disabled 25
- Have GDT 1 mode:** 1 DTC\_RUN
- Have GDT 2 mode:** [Empty]
- PG-GDT 1 mode:** 1 DTC\_RUN
- PG-GDT 2 mode:** [Empty]
- DNS IP Address:** 10 - 10 - 10 - 10

Buttons at the bottom: OK, Cancel, Apply.

- In the profile make sure the DNS IP address is configured and the packet data GW 1 node number is configured.
- If the MS is to be used for packet data transfers make sure an IP address is configured within the specific subscriber. E.g. Bellow: SSI 100502 has IP 172.28.0.23.

**Change Site**

Site: 0000002

Site Type: Access

Description: 4

Profile No.: 40 Priority: 2

Org. No.: 0 [All Organizations]

IP Address: 172.16.1.1

IP Mask: 255.255.255.0

TOS: normal Subnet

TTL: 65535/1,1,1,1,1,1,1,1

DSCP:

Blocked: ☒ Yes ☐ No

Security set: 2002-09-25-01:04

Authentication: OFF ☐ Throttle


No. of Sites: OFF ☐ Throttle

Link transfer: None

Transfer no.:

Transfer time: 30

OK Cancel Apply

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### 2.13.2 Packet data PC network configuration

This chapter explains how to make the packet data connection on the MS site of the connection.

Using a standard Windows XP or 7 machine use the following steps to setup the modem connection between the PC and the Tetra MS.

- Sepura
  - See Reference Document MOD-06-195 (Sepura Packet Data User Guide)
- Modem configuration
  - From the Control Panel open the “Phone and Modem Options”.
  - Chose the Modem banks and type the Add button to add a new hardware wizard.
  - On the hardware wizard select “Communications cable between two computers” and type next.
  - Chose the appropriate Com port connecting to the MS.
  - When Windows is finished configuration select properties on the modem connection.
  - Setup the Maximum Port speed to 38400 bps.


#### 2.13.2.1 Network configuration

- From the Control Panel open the “Network Connections”
- Chose “Create a new connection” to create a direct connection.
- Select the network in the connection wizard and type “Set up an advanced connection”.
- Select “Connection directly to another computer” within the Advanced Connection Options.
- Configure the PC role for Guest.
- Assign an appropriate name for the connection.
- Select the modem device for connection.
- Configure the connection availability for anyone’s use.
- Make sure the Phone number is \*99#.

#### 2.13.2.2 MS configuration

To request the IP address from the SwMI subscriber database the MS must be configured for dynamically IP request

- Sepura
  - Open the radio programmer and upload the MS configuration.
  - Make sure the IP parameters are all configured to 0.0.0.0.
  - Set the MTU size to 1500.
  - Download the new nettings to the MS

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### 2.13.3 Main router

For incoming attempts make sure a static route is configured for the packet data GW IP address.

## 2.14 APPLICATION GATEWAY

### 2.14.1 Application Programming Interface (API)

Application Gateways can be activated on any node, allowing applications/dispatchers to be connected to the system.

Several applications can connect simultaneously to an Application Gateway, and they will register to the system like a terminal by finding a working Application Gateway from its list of IP addresses. This allows Gateway redundancy between a redundant BSC as well as Application Gateway Nodes.

Applications are connected to the Gateway through the DAMM provided TetraFlexApi.dll Dynamic Link Library, which is handling the complete interface protocol. The TetraFlexApi.dll will also take care of its basic configuration and the Voice interface to PC sound system. The TetraFlexApi.dll is License Dongle protected.

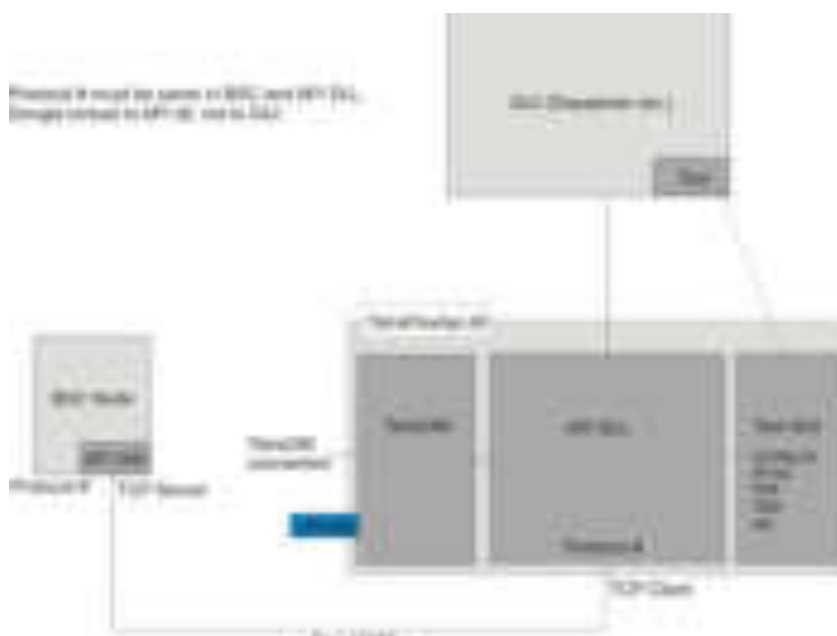



Figure 2-25: API function

At registration the TetraFlexApi.dll will check for identical protocol version numbers in the Gateway and TetraFlexApi.dll. System software updates will include an updated TetraFlexApi.dll, which shall be installed with all applications.

DAMM delivers an English standard Graphical User Interface (GUI) toolkit together with the TetraFlexApi.dll, which can be used as reference for development.

The Application Gateway and TetraFlexApi.dll initially provides access to functions like: Making Individual and Group Calls, discreet listening and connection to group calls, send and receive SDS and handle the setup of DGNA etc. You can use the Toolkit or Dispatcher to see what functions are available in the API.

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### 2.14.2 API Support

The TetraFlex API is the connection tool for the DAMM dispatcher application. The API itself is fully documented in the TetraFlexApi.h file, which can be used of third party vendors to create their own Applications.

The use of the API demands a combination of Tetra knowledge and programming skills. The API itself is an offer so users may be able to create their own applications e.g. their own Dispatcher.

API programming is not directly supported, but specific questions will be answered by DAMM support.

### 2.14.3 API Compatibility

The API will be kept backward compatible, so that new versions of the TetraFlexApi.dll will support all methods contained in earlier released versions. That ensures that new TetraFlexApi.dll versions coming with new system software releases will always work together with GUI Applications written for earlier versions

### 2.14.4 API Test applications

The SW package also includes an API toolkit SW programmed in C++, C# and Delphi for testing the different API calls without having to write an application.

### 2.14.5 API Configuration

The following criteria must be met to be able to access the API

- The Node Dongle must allow API
- The Node Dongle is delivered as default with 5 connections
- API client dongle must be present
- Configuration file must be defined
- Application subscriber must be defined in the subscriber register

### 2.14.6 API Installation

#### 2.14.6.1 To install the API client (dispatcher)

- On the PC where the client must be installed press windows "Start" ->"Search" -> "Files and folders"
- Select "Printers, Computers or People"
- Select "A computer on the network"
- Insert the IP address of the WAN port on the GW node in question and select "Search"
- When search result appears, double click on the result
- Enter user name and password (standards = tetra and tetra)
- Now the shared directories are accessible
- Select the \tetra\share\API dll directory
- Copy the files to the local PC.



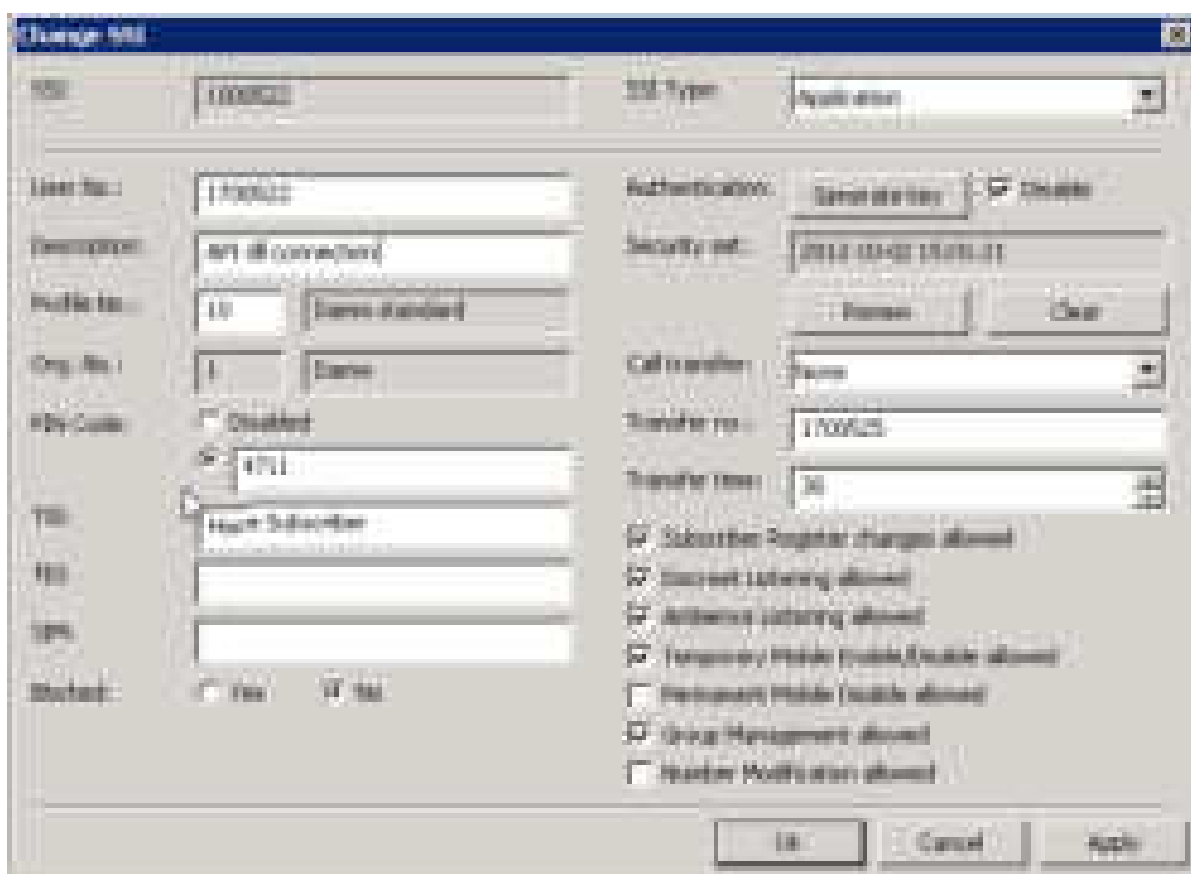
The API development files and test applications can be downloaded from [www.damm.dk/extranet](http://www.damm.dk/extranet).

Before the application (test application or dispatcher) can connect to the BSC node you must configure the system as it is described in the next section.

## 2.14.6.2 Bringing the API to work on your system:

### 2.14.6.2.1 In the subscriber register:

Create an application subscriber (SSI) and enter the relevant Application data



**Figure 2-26: Application Subscriber**

The API application (e.g. DAMM dispatcher) can either use the User No. or the TSI (Tetra Subscriber Identity MCC:MNC:SSI). The use of PIN code can be chosen and must match in the API settings.

### 2.14.6.2.2 In the Application (Dispatcher) folder:

Edit the "Config.txt" file with the correct data

- The config.txt must reflect a relevant TSI or User No. (the application SSI created in the subscriber register) for your system. Also enter the PIN code and user number assigned in the subscriber register. At least one gateway needs to be set. This is

where the IP address of BSC WAN is entered. The IP address must contain full octets, so leading zeroes must be entered - e.g. 010.239.016.200.

- Save your changes.

```

*****
;
;***   TetraFlex API DLL Configuration   ***
;
;*****
; DLL Version: 7.52 2011-09-09
; Date/time..: 2011-11-01 14:29:43

```

```

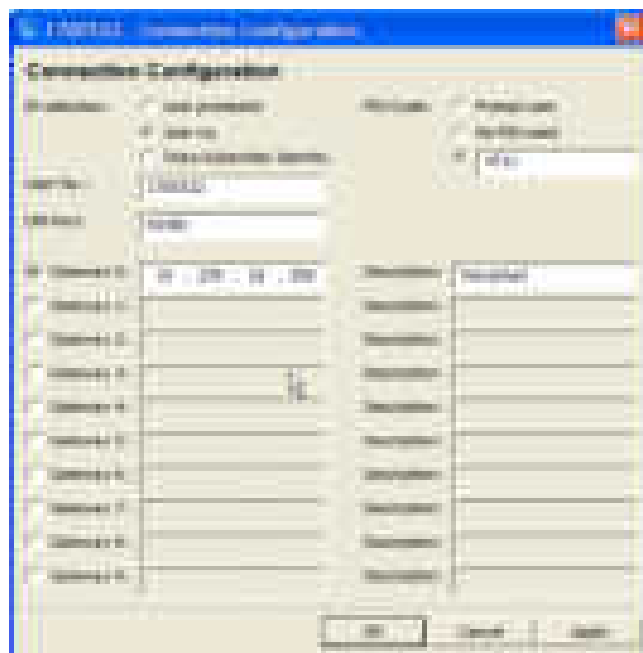
***** 71 Common *****
;
71/IDPROMPT/-
71/USERNO/1700522
71/PIN/4711
71/OMPORT/42382
71/OMPIN/1841803245

```

```

***** 72 Gateways *****
;
72/0/010.239.016.200/TetraStar
72/1/-
72/2/-
72/3/-
72/4/-
72/5/-
72/6/-
72/7/-
72/8/-
72/9/-

```



**Figure 2-27: Configuration methods. Configuration file and dispatcher connection**

- A different configuration method is to start the dispatcher and select: “Views -> Connection Configuration” from the top menu this will create the Config.txt file with this settings.

Provided the previous steps have been accomplished, the Application will start up and initiate connection to the BSC.

## 2.14.7 API Dongle settings

E.g. of dongle settings for using the API DLL

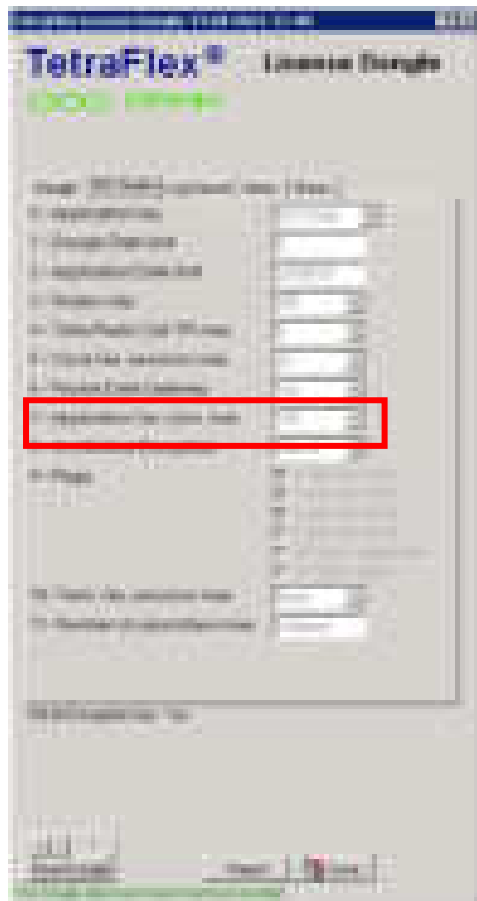


Figure 2-28: Node dongle



Figure 2-29: Client Dongle

To allow communication between the API.DLL and a Node, the Node Dongle must have the Application Gw. Conn. Max set to a number >0 to allow the Application GW to be used by the API.DLL (Dispatcher) and the Client Dongle (used in the PC) must have the API.DLL settings enabled

## 2.14.8 API Configuration file

Examples of “how to use a txt editor” to set the connection configuration of the API DLL in the config.txt file:

NOTE: All blanks must be filled out. This means that a SSI must be 8 digits, MNC must be 5 digits, and IP address segments must be 3 digits and so on.

```

*****
;
***   TetraFlex API DLL Configuration   ***
;
*****
; DLL Version: 7.60 2012-11-02
; Date/time...: 2012-11-21 11:26:05

***** 71 Common *****
;
71/IDPROMPT/-
71/TSI/0238:00004:01000525
71/PIN/4711
71/OMPORT/42382
71/OMPIN/2081304613

***** 72 Gateways *****
;
72/0/010.239.016.200/TetraStar
72/1/-
72/2/-
72/3/-
72/4/-
72/5/-
72/6/-
72/7/-
72/8/-
72/9/-

```

**TSI (MCC:MNC:SSI) Same as set in NM, Config and subscriber)**  
**PIN: If used must also be defined in subscriber reg.**  
**Access port for TetraOM (cannot use 42380)**  
**TetraOM pin code that must be entered for using OM**

**Range of node IP addresses where the API can connect.**  
**The API will try to connect to first IP, if not present the next IP will be tried and so on**

Example using User number:

```

*****
;
***   TetraFlex API DLL Configuration   ***
;
*****
; DLL Version: 7.60 2012-11-02
; Date/time...: 2012-11-19 11:07:06

***** 71 Common *****
;
71/IDPROMPT/-
71/USERNO/1700525
71/PIN/4711
71/OMPORT/42382
71/OMPIN/2081304613

***** 72 Gateways *****
;
72/0/010.239.024.097/Gateway 2
72/1/-
72/2/-
72/3/-
72/4/-
72/5/-
72/6/-
72/7/-
72/8/-
72/9/-

```

**Application user number must be defined in subscriber reg.**

## 2.14.9 Test of API function

To test if the API functionality is configured correctly, two methods may be used (API test tool or OM commands) **Both methods require the API to be initiated.**

### 2.14.9.1 API test tool

The API test tool can be downloaded from [www.damm.dk](http://www.damm.dk) extranet and is available in a C# version and in a Delphi version. The API test tool must be in the same directory as the API DLL and the config.txt file (e.g. c:\tetra\applications\dispatcher\default).

For initialization of the API

- Execute the API test tool TetraFlexApiTest\_C#.exe
- Or TetraFlexApiTest\_Delphi.exe

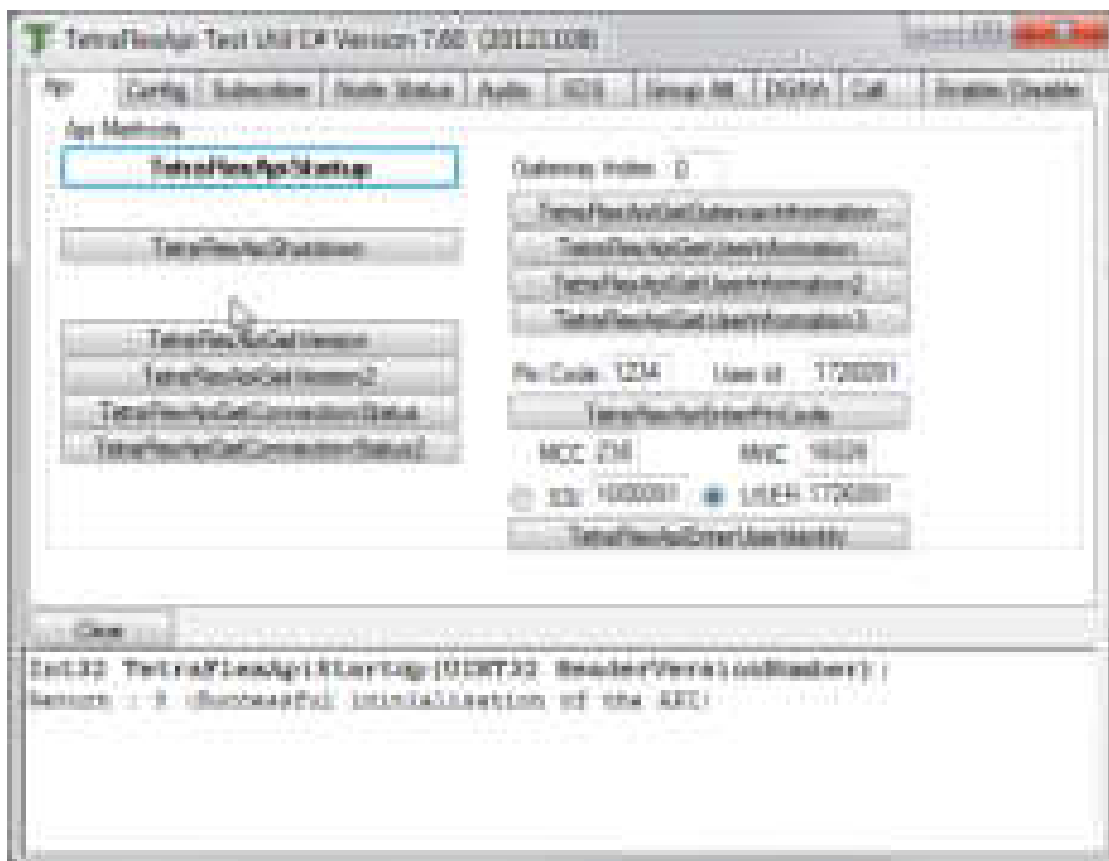


Figure 2-30: C# Test

- Select the  button.
- Check that the following message appears in the message field.

```

[Init] [2] TetraFlexApiStartup (TINT32 ReaderVersionNumber)
Return : 0 (Successful initialization of the API)

```

**Figure 2-31: C# Test API**

#### 2.14.9.1.1 Check API connection

- Select the “TetraFlexApiGetConnectionStatus” button

This will result in a message showing that the API is connected:

```

[Init] [2] TetraFlexApiGetConnectionStatus (bool StartUp, boolReader,
                                bool StopUp, boolReader,
                                bool StartUp, GatewayControlIpAddressMode,
                                bool StopUp, GatewayControlIpPortMode,
                                bool StartUp, boolReader, boolReader) /
Return:
  bool Connected: true
  bool Reader: true
  bool StopUp: false
  GatewayControlIpAddressMode: 10.239.28.69
  GatewayControlIpPortMode: 42382
  boolReader: 0000-0000-0000-0000-0000-0000-0000-0000

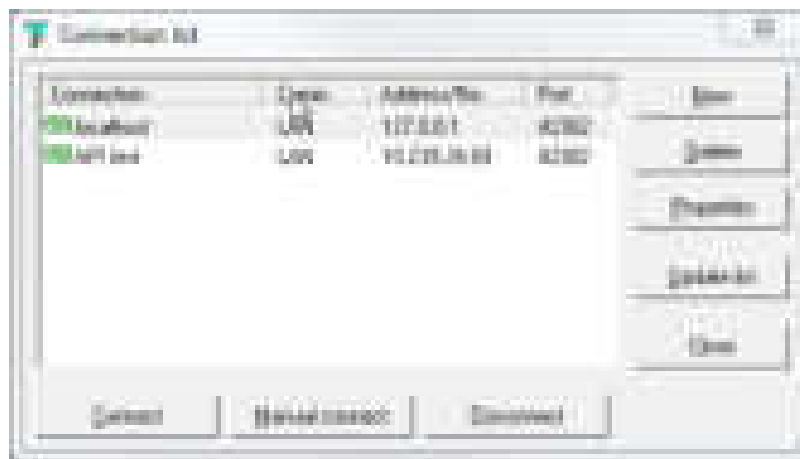
```

**Figure 2-32: C# Test API connection**

#### 2.14.9.1.2 Test via API OM

**To be able to connect to the API via TetraOM, the API must be initialized as described before.**

- Install a TetraOM at the client PC
- Configure the OM to connect to the client PC localhost IP address 127.0.0.1 or its wan address (ex. 10.239.28.69) using the Port assigned in the config.txt file (e.g. 42382).



**Figure 2-33: TetraOM connections**

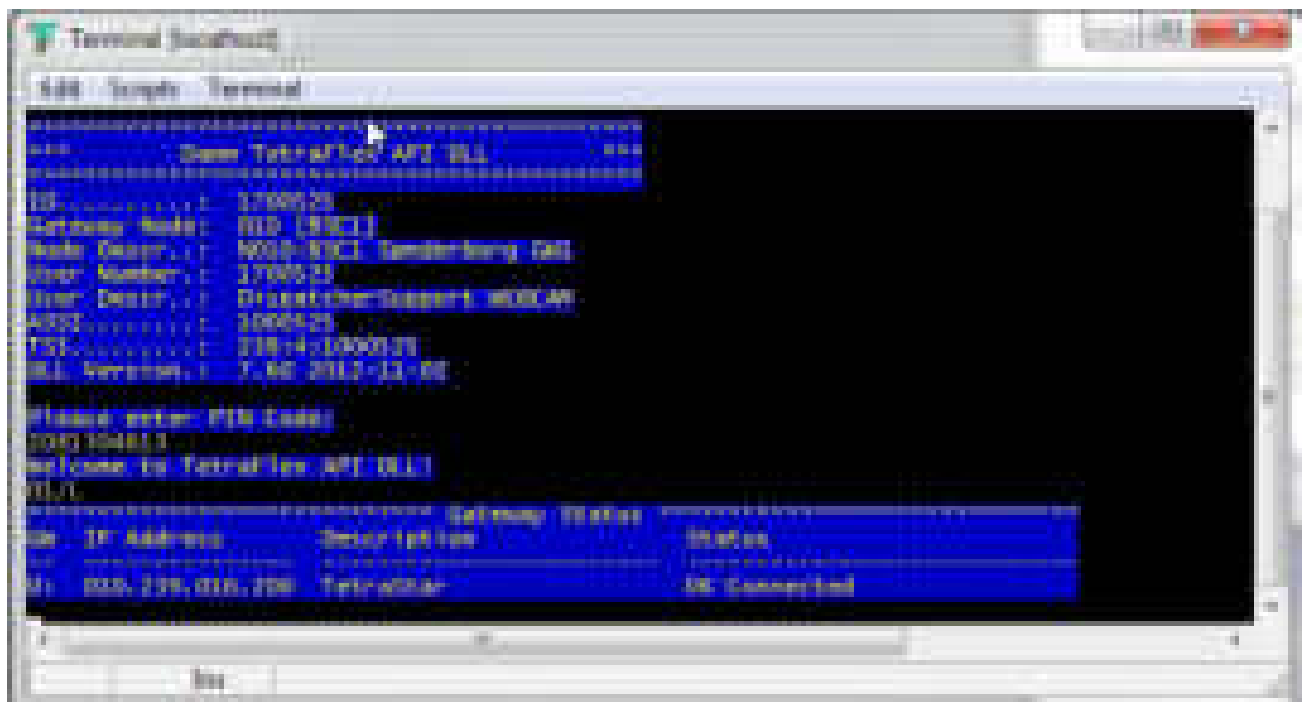
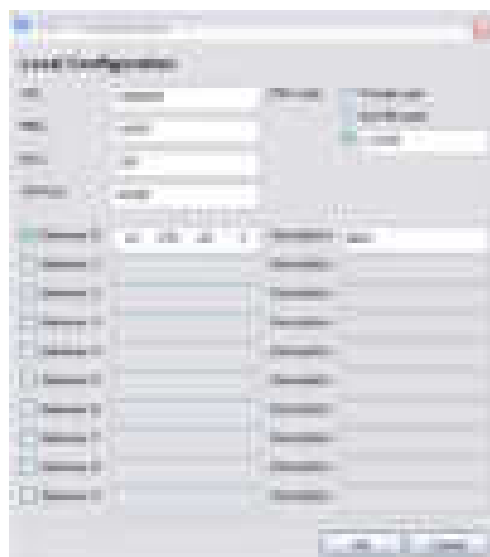


Figure 2-34: API connection status

- Enter Pin Code (find the PIN code in the config.txt file)
- TetraOM command 01/L (R/01/L for dynamic) will show the connection status

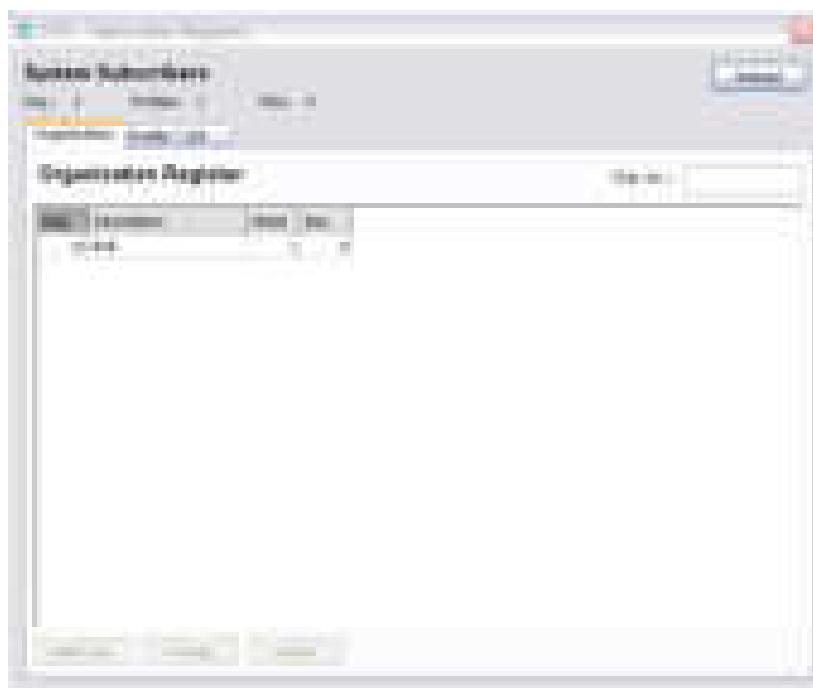
#### 2.14.9.1.3 Useful commands

- In the Config header press  , or TetraOM command 30/CONFIG/GUI, the GUI configuration window opens.



**Figure 2-35: GUI Window**

- In the Subscriber header press  , or TetraOM command 30/SUBSCR/GUI, the GUI configuration window opens.



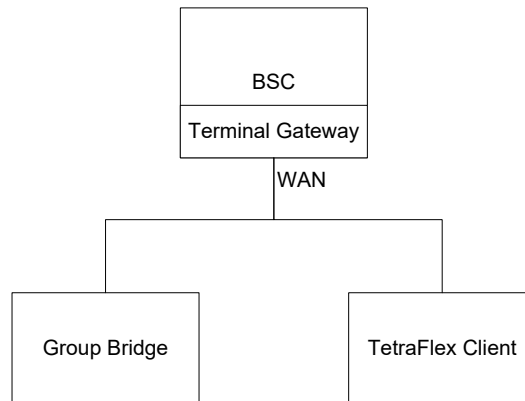
**Figure 2-36: Subscriber window**



## 2.15 TERMINAL GATEWAY

The terminal gateway is used for connecting TetraFlex with the Group Bridge Application and the Android Tetraflex client for smart phones and tablet devices.

For details about the Group Bridge and TetraFlex Client application see these chapters.



The Terminal Gateway can be compared with the Application gateway, but with reduced functionality and it does not require an API.dll on the client site.

The Terminal Gateway requires that the terminal gateway flag is set in the dongle before it can be activated.

The gateway can be activated from NM, BSC-GUI and OM command:

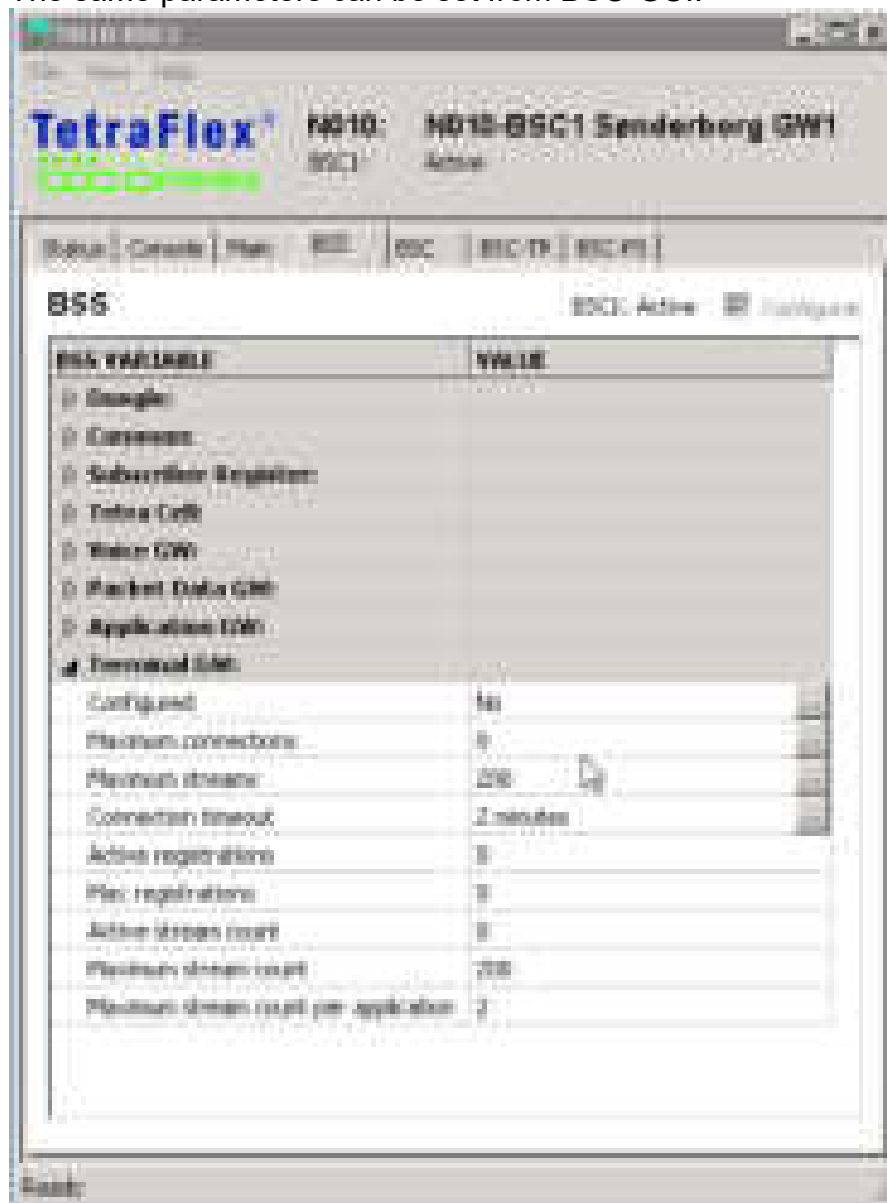
NM:



Set the **Config** flag to Yes and select the numbers of max. Connections (**Conn. Max.**) that is needed (up to the limit in the license dongle). Also the number of **Streams max** can be defined (up to 200). The **Timeout** reflects how often the gateway scans for connected devices.

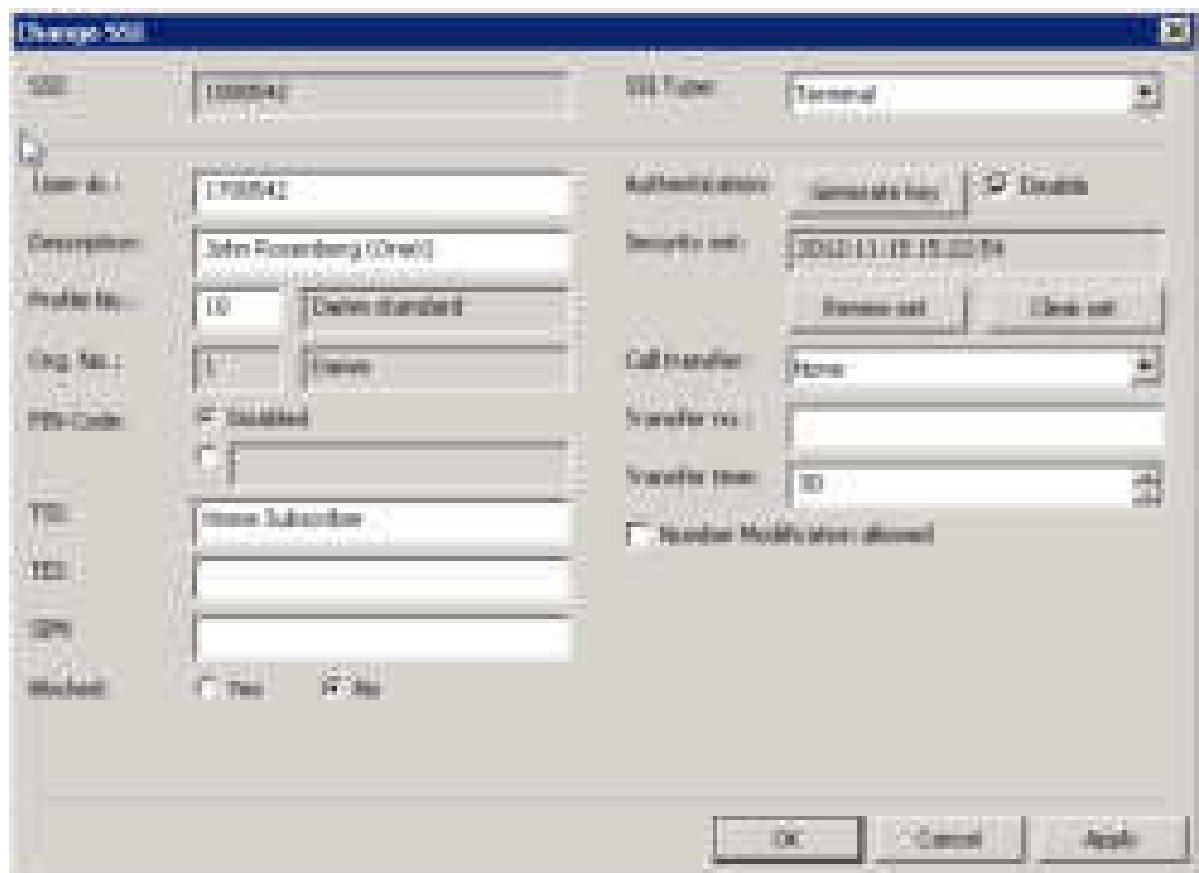
BSC-Gui:

The same parameters can be set from BSC-GUI:



OM Commands: See help file for OM commands regarding the Terminal Gateway starting with S76.

Like an application that wants to use the Application Gateway, the Group Bridges and TetraFlex Clients that want to connect to TetraFlex using the Terminal Gateway must be set-up in the Subscriber register:



The screenshot shows the 'Change SSI' dialog box. The 'SSI' field is set to '1700042' and the 'SSI Type' is set to 'Terminal'. The 'User no.' field is '1700042' and the 'Description' is 'John Fossberg (Orn)'. The 'Profile no.' is '10' and the 'Ring No.' is '1'. The 'PIN Code' is '12345678'. The 'TSI' field is 'New Subscriber'. The 'TSI' field is empty. The 'PIN' field is empty. The 'Number Modification allowed' checkbox is checked. The 'OK', 'Cancel', and 'Apply' buttons are at the bottom right.

For the Terminal Gateway client a Terminal SSI must be setup and the User number is used as the connection identifier. For details about Terminal SSI please see the chapter regarding NM and Subscriber register.

## 2.16 TETRAOM

### 2.16.1 TetraOM

This section describes how to communicate with the BS4xx Base Stations and control applications in order to handle the units during installation and maintenance.

The TetraFlex® system incorporates a Base Station Controller, referred to in this document as the BSC

For a complete list of TetraOM commands see the TetraOM help files manual or the on-line help in the OM.

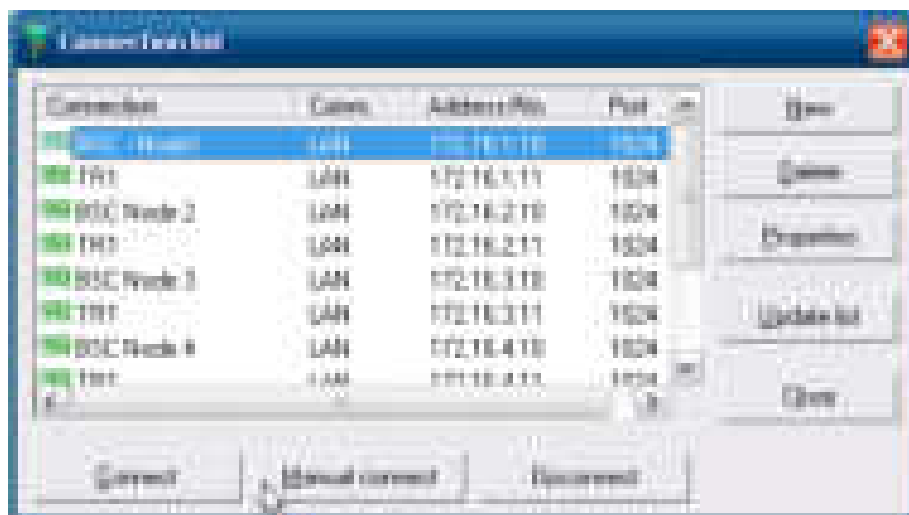
Several methods of communication are available depending on the actual need and tasks to be done.

**Outdoor units (SB421/BS421)** must be addressed by their IP address :

Default IP for TR11 is 172.16.x.11, for TR12 it is 172.16.x.12 and so on

Default IP for BSC1 is 172.16.x.10, for BSC2 (redundant BSC) is 172.16.x.19

Where x is the node number (1 for the first and 2 for next etc.)



E.g. To check connection to BS421 on IP 172.16.1.11, ping the IP:



Figure 2-37: IP Ping

### 2.16.2 Power supply addressing outdoor (SB421)

The internal Power supply in the SB421 can be addressed with the OM command:

**AP**

When succeed, the response from the PS is: "Address: AP [PS421]"

Note: The Power Supply can only be addressed when the SB421 IP address is selected in the connection list.

### 2.16.3 TR412, Combiner, Power supply addressing indoor (BS4xx)

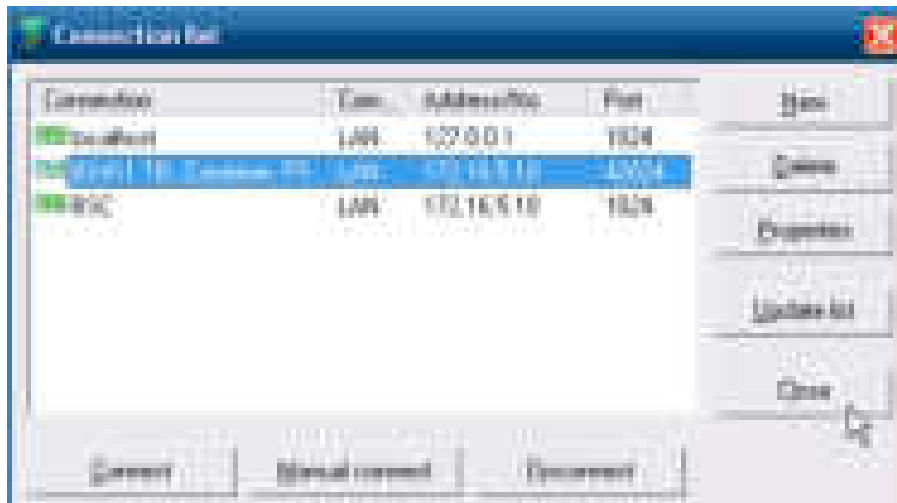
**For the indoor BS41x**, IP connection to the TR412's, combiner and Power supply is not possible and must be made via the HDLC bus.

To activate the HDLC bus UART, use TetraOM command **AU+**. If for some reasons the HDLC cannot be activated use **AU/FORCED** first.

For onsite situations, a CRT, keyboard, and mouse can be connected directly to the BSC with standard extension cables. This also allows monitoring of the Windows booting, modification of the BIOS CMOS set-up, and makes it possible to alter the IP address when lost.

When a TCP/IP connection is available, file transfer to and from the BSC is possible and may be used for backup, restore and software upgrade.

To get access to these units the IP address for the BSC must be used and **Port 42024** as shown in the connection list below:



Then the units can then be addressed according to this scheme:

<b>AU+</b>	<b>Activate HDLC bus (TR412 only, not TR421)</b>
<b>AU/FORCED</b>	<b>If the HDLC connection is used by someone else</b>
<b>A11...18</b>	<b>Select TR 1 to TR 8 in rack 1</b>
<b>A21... 28</b>	<b>Select TR 1 to TR 8 in rack 2</b>
<b>AP11...17</b>	<b>Select PS1 to PS7 in rack 1</b>
<b>AP21... 27</b>	<b>Select PS 1 to PS7 in rack 2</b>
<b>AT11...AT12</b>	<b>Select combiner 1 or 2 in rack 1</b>
<b>AT21...AT22</b>	<b>Select combiner 1 or 2 in rack 2</b>

### 2.16.3.1.1 Functional Description

All test commands for the Transceiver, Power Supply and the Combiner (only in BS41x) consist of a 2-digit command in the range 00 to 99 with an optional parameter. Commands without parameters are display-only commands and will not make any changes. Therefore, it is possible to "page through" the commands to find the right one without any risk to change vital parameters.


The commands are divided into groups, covering the different functions in the TR. For example, all the TR commands are in the 10 to 19 group. If the first two characters are not representing a valid number in the 00 to 99 range, an error message will be displayed:

```
Invalid TR412 command
```

This is however not the case if the first character is a +, which are reserved for commands to the test box. In this case no response will be sent. If an unimplemented TR command is called, the following response is displayed:

```
Unimplemented command
```

### 2.16.3.1.2 Commands

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OM commands organization:

- M xx - Main BSC OM Commands
- F xx - Base Station Controller (BSC) OM Commands
- S xx - Base Station Switch (BSS) OM Commands
- H xx - Base Station (BS) OM Commands (only for BS41x)

xx - OM Commands without a letter in front is used for TR, PS or TCC

#### 2.16.3.1.3 Repeating commands

The TetraOM allows automatic execution of a TetraOM command repeated (R) or continuously (C):

- R"OM command" can be used to poll a state within the BSC,TR. PS, Combiner.
- C"OM command" can be used to view the messages from the message queue.

Example: R/07/S (Show the actual time date and century seconds)  
C/63/N (Shows the GPS data stream from a BS421)

#### 2.16.3.1.4 Simultaneous commands

From the TetraOM terminal window, it is possible to combine several TetraOM commands using the "|" (Pipe symbol).

Example: 00|03/A (shows software version and alarm flag list)

#### 2.16.3.1.5 Local blocking mode


After power-on, the TR always starts in normal operating mode. If a given command requires local blocking, it is shown in the help area for the command. Commands that require local blocking are not available during normal operation for operator interference. If a protected command is called, the following response is displayed:

Local blocking necessary

Only commands with a parameter are protected. After activation of local blocking (01+), all commands except factory configuration commands are available.

#### 2.16.3.2 Parameters

Two types of parameters are used.

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Generally + is used as parameter to turn on, enable or step up and - is used as parameter to turn off, disable or step down.

E.g. 11+ (turn power supply on)  
11- (turn power supply off)

For more complex functions, a / is used as separator after the command no. followed by the necessary no. of characters for the actual function.

E.g. 13/27 (set output power to 27dBm)

If the parameter is not valid for the actual command, the following response is displayed:

Invalid parameter



### 2.16.3.3 Saving Configuration

A number of calibrations and system parameters are stored locally in a sector of the Flash chip. At power-up and reset, all settings are copied into the workspace RAM, from where the different software tasks take the settings.

All changes in the configuration are made in the workspace RAM only . To store the new configuration locally, a save command shall be made. The configuration is divided into two separate entities:

- System configuration
- Factory configuration (only to be done by DAMM)

System configuration parameters can be changed with the 7x OM commands and are automatically saved.

### 2.16.3.4 TetraOM set up

More possibilities exists “how to start the TetraOM program”:

- Start via the NM
- Start via BSC-GUI
- Start the TetraOM program from the start menu or the taskbar
- Start the TetraOM program on the BS421 directly using the VNC program.

The TetraOM program files are located on the BSC in the directory C:\Tetra\Active\Pgm\Om. It is possible to copy all files to a similar directory on your own PC and to create a shortcut to the TetraOM.exe file for start-up. The PC must be on the same LAN as your nodes to be able to connect to them using OM.

After starting the TetraOM program, the connection window is shown:



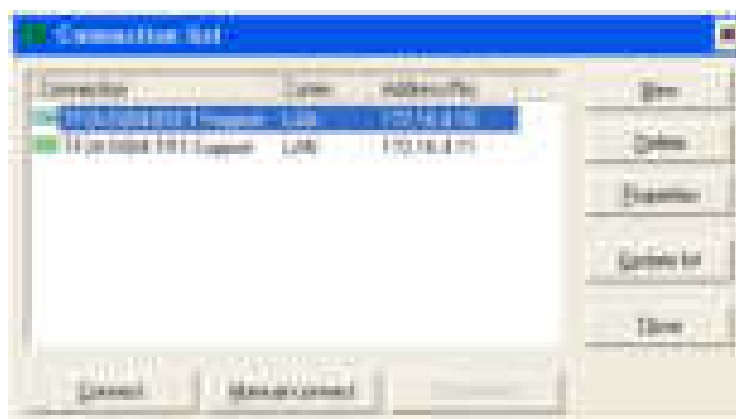


Figure 2-38: OM Connection

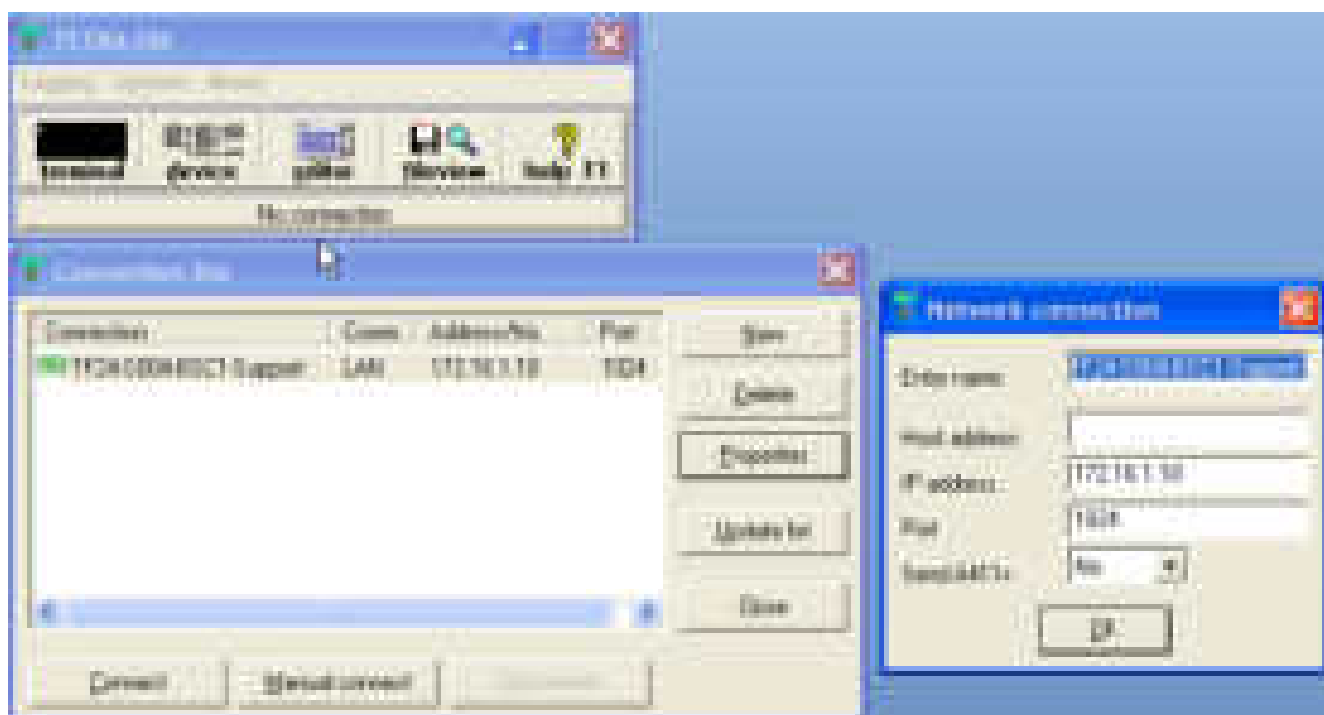
The connection list may be empty. To connect to the TR or BSC, a new entry in the list may be created by selecting New and afterwards double-click on the entry.

It is recommended to name the connection into some well defined name.

As an example this syntax might be used:

**“System Number”-“Node Number”-“Unit Description”-“Organization”**

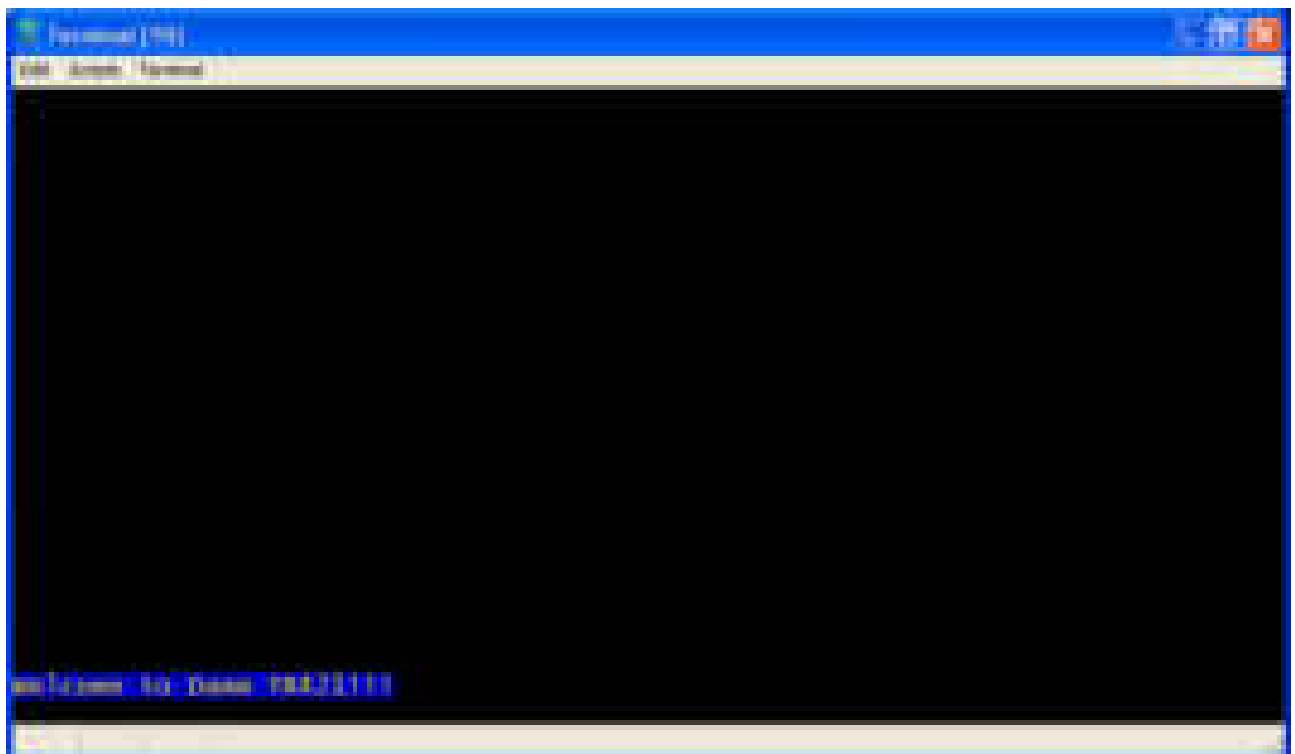
**E.g. TF24-S004-BSC1-Support**



To make a new connection push the “New” button and select the connection type (normal Network) and fill out the entry name and IP address of the unit (*Send A411+* set to No).

The units can then be accessed with OM by clicking on the list and push Connect.

Manual connect is possible as well, selecting the Manual Connect button and manually entering the connection parameters.



**Figure 2-39: TetraOM communications window**

When connected, the TetraOM communications window will appear. Normally this window will be a black command screen with a welcome text or an error message if some commands have failed.

Communication with the BSC, TR, PS and Combiner (BS41x) is now possible by issuing TetraOM commands. As an example if command 71 is entered the TR will respond back as shown below:

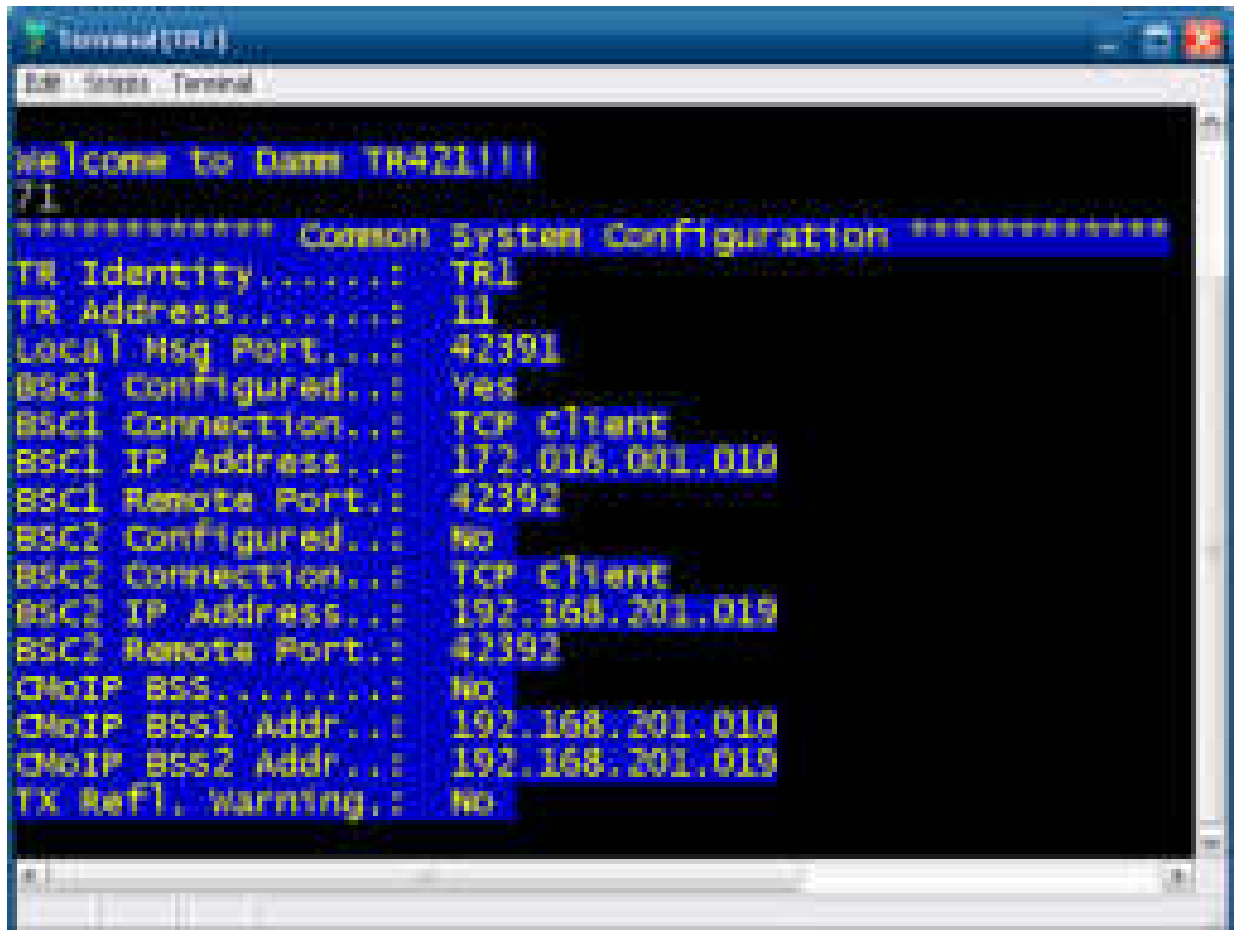


Figure 2-40: TR Identity

### 2.16.3.5 TetraOM Help

Most used commands will soon be familiar. For more rarely used commands, a help system is available documenting all available commands and options. The HELP is accessed either by pressing F1 or by clicking on the Help button.

The help system contains a help file for each device in the base station. Start to select the BSC (BS421), as this help file contains information about how to address the different devices.

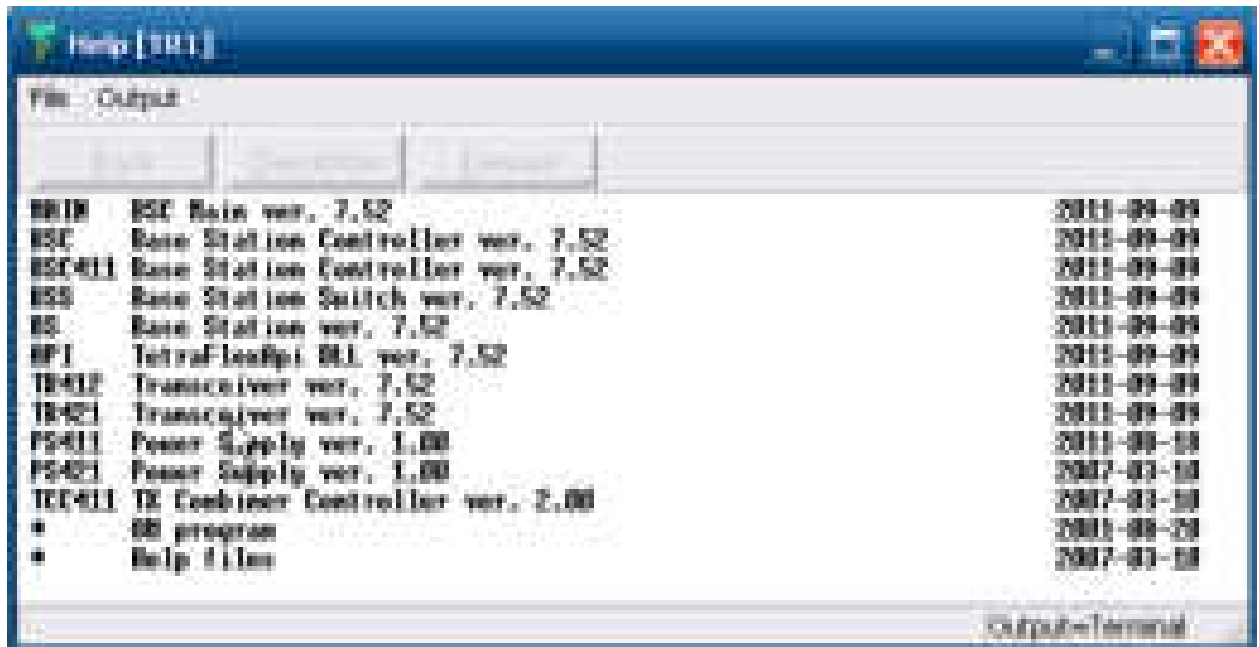


Figure 2-41: OM Help

After selecting a device, a list of all available commands is shown:

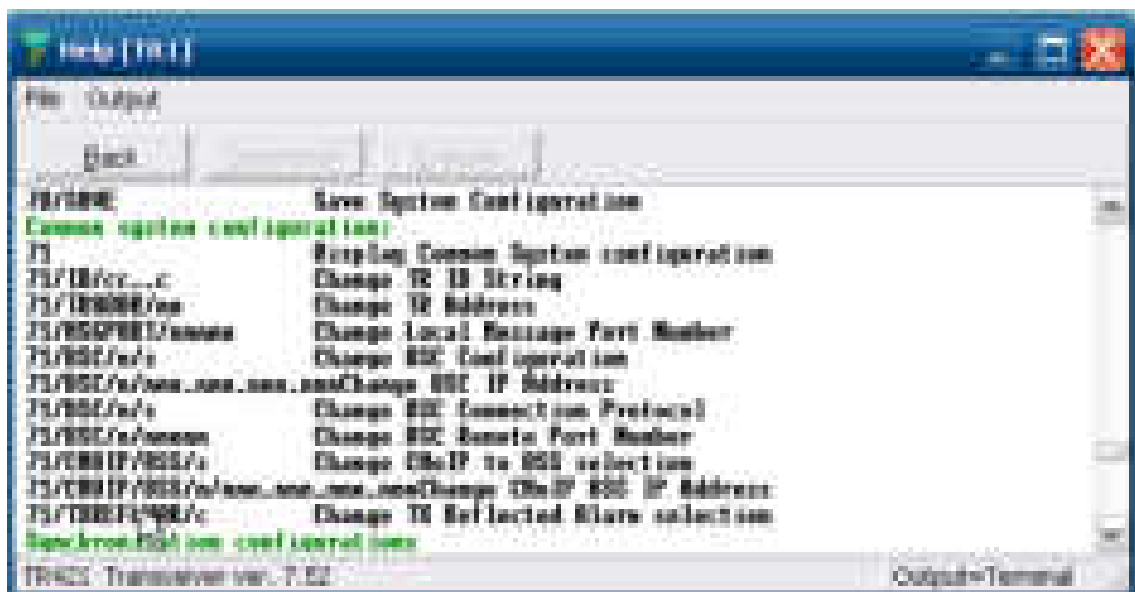


Figure 2-42: OM Help

After selecting a specific command, an execution window appears. In this window the command syntax is explained and applicable command parameter(s) may be entered.

Please observe that all of the yellow marked fields must be filled in

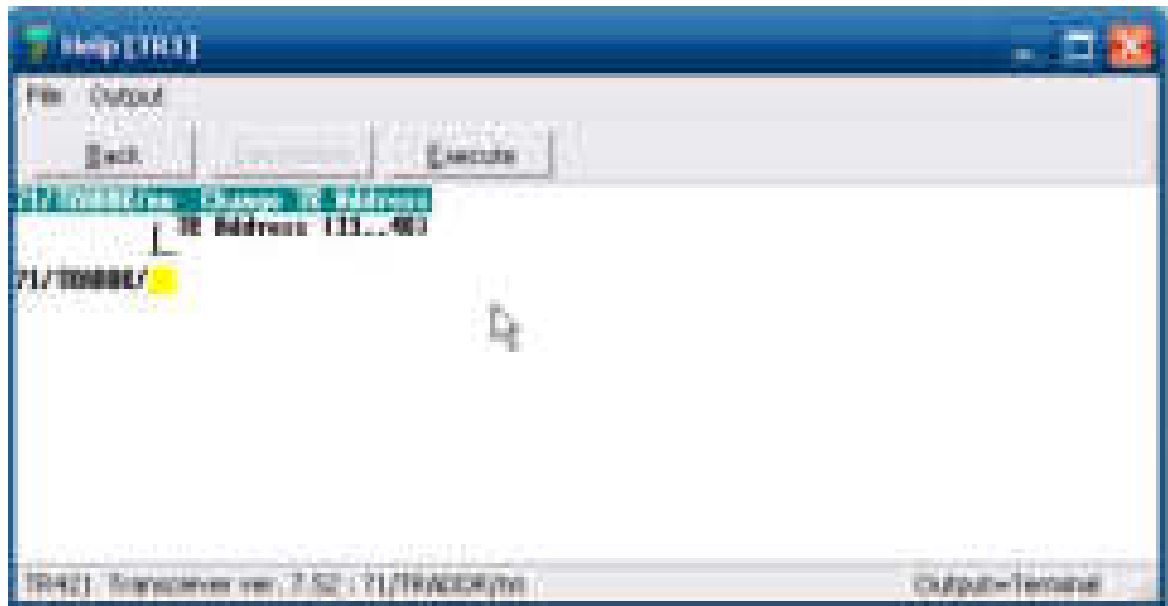


Figure 2-43: OM syntax

When the yellow spaces are filled in and the Execute button is selected (or the enter key is pressed), the command is send to the unit.

The TetraOM will return to the terminal window, and the command response is shown.


Do not forget to save (70/SAVE or F70/SAVE for the BSC)

#### 2.16.3.6 TetraOM Editor

The TetraOM program also contains an Editor, where command files may be edited. When the editor is active, commands from the help system are put into the Editor instead.

Command files can be sent from the Editor. Command files can also be executed directly from the disk.

Note that the system configuration files (Cnfgxxx.txt) on the BSC is ASCII files in a TetraOM compatible format, which can be edited directly in the TetraOM Editor. However they are normally created and updated automatically from the system.

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### 2.16.3.7 TetraOM logging

#### Air Trace Logging

The TR has a built in functionality to collect all messages sent over the air interface using the TetraOM command 48. It is possible to setup logging to a file or log real-time to an air trace application.

#### 2.16.3.7.1 Logging to File

1. 48/FILE/"destination" – e.g. \CF-Card\tetra\work\trace1.lan, this saves the file on the TR, if you want to save the log file on the BSC or a PC on the network you must use the Host name and a shared folder on the BSC or PC (CE doesn't support num. IP address so you have to use the host name):

e.g. 48/FILE/\\<host name>\<sharename>\<filename.lan>

This will only work if the TR is allowed to logon to the host, it might be necessary to go to the TR with VNC and type the user name, password and domain of the host BSC or PC to get access.

- 48/"timeslot"/U "timeslot" is the timeslot number  
Collects unencrypted messages. To collect from several timeslots, repeat the command with different timeslot numbers
- 48/FILE/+ Start collecting to file
- R/48 could be used to verify trace session
- 48/FILE/- Stop collecting to file


#### 2.16.3.7.1.1 UDP transfer

48/UDP/"destination IP address"/"port number to be used"

- 48/"timeslot"/U Collect unencrypted messages. It's possible to collect from several timeslots.  
48+ could be used to collect from all timeslots
- 48/UDP/+ Start trace session  
R/48 could be used to verify trace session
- 48/UDP/- Stop trace session
- 48-

#### 2.16.3.7.1.2 Message logging from the test queue

- 65/N Display only the message ID
- 65/N+ Display content of the message

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### 2.16.3.7.1.3 *Creation of OM log files*

- Select the TetraOM main form and chose logging.
- Browse to enter destination and filename.
- Click only terminal responses to collect the message responses exchanged between the TR, PS, Combiner and BSC.
- Type the TetraOM command to be logged: R/ or C/" TetraOM command".
- Enter the bottom 'Create' to start logging to file
- Enter the bottom 'Stop logging' to stop TetraOM logging to file.



### 2.16.3.8 Some useful TetraOM Commands

Note: Only main commands are listed, subcommands may be available

BSS (Base Station Switch).

S00	SW Version
S00/C	Compiler options
S04	License dongle setting
S10	Network status
S12	Tetra Cell Status
R/S12/TS	(repeating) Radio cell Timeslots Status
S13	Voice GW status
S14	Packet Data Status
S15	Application GW status
S16	Terminal GW status
S20	Subscriber registers
S20/SAVE	Save actual register to text file
S20/READ	Load data from text file
S21	Subscriber profile
S21/nnnn	Show profile nnnn
S22	SSI Register Status
S65	Multicast / Unicast addresses
S71	General Node configuration

BSC (Base Station Controller):

F00	Version number
F15	TR status (Century Seconds)
F15/F	TR status (Frequency)
F98	Hardware serial number information

BS421 (Transciever) :

00	SW Versions
02	TR operating mode
03/A	Alarm Flags*
05	BSC status
06	Network setting
10	TX key state
11	TX output
13	Power setting
21	RSSI level
31	OCXO sync
R/34	(repeating) Display all CMoIP connections
63	Internal GPS status
63/VER	GPS module version


71 Common system configuration  
71/TXREFLWR/c SWR alarm setting (- Tx reflected blocking alarm (default, + warning only alarm)  
98 Hardware ID  
99/RESTART Restart BS421 (Soft restart)

*) Alarm BS 421 (OM command 03/A)	Comment
00: TX PLL unlocked	Blocking Alarm (Hardware fault)
01: TX loop unstable	Blocking Alarm (Hardware fault)
03: TX temperature high	Blocking Alarm (TR421 temperature over 80°C TX stopped)
06: TX output power	Blocking Alarm (Check TX out power)
07: TX ant. reflected L2	Blocking Alarm (can be changed to non blocking with command 71/TXREFLWAR/+)
08: TX ant. reflected L1	Non Blocking Alarm
10: RX PLL unlocked	Blocking Alarm (Hardware fault)
11: RX LO1 injection low	Non Blocking Alarm (Hardware fault)
16: 36.864MHz PLL unlocked	Blocking Alarm (Hardware fault)
18: L3 Frequency Setup	Non Blocking Alarm
19: DSP watchdog	Blocking Alarm
20: DSP Time Sync	Non Blocking Alarm
21: BSC Message Link	Blocking Alarm (No Link to BSC)
22: BSC1 Message Link	Non Blocking Alarm (No Link to BSC1)
23: BSC2 Message Link	Non Blocking Alarm (No Link to BSC2)
24: Time Sync	Non Blocking Alarm
25: Internal GPS RX	Non Blocking Alarm
26: External 1 Sync input	Non Blocking Alarm
27: External 2 Sync input	Non Blocking Alarm
28: Sync Phase Detector	Non Blocking Alarm
29: Century Second error	Non Blocking Alarm

## TR412 (Transciever):

00	SW Versions
02	TR operating mode
03/A	Alarm Flags*
05	Display Config/ Status from BSC (BS)
10	TX key state
11	TX output
13	Power setting
21	RSSI level
31	OCXO sync
34	CMoIP downlink status
R/34	CMoIP downlink status Dynamic
98	Hardware ID

*) Alarm TR 412 (OM command 03/A)	Comment
00: TX PLL unlocked	Blocking Alarm (Hardware fault)
02: TX VSWR protection	Blocking Alarm (Hardware fault)
03: TX temperature high	Blocking Alarm (TR412 temperature over 80°C TX stopped)
04: TX volt. reference	
05: TX +26V supply	
06: TX output power	Blocking Alarm (Check TX out power)
07: TX ant. reflected L2	Blocking Alarm
08: TX ant. reflected L1	Non Blocking Alarm
09: TX combiner TP high	
10: RX PLL unlocked	Blocking Alarm (Hardware fault)
11: RX LO1 injection low	Non Blocking Alarm (Hardware fault)
12: RX LO2 injection low	
13: RX TMA/RMA L2	
14: RX TMA/RMA L1	
15: 12.8MHz PLL (2.048MHz)	

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16: 36.864MHz PLL (8kHz)	Blocking Alarm (Hardware fault)
17: 1sec. missing	
18: L3 Frequency Setup	Non Blocking Alarm
19: DSP watchdog	Blocking Alarm
20: DSP Time Sync	Non Blocking Alarm
21: BSC Message Link	Blocking Alarm (No Link to BSC)

## 2.17 BS421REMOTE DESKTOP COMMUNICATION (VNC)

### 2.17.1 VNC setup

An alternative way to communicate with the Base Station is to use the VNC program.

The BS421 is as a standard provided with a VNC Server to allow one user at a time to establish a remote desktop session with the BS421.

To establish a remote session, start VNC on the Windows computer. (If it does not connect please check the VNC connection options “Format and encoding” change to “Raw”) You will get the following window:

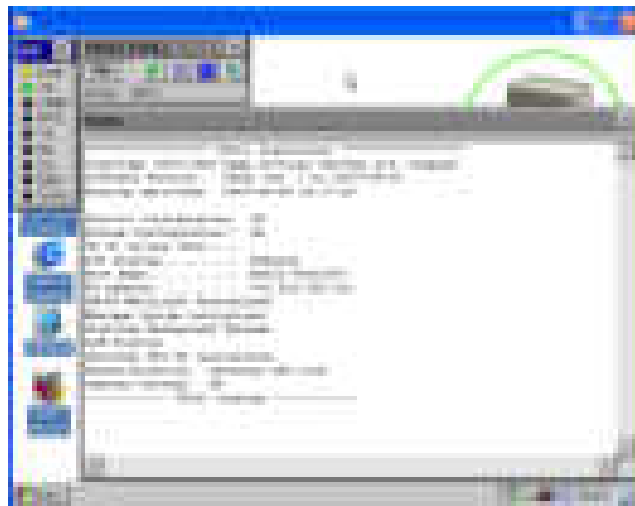


Figure 2-44: VNC picture

By pressing the LED, the LED window will close and give access to the “MY device” icon (or just move the active windows until my device icon is shown)

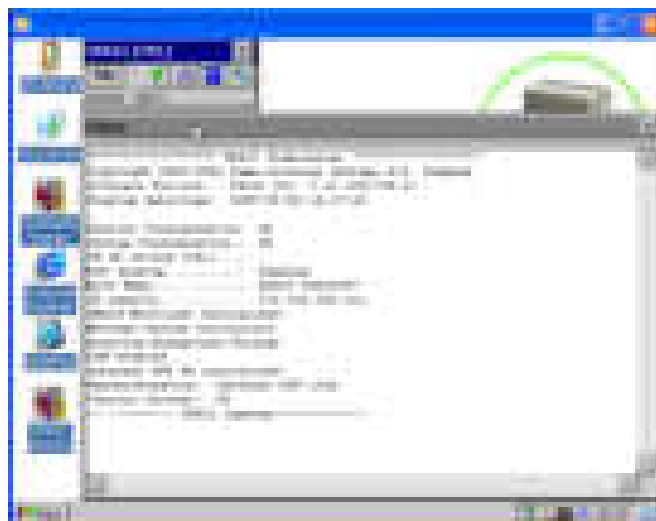



Figure 2-45: VNC My Device

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Selecting “My Device” will open the device window

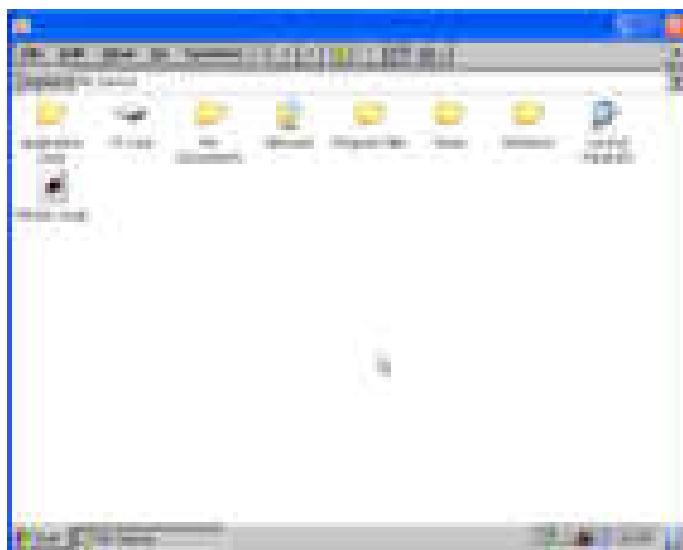


Figure 2-46: VNC CF card directory

The files on the BS are now accessible; for an instance the CF-Card directory contains all SW for the BS.

You can now operate the Windows CE on the BS remotely from your computer.

#### 2.17.2 File transfer via to/from BS

To copy, upgrade or backup files or software from the BS421 CF-card, select Start -> Search -> for files or folders

Select Computers and enter the IP address of the unit to be found.

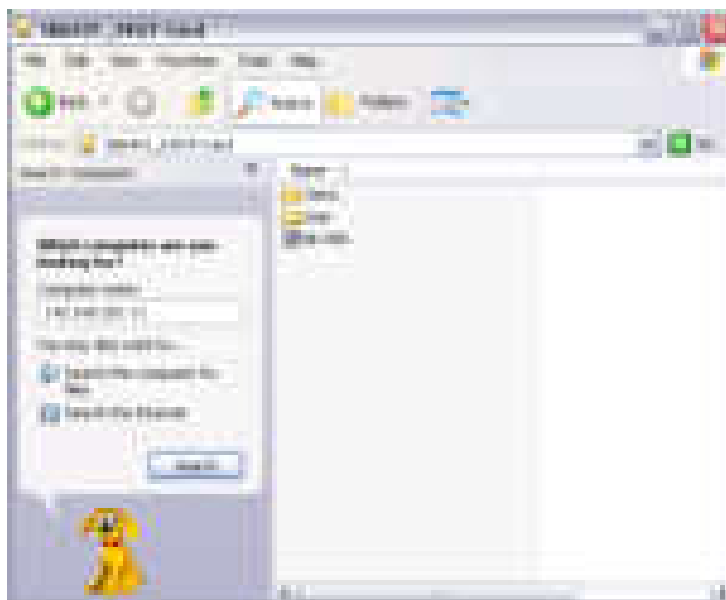


Figure 2-47: File Transfer

Now it is possible copy files to / from the CF-Card

### 2.17.3 Changing General setup and Sync

Pressing the tool icon will show a toolbox where it is possible to setup general parameters

- TR number
- TR ID string
- TX output
- RX-B input (6dB diversity preamble)
- BSC connection IP's
- Synchronization

For Sync and SyncOut, set the values to the opposite IP i.e. on TR1 set to TR2 IP and vice versa.

An option to restart the TR with the default values is present as well

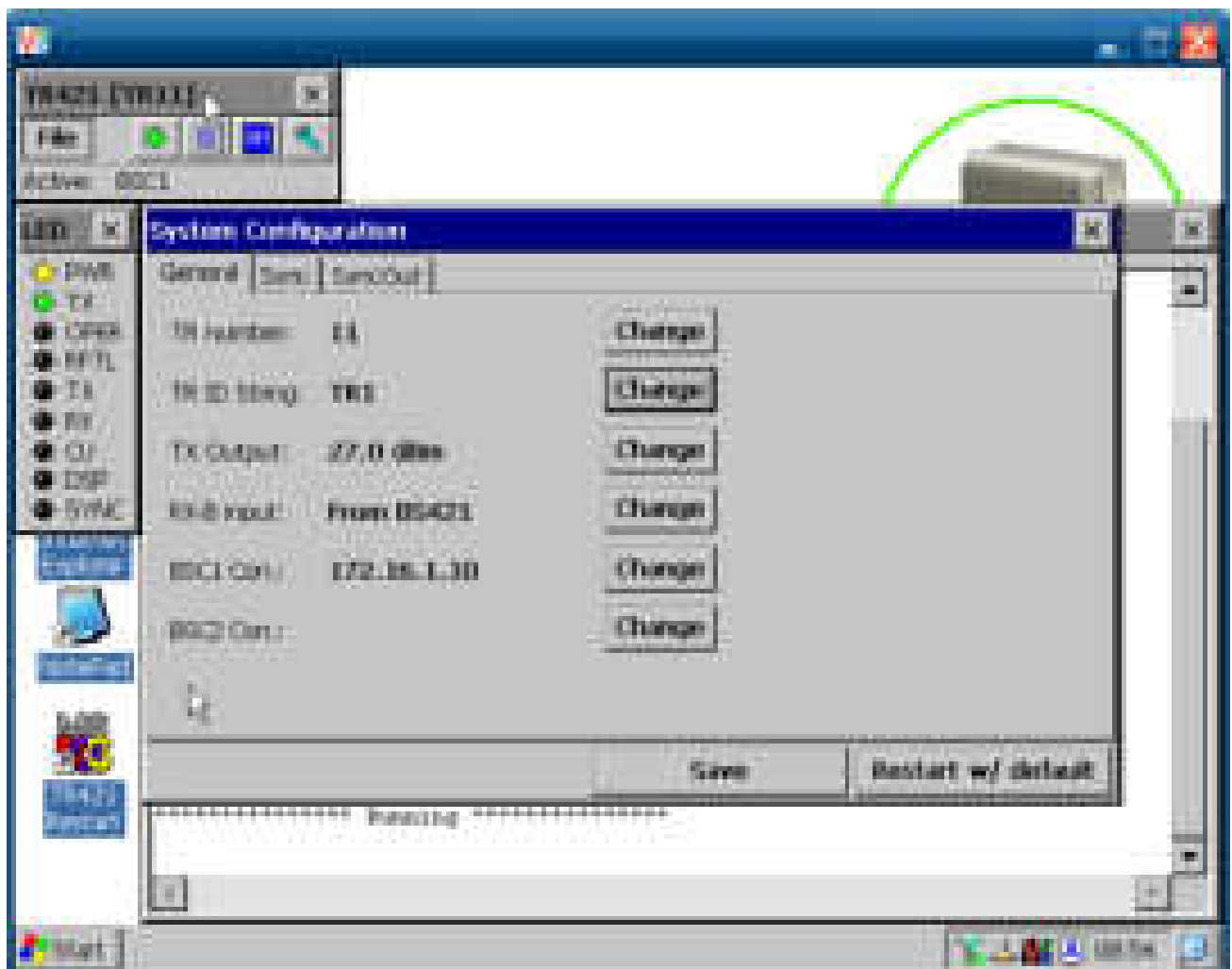


Figure 2-48: TR setup and sync

## 2.18 IP BACKBONE NETWORK LAYOUT AND CONFIGURATION

### 2.18.1 Multi node router considerations

From release 7.40 it is deemed mandatory to implement routers for realizing the interconnection. In fact it is not in relation to changes introduced in 7.40 that the routers have been mandatory. In fact the nature of multicast – when connected over switched networks (layer 2) can create problems with broadcast like behavior of the traffic. Meaning that a network which is shared with other users may be flooded with traffic from TetraFlex nodes.

While saying that routers are mandatory – it is also a fact, that the rendezvous point (RP) router is mandatory. It may lead to the misconception that RP is single point of failure. In the basic configuration of the router network this might be correct – as the RP is sitting as hub for all other routers, i.e. all traffic passes here. However – there are router techniques available – making it possible to introduce load sharing and redundancy setup for RP's.

Recommendations for this are under preparation. Cisco acronyms for this are MSDP (multicast source discovery protocol) and Anycast RP. The configuration for multiple RP and Anycast RP is not covered by this manual. Please consult Cisco representatives to obtain guidance on this topic.

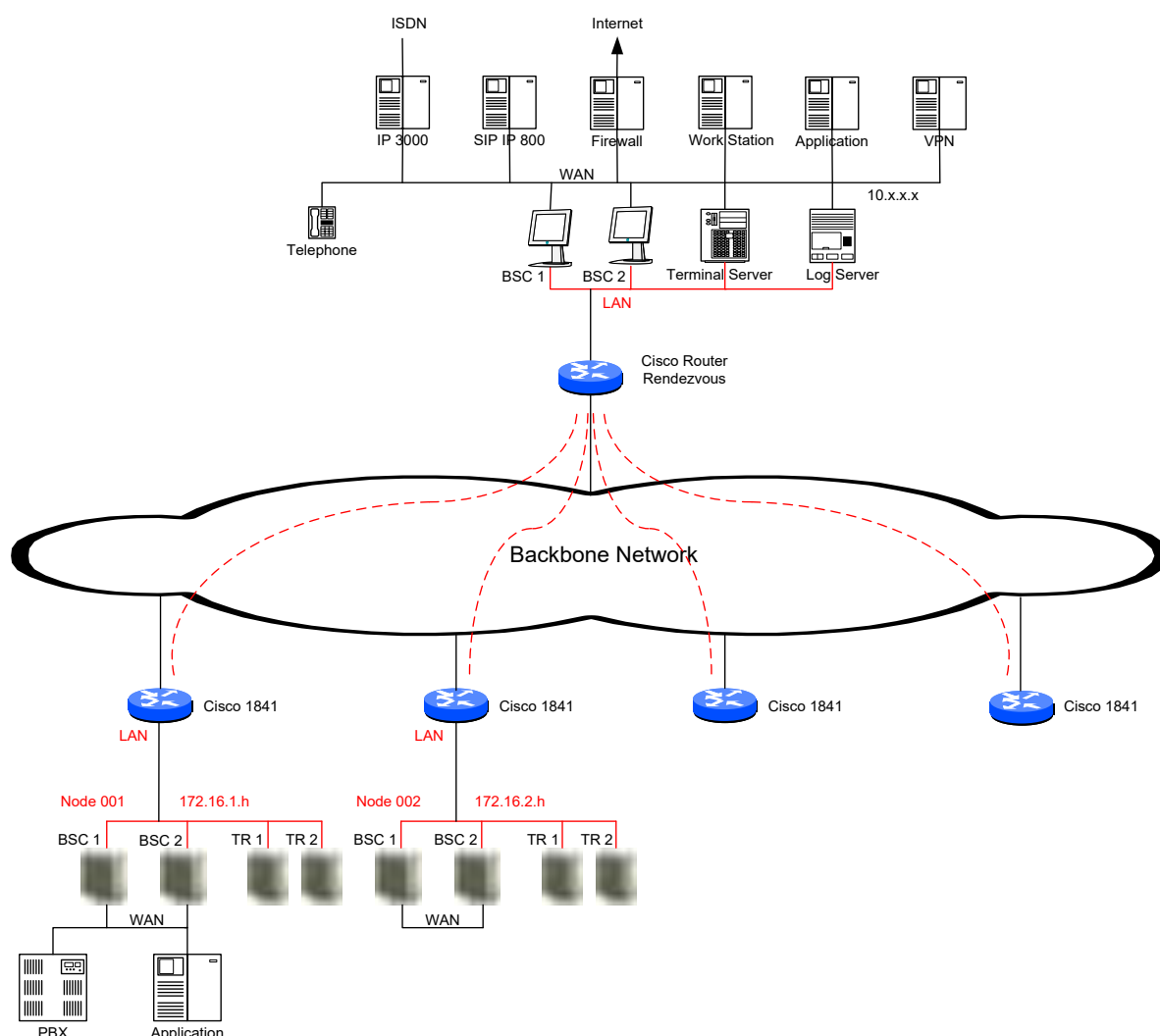
### 2.18.2 Network layout principle

As opposed to the virtual network between the TetraFlex® sites – which in its nature is a mesh network, the routers connecting the sites are connected in a star type network. The connections through the internet, which the routers use as their backbone, are all radiating like spokes in a wheel from one router that is announced as the rendezvous point. The routers then facilitate mesh type communication around the network, through routing tables built inside the network.

In reality the multisite Tetra network from Damm Cellular Systems A/S is two or more release 7 TetraFlex® nodes – working together through an IP network. All parties are equal and no node is single point of failure.

The subscriber relevant information is contained in two registers. Inside the network, these registers are distributed and present on all nodes at all times. The distribution of the registers is done through multicast routing in the connecting router network. With respect to the registers and housekeeping of the same – a node is pointed out to contain the master mode register. This node keeps track of register checksums on all nodes in the network. In case of checksum mismatch on one or more nodes, the master register will initiate a download and overwrite of the relevant register(s).





**Figure 2-49: Backbone network principle**

## 2.18.3 Backbone network physical connection

### 2.18.3.1 Outdoor/SB421


Installation of connection to router backbone for multinode TetraFlex is done via terminal points LAN\_IN and LAN\_OUT on the LAN+WAN connector of the below shown module. Connection is made from pins 8/7 and 6/5 using cat5 or cat6 networking cable and to the designated port on the router.

Please refer to section 1.1.4.5.8 for the full pin out of the cabling.

### 2.18.3.2 Indoor/BS41x

Internally in the BS41x rack the cabling for the LAN (and WAN) is connected to the connection box at the rack top.

For making connection from BSC LAN port – connect a cat5 or cat6 cable from the corresponding connector BSC1 or BSC2 LAN on the connector box to the designated LAN port on the router.

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### 2.18.3.3 Redundant BSC – SB421 or BS41x

In case the node has redundant BSC – the router will need to have optional module installed.

### 2.18.4 IP addressing schemes

IP addressing recommendation is based upon a 172.16.x.x address. Inside a given node – the 4<sup>th</sup> octet of the address is assigned as the host address: .10 and .19 for BSC1 and 2. .11, .12, .13 and .14 for the BS421's. The 3<sup>rd</sup> octet is reflecting the node number.

For IP interconnection via routers, the subnet mask is set to 255.255.255.0 or /24.

For IP interconnection via switched network, the subnet mask is set to 255.255.0.0 or /16.

If changing these masks – remember to change also in the DHCP server on outdoor type TetraFlex®.

All communication between the nodes in the multisite network is based purely upon IP. The network must provide both unicast routing and multicast routing. Group calls and register replication uses multicast communication and full duplex calls between two mobiles or to external PSTN via SIP also uses multicast although in nature being point to point. In TetraOM connection to the BSC – use the command S71 to display the relevant settings in regards to multicast networking.

224.239.016.000/28 is the default multicast address segment in use by the system for register replication and for signaling of call activity between BSCs in the TetraFlex® network. The address can be changed to meet special requirements. 224.239.016.000/28 results in a address of 224.239.16.1 for exchange of control packets between BSCs and for call signaling. Further an address of 224.239.16.3 is created – which is used for multicast traffic relating to discreet listening. 224.239.16.4 is the multicast address used for replicating the subscriber register

224.239.017.001 is the default multicast address in use for log server . The address can be changed to meet special requirements, amongst others allowing for more than one log server.

225.000.000.000 is the so called CMoIP base address. CMoIP is the actual communication data stream (VoIP). The address can be changed to meet special requirements. It is possible to change the first octet of the address – whereas the last octets are assigned automatically by the system. The CMoIP address for a given call is constructed from the following principles:

1. CMoIP base address is used as the fundament
2. The node number will be deciding the 3<sup>rd</sup> octet of the CMoIP address – e.g. if base address is 225.0.0.0, a node 4 will set CMoIP addresses of 225.4.x.x – a node 200 will set 225.200.x.x
3. The assignment of CMoIP address is done by the originating BSC and is done as incremental and round robin – meaning start at 225.n.0.1, next call 225.n.0.2, and next 225.0.0.3 until 225.n.255.254. Then system restarts numbering from 225.n.0.1.

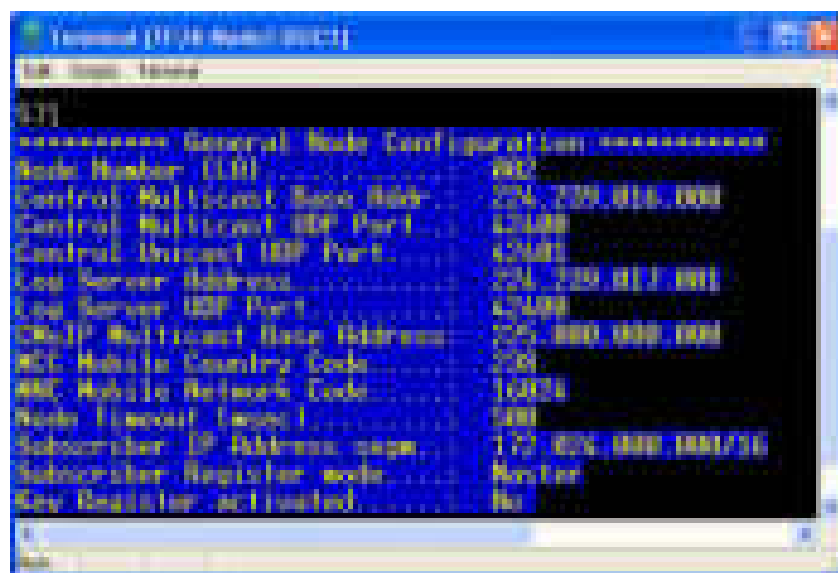
The CMoIP address is assigned to calls in the TetraFlex system and signalled to all other BSCs through the signaling group 224.239.16.1.

When a BSC starts up – it automatically involves the IGMP (Internet Group Management Protocol) and send of an “IGMP join” message to the network on the LAN. This “join” is sent for both the signaling group and the log server group. The joining of the two groups will be active for as long as the BSC is active.

When a call is initiated, it is signaled to all other BSC on multicast group .1. All other active BSC will receive this message. The signaling makes it possible for all the BSC's to decide whether a given call is relevant to any terminal under its control. At same time – the originating BSC will assign a CMoIP address to the actual call and send an IGMP join message to the network to create the group in the routers. The address of this given group is contained in the signaling.

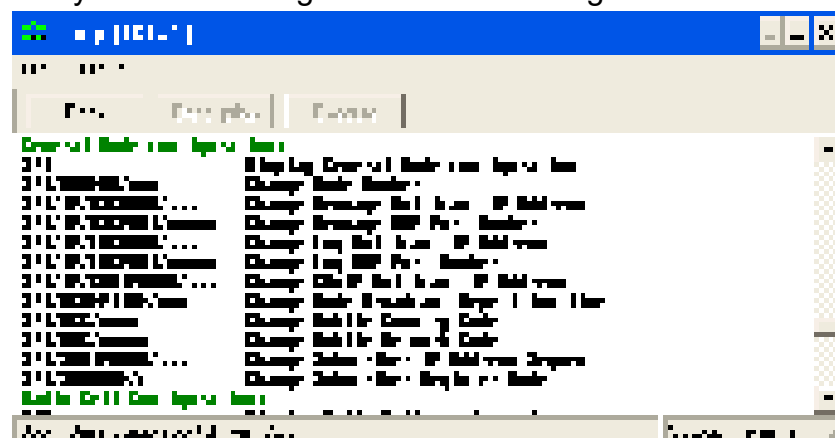
Any BSC that has interest in receiving the packets from the CMoIP group will make an IGMP join on the CMoIP address. After the call activity is terminated – the given CMoIP group will be taken down by IGMP disjoin messages.

The above mechanism is used both for group calls, full duplex calls, semi duplex calls and voice gateway calls.




**Figure 2-50: BSC multicast settings**

If you need to alter any of these settings – use the following commands:



**Figure 2-51: Applicable OM commands**

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Don't forget that in TetraOM, pressing "F1" will open the help files. Instead of the default gateway entry on the LAN port settings in WinXP/WES2009, it is necessary for the routing of unicast and multicast packets – that the SB421 is told otherwise how to deliver the packets relevant for other parts of the network – to the router.

This is done by using the command tool – or DOS prompt if you wish – to enter a persistent routing to the LAN interface. Use the "Start" → "Run" in the start menu and type "cmd". This will open the command prompt window.

"route print" will give an output of all the routing information currently contained in the IP stack.

"route add" with "subnet" mask "subnet mask" "router interface address" –p will establish a permanent routing information into the stack of the XP. Look at example below for better understanding.

Example:

Route add 172.16.0.0 mask 255.255.0.0 172.16.1.1 –p adds a persistent route to the 172.16.0.0/16 network with default router 172.16.1.1

See also below figure.

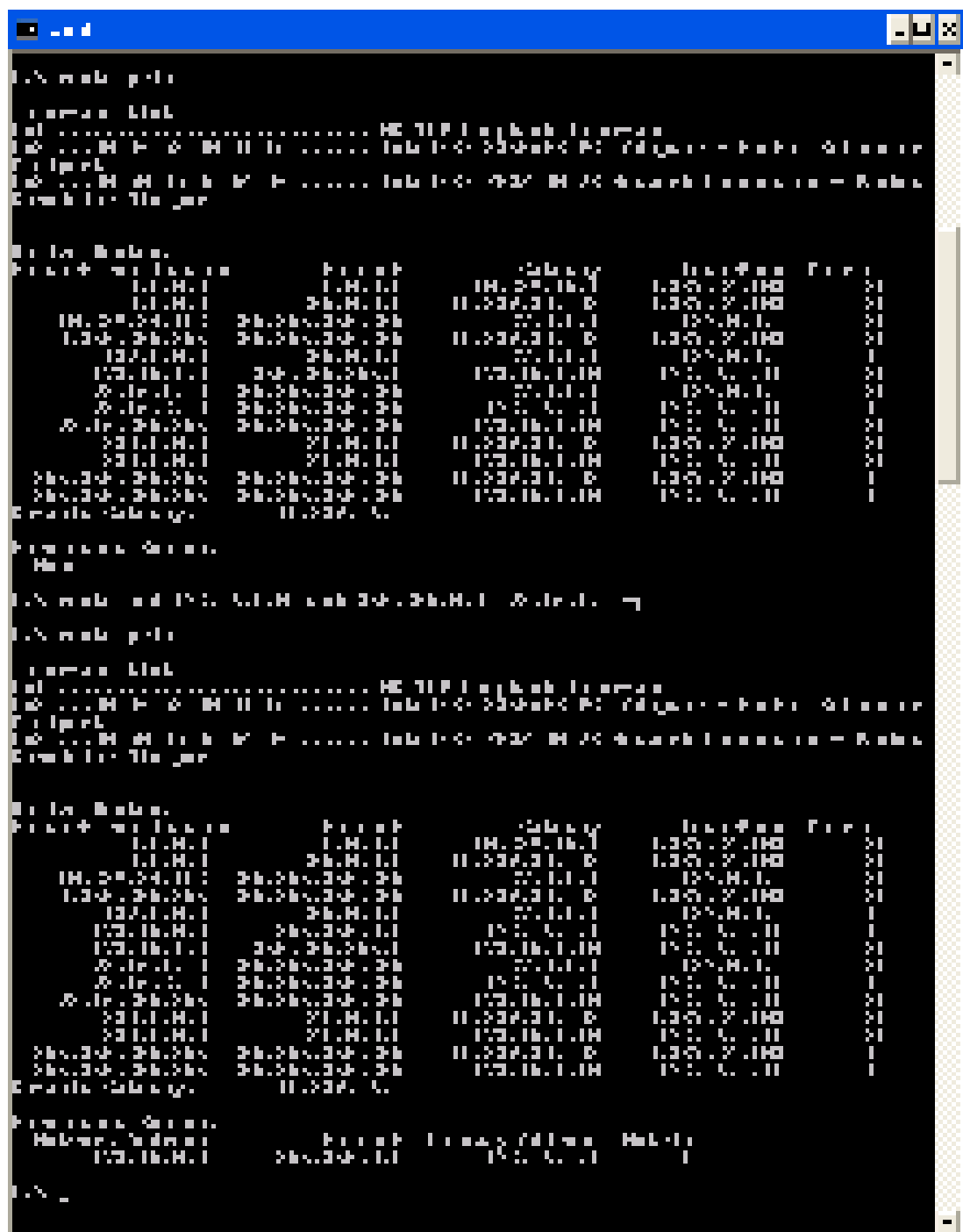



Figure 2-52: Adding persistent route entry

**NOTE:** Adding persistent route is not applicable when using switched network, i.e. without routers involved.

### 2.18.5 Considerations about network bandwidth

When designing a backbone network for the TetraFlex<sup>®</sup> multinode system it is applicable to take into account also the traffic load i.e. the bandwidth consumption originating from the various services available through the TetraFlex<sup>®</sup> system.

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Activity in the TetraFlex® nodes may induce traffic load on the connecting IP backbone network. This load varies, depending on the type of activity.

#### 2.18.5.1 Group call:

The communication scheme in use for group calls is point to multipoint. As the call type by nature is one to many – this is comparable to point to multipoint. The BSC with PTT'ing terminal will generate a stream of data packets.

All nodes with members of the same group as the PTT radio will receive the data stream and present it on their air interface. The CMoIP stream will be at approximately 12 Kbit/s on the LAN port of the SB421. After having passed the router, the resulting bandwidth will be 20 Kbit/s. The difference is relating to the fact that IPsec and GRE both will add protocol overhead to the stream.

At the rendezvous point – the data stream will be replicated as applicable – resulting in one or more data streams leaving the rendezvous router (RP). Amount of outgoing streams from RP is decided through the IGMP mechanism.

To summarize: at the RP router – there will be one incoming voice stream with bandwidth 22 Kbit/s per active group call (from the PTT'ing BSC). The amount of outgoing bandwidth is decided through IGMP (at joining BSC's) and is 20 Kbit/s per receiving BSC. The incoming/outgoing pattern will change according to which node has the PTT activity.

#### 2.18.5.2 Full duplex:

Full duplex call is point to point. In TetraFlex® it is still transported as multicast. The full duplex call will generate a bidirectional voice packet stream. So at each BSC relating to the call there will be 12 Kbit/s outgoing and ingoing. Thus a full duplex call will load the RP with 2\*20 Kbit/s in both ingoing and outgoing direction.


#### 2.18.5.3 Half duplex:

Half duplex call is point to point. In TetraFlex® it is still transported as multicast. Half duplex call will generate a voice packet stream where the direction of packets is decided by the PTT BSC. So a half duplex call will load the RP with 20 Kbit/s ingoing and outgoing.

#### 2.18.5.4 Replication:

The replication of subscribers is done via the signaling group and the replication group. All active BSCs are listening to the signaling group. When a master register decides to replicate because of checksum errors or a forced download of subscriber details is initiated through TetraOM, it results in a data stream from the BSC with the master register to the RP and outgoing stream from the RP as many as there are BSC's with faulty slave registers. The replication is done at a rate of 130 Kbit/s on the LAN – resulting in 158 Kbit/s on the “outside” port of router. So in a scenario with 10 nodes (1 master register and 9 slaves) this will result in RP load of 1\*158 Kbit/s incoming and 1\*158 Kbit/s outgoing if 1 slave register is faulty. If 2 slave registers are faulty the resulting load on RP is 1 ingoing and 2 outgoing streams.

#### 2.18.5.5 Control packets:

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There will, at all times when the network is activated, be a background load on the router network. The load originates from the control messages exchanged between the BSCs. The control packets will load the router network with 0.3 Kbit/s per active BSC.

#### 2.18.5.6 Log server:

The load on the RP relating to a log server being present in the network depends on different factors. The log server must have connection to the multicast network. Any traffic, relevant to the log server, will be signaled to log server at the log server's multicast address. Log server will – in case it is configured to log a given activity – join the given CMoIP group. Joining the given CMoIP will make the data available for the log server. From this – it is log server configuration and network configuration dependant how the traffic to the log server loads the routers and especially the RP. As it is the same CMoIP stream which is joined – the bandwidth per logged activity is still 20 Kbit/s.

#### 2.18.5.7 Multi vocoder:

When enabling support for multivocoder on one or all nodes in the TetraFlex® network – a significant impact on the loading of backbone will occur. All the above bandwidth calculations are based on the load figures arising from the use of ACELP (Tetra) codec.

Multivocoder support allows the use of G.711 linear codec also. Where ACELP is a 7,2 kbit/s codec – the G.711 is at 64 kbit/s. This will increase the load from CMoIP with a factor 8:1 seen at the codec level.

Looking at the resulting load after UDP encapsulation and GRE/IPSec – the increase is 4:1 as the packet size will be larger – so the UDP/GRE/IPSec overhead will be comparably smaller.

In numbers – the load from a G.711 encoded CMoIP stream will be approximately 80 kbit/s.

#### 2.18.6 The IP interconnection scheme of TetraFlex® per site

All communication between the components of the TetraFlex® is based on IP. In relation to the outdoor type TetraFlex, the SB421 service box with its Windows XP operating system contains a DHCP server. IP address of the SB is x.x.x.10 and the 1<sup>st</sup> BS421 has IP address x.x.x.11, the 2<sup>nd</sup> BS421 has x.x.x.12, the 3<sup>rd</sup> has x.x.x.13 and the 4<sup>th</sup> has x.x.x.14. In case a redundant SB is in use, it must be numbered x.x.x.19.

The SB421 has the LAN address x.x.x.10 or x.x.x.19. The same must be the case for the BSC configuration on the given SB421.

In relation to indoor type TetraFlex® – the BSC412 must be configured LAN port x.x.x.10, respectively .19 for redundant BSC.

Above address assignments are guidelines. But to ensure efficient support in case of trouble – it is recommended to keep this structure.

Node No	BSC LAN	2 <sup>nd</sup> BSC LAN	1 <sup>st</sup> BS421	2 <sup>nd</sup> BS421	3 <sup>rd</sup> BS421	4 <sup>th</sup> BS421
1	172.16.1.10	172.16.1.19	172.16.1.11			
2	172.16.2.10	172.16.2.19	172.16.2.11	172.16.2.12	172.16.2.13	172.16.2.14
3	172.16.3.10	172.16.3.19	N/A	N/A	N/A	N/A

Figure 2-53: Addressing examples

Above is shown a small example on addressing according to recommendation. Node 1 is a single carrier outdoor. Node 2 is a 4 carrier outdoor. Node 3 is an indoor. All three nodes have redundant BSC.

It can be observed that 3<sup>rd</sup> octet of IP address is equal to the node number.

Use the TetraOM to connect to the BSC locally. Issue command “F71” to check the local settings for the IP connections. The command will list the LAN and WAN IP addresses which are set in the BSC. Make sure these addresses correspond with the actual settings on the LAN and WAN cards in WinXP.

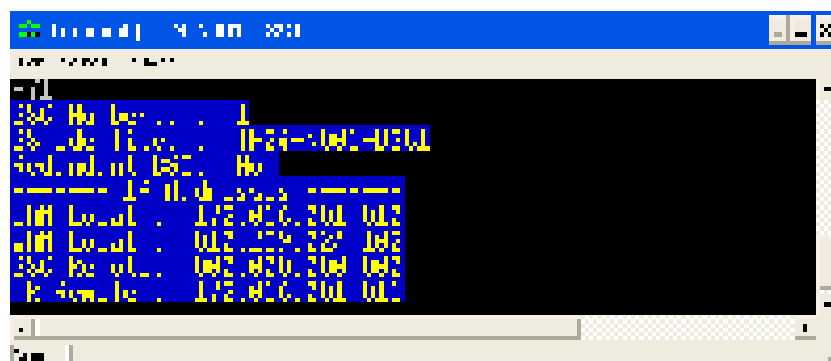


Figure 2-54: Viewing IP configuration

In case you need to alter these settings, use the below selection of commands:

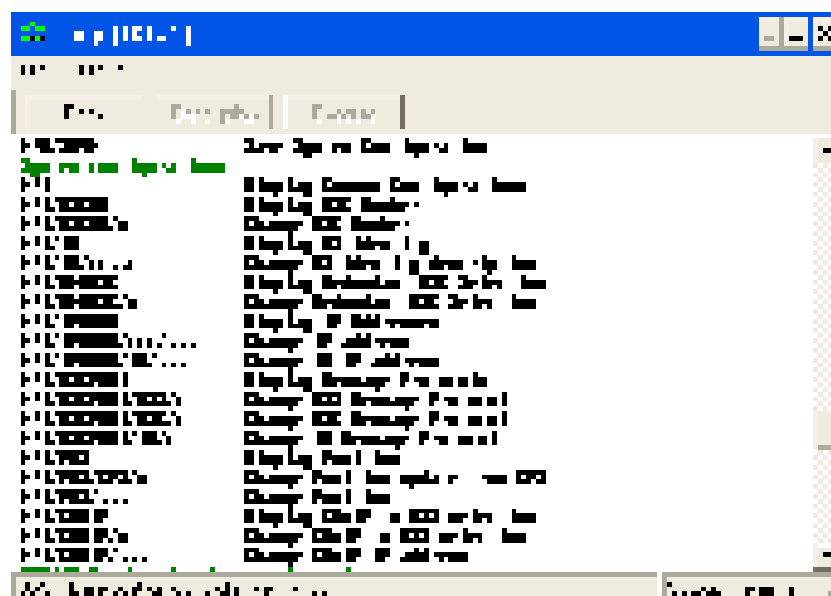


Figure 2-55: Applicable OM commands

Always remember that in TetraOM, pressing “F1” will open the help files.

The LAN port in the SB421 must have settings corresponding to the below example. Do not enter any default gateway settings on this port.



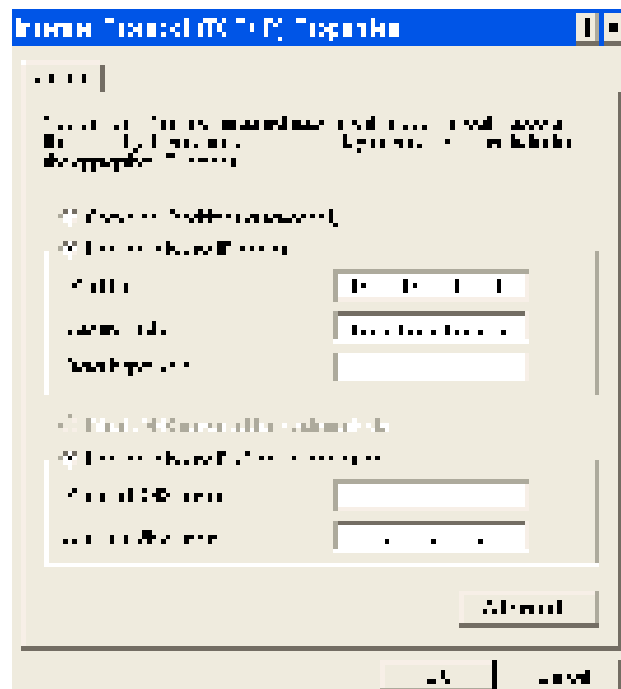


Figure 2-56: IP configuration of LAN interface card

### 2.18.7 Recommendation

It is strongly recommended that installers of the router network are familiar with IP networking, router technology and especially Cisco products.

If such familiarity does not exist, it is strongly recommended to seek advice with a knowledgeable Cisco installer.

### 2.18.8 Recommended router hardware

The router hardware recommended from Damm Cellular Systems A/S is a Cisco 1921 modular router.

This router type has been tested and verified with the TetraFlex® multisite system.

Other router types and brands may be applicable. But in case the router type is not Cisco – Damm Cellular Systems A/S will not be able to offer any support.


### 2.18.9 Applicable router techniques

As described previously in this document the router network between the nodes must provide both unicast transport and multicast transport. Damm Cellular Systems A/S recommends the use of Cisco products and especially the 1921 router has been tested and found suitable for this purpose.

The following is a brief sketch of the techniques in use in the router network to form a routing that can cater for the needs of the TetraFlex multisite environment.

#### 2.18.9.1 VPN

Using IPSec with 3DES or AES encryption on all traffic between the routers maintains security and integrity of the voice and data transported between the nodes in the network.

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### 2.18.9.2 Multicast networking

Multicast is a 1-to-many routing scheme. As opposed to unicast which is 1-to-1, the multicast allows a sender of information to address several receivers by sending one instance of the data. The multicast network replicates the sent data as applicable.

#### 2.18.9.2.1 Routing multicast:

Protocol-Independent Multicast (PIM) is a family of multicast routing protocols that can provide one-to-many and many-to-many distribution of data over the Internet. The "protocol-independent" part refers to the fact that PIM does not include its own topology discovery mechanism, but instead uses routing information supplied by other traditional routing protocols such as Border Gateway Protocol (BGP) or in this specific case static routing entry. The way PIM is routing is known as RPF, reverse path forwarding. The routing path of multicast packets is based upon the routing path for unicast packets – but is turning it around by 180 degrees. In unicast – the routing table is built on destination i.e. where the packet needs to go. In multicast the routing is based on where the packet comes from. In popular, the PIM forwards packets on all interfaces belonging to a multicast group – except for the receiving interface.

A sub configuration of PIM is PIM Sparse Mode (PIM-SM). This version explicitly builds unidirectional shared trees rooted at a Rendezvous Point (RP) per group, and optionally creates shortest-path trees per source. PIM-SM generally scales fairly well for wide-area usage.

#### 2.18.9.2.2 Group management in multicast:

The control of members of the multicast environment, i.e. the nodes around the network that need to send or receive multicast traffic is done by Internet Group Management Protocol (IGMP). IGMP is used by IP hosts and adjacent multicast routers to establish multicast group memberships. It is an integral part of the IP multicast specification, like ICMP for unicast connections.


The TetraFlex release 7 supports version 3 of IGMP. Default setting in Cisco is version 2, but can be changed through configuration.

All interfaces in the router network that must be able to join in a multicast group must have IGMP and PIM-SM enabled.

##### 2.18.9.2.2.1 Multicast and VPN

As such – VPN/IPSec does not support the transport of multicast packets. GRE tunneling does support multicast routing – but is not encrypted. Therefore the configuration shown at end of this document – the recommended configuration – uses IPSec encrypted GRE tunnels. Combining the IPSec and GRE will ensure the routing of both unicast and multicast – and still maintaining integrity and intrusion security of the network.

##### 2.18.9.2.2.2 GRE tunneling

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Generic Routing Encapsulation (GRE) is a tunneling protocol designed to encapsulate a wide variety of network layer packets inside IP tunneling packets. The original packet is the payload for the final packet. GRE was developed by Cisco and was designed to be stateless; the tunnel end-points do not monitor the state or availability of other tunnel end-points. GRE creates a virtual point-to-point link with routers at remote points on an IP internetwork.

#### 2.18.10 Applicable tools for router programming

The Cisco offers a CLI – Command Line Interface. This is accessible through the console port of the router. Use the blue cable delivered with the router. In this case use the serial port of your PC. You can use any of a variety of terminal emulation programs.

If you know the IP address of one of the Ethernet ports on the router – you can also telnet into the router and use the same CLI.

The configuration of any Cisco router – can be exported from the router and onto a so called TFTP server. The router configuration file is then an ASCII formatted text string. This can be opened – edited and saved by the use of any of a variety of text editor programs.

After editing – the file can be re-imported to the Cisco router. After a reload of the router – it will reflect the newly introduced configuration changes that you made offline.

##### 2.18.10.1 Ultraedit:

- A text editor program for offline editing of configuration files.

##### 2.18.10.2 WordPad:

- A text editor program for offline editing of configuration files. Available typically in Windows.

##### 2.18.10.3 HyperTerminal:

- A Windows standard program that can do both serial communication and also use TCP/IP to connect to router via Ethernet.

##### 2.18.10.4 Putty:


- A very versatile program that does serial and IP connections.

##### 2.18.10.5 3CDeamon:

- A TFTP program from 3COM.

##### 2.18.10.6 Tftp32:

- A TFTP program from <http://tftpd32.jounin.net>: Freeware.


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	TetraFlex® - General system description		



# PART-3: TetraFlex® Applications

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 Damm Cellular Systems A/S, Denmark	Doc. No.	Rev.	Date
	TetraFlex® - General system description		

## 3.1 GENERAL SYSTEM DESCRIPTION

### 3.1.1 TetraFlex V7.6 General System description

For complete system description, refer to ref.1: "TetraFlex v7.6 System description.pdf"

### 3.1.2 Site versus Node:

Until the DAMM TetraFlex® system software was introduced we have used the word "Site" to indicate how many radio sites there were in a system. There was coherency between number of "Sites" and number of "Radio sites".

The DAMM TetraFlex® concept opens for "Sites" meaning the actual geographical position of the equipment and a NODE meaning any unit running a BSC.exe application (except for the redundant BSC).

A node could be a radio node, GW node or a combination of these.

### 3.1.3 Software packages:


All DAMM TetraFlex® system software packages with all Functions and Applications are available on <http://www.damm.dk/> restricted area in encrypted form for a period of minimum 18 months after Release Date

- All Software Releases consist of:
  - Software package with Software Release number.
  - Release Note.
  - Commercial Note.
- A software package can be de-encrypted by means of any valid DAMM dongle.
- If a new Software Release contains bug fixes, which have a serious effect on the operation of a system, the Application Date can be set to an earlier date, and thereby allow execution on systems, where the dongle Application Date Limit has expired. DAMM Support Department is responsible for keeping the [www.damm.dk](http://www.damm.dk) restricted area updated
- Software packages with a Release Date older than 18 months will be removed from [www.damm.dk](http://www.damm.dk)


#### 3.1.3.1 Software packages execution or update:

The dongle controls which software release and which part of the release that can be executed on the BSC4XX or PC in which the dongle is inserted.

The customer may decide to execute the total package or only some of the files in the package.

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If the End-User decides only to execute some of the files in the package he must check the release note for the new release against the release note for the present release and make sure that all files not identical are updated.

 Damm Cellular Systems A/S, Denmark	Doc. No.	Rev.	Date
	TetraFlex® - Base Station Controller		

## 3.2 BASE STATION CONTROLLER

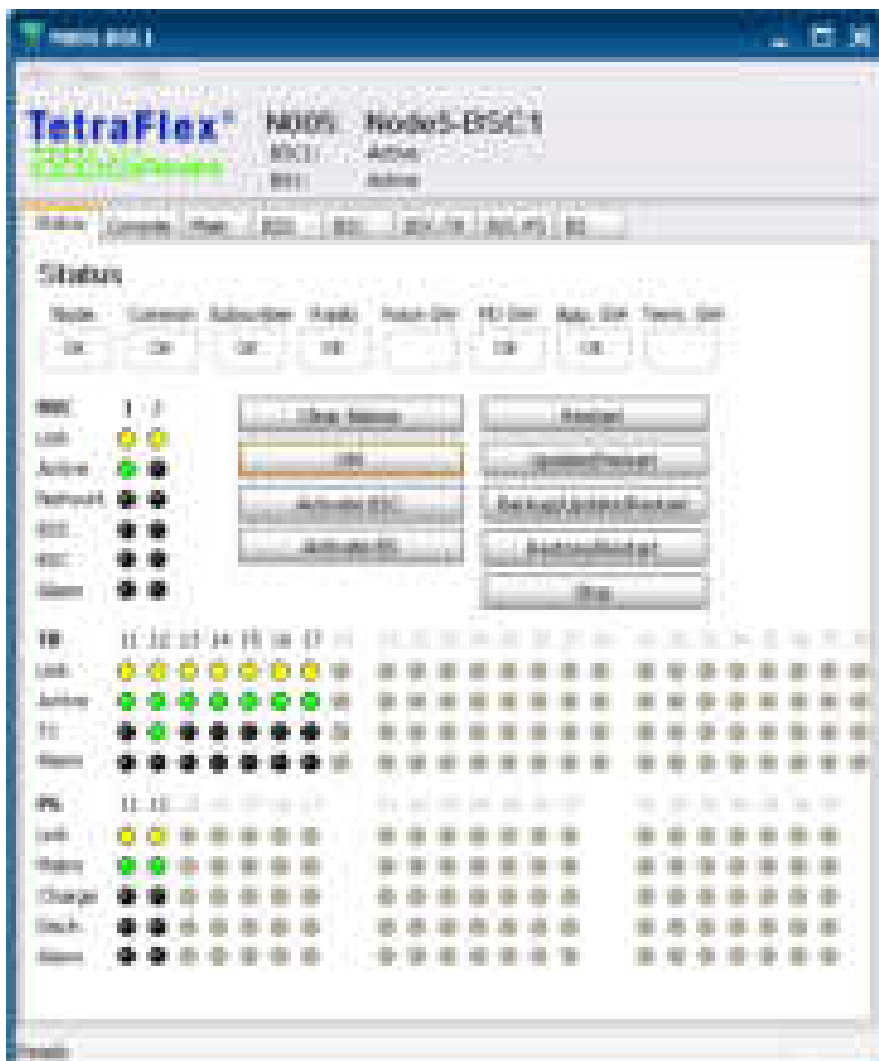
### 3.2.1 BSC.exe description

The core software for the TetraFlex® system is the Node Software (BSC.exe) running as a service under Windows XP or Windows 7. It can run on both the BSC421 and BSC412 Base Station Controllers (and on an ordinary PC or Server as well), and adapts automatically to the detected hardware platform. The BSC.exe service contains all the functions needed to run a complete Tetra system, including Subscriber Register with Security Key Register, Radio Cell, Voice Gateway, Packet Data Gateway (extern connection) / Server (Tetra-Tetra connection), Application gateway and Terminal Gateway.

The software supports the use of Redundant Base Station Controllers, as one BSC will be active and the other BSC standby. Communication and supervisory between the two BSC's will ensure, that the standby BSC automatically takes over, if the active BSC fails.

### 3.2.2 BSC-GUI

The user interface for the BSC.exe from version 7.6:



**Figure 3-1: BSC-GUI**

The BSC-GUI can be started from the TetraFlex Start menu or from the Taskbar. The GUI can only operate on the BSC.exe which is running on the same node as the BSC-GUI is started.

The GUI has 7 tabs (8 for the BS41x version):

**Status:** (se figure 3-1) gives an overview of the status of the BSC, TR (Transceivers) and PS (Power Supply's). It is possible to clear alarms, access the OM command system, Activate BSC and BS (Only BS41x), Restart and Stop the BSC, and Update of software and Restore and Backup of software and settings. These functions are also available in Network Management.


**Console:** The Console window is updated at each BSC start-up, and shows the start-up status of the system. The window is dynamic and will be updated when the status of the BSC changes e.g. from active to inactive





The *Clear* Button deletes the actual content of the console window.

**MAIN:** From the Main window the fundamental parameters for the BSC can be set and displayed. The corresponding OM command to Main starts with M (e.g. M00). The settings are stored in c:\tetra\active\data\CnfgMain.txt



**TetraFlex** **N005 Node5-BSC1**

### Main

MAIN VARIABLE	VALUE
<b>Main</b>	
Description	Node5-BSC1
LAN IP address	172.16.3.10
WAN IP address	10.229.24.125
Position change from GPS allowed	Yes
Latitude	54.5858439
Longitude	5.4825998
Hardware type	BSC412
<b>PS421 Configuration</b>	
Configured	No
PS421 address	PS11
PS421 BSC1 IP	
PS421 BSC2 IP	
<b>Software versions</b>	
BSC core version	7.60 2012-11-02
Main version	7.60 2012-11-02
BscLib version	7.60 2012-11-02
BscLib version	7.60 2012-11-02
BscLib version	7.60 2012-11-02
BscCoreLib version	7.60 2012-11-02
BscCodeLib version	7.60 2012-11-09
BscLib version	7.60 2012-11-02
QxmLib version	7.60 2012-11-02
GUI interface date	2012-09-28
Application FW/ protocol version	8
<b>Factory config</b>	

Ready

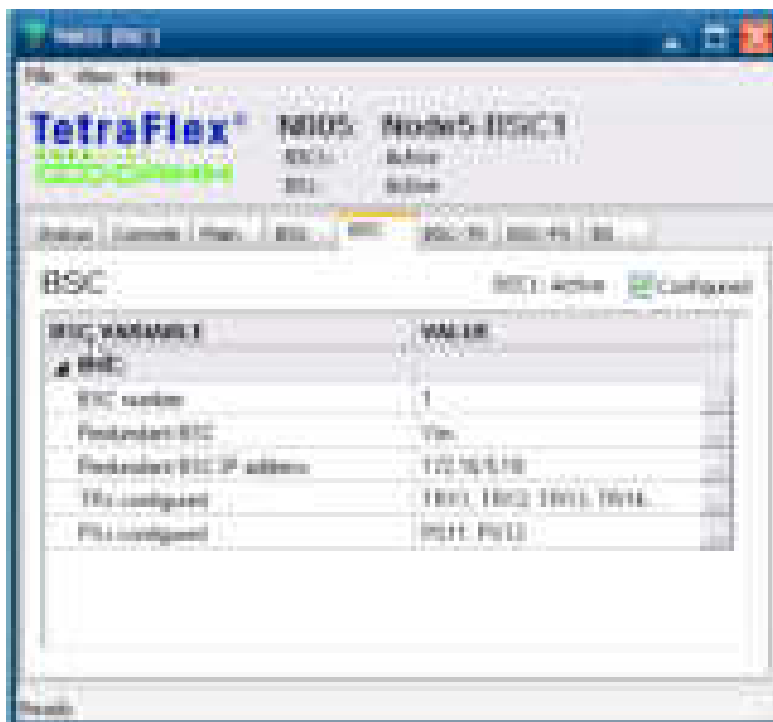
The LAN and WAN address can be selected from the actual IP setting in Windows and the input of GPS data can be enabled and disabled (yes /no). If GPS is enabled the GPS coordinates are shown in the Latitude and Longitude fields. If it is disabled the coordinates can be set manually.


**BSS:** From the BSS window most of the SwMI parameters can be set and displayed. The corresponding OM commands to BSS starts with S (e.g. S00). The settings are stored in c:\tetra\active\data\CnfgBss.txt.

The corresponding parameters can be set in NM so please find the explanation for the various parameters in the chapter covering NM –BSC list.



**BSC:** From the BSC window a Redundant BSC can be defined. Also the Transceivers (TR) connected to BSC can be setup. The corresponding OM command to BSC starts with F (e.g. F00). The settings are stored in c:\tetra\active\data\CnfgBsc.txt



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	TetraFlex® - Network Management		

## 3.3 NETWORK MANAGEMENT

### 3.3.1 Network Management

The TetraFlex® Network Management (NM) application is a graphical user interface to the TetraOM application (OM). This indicates that most of the functions in the NM may be executed in the OM using the appropriate OM command

The Network Management (NM) software may be executed on any PC which has an IP connection to the infrastructure. The NM must be able to listen to the multicast which means that the PC must be connected to the LAN

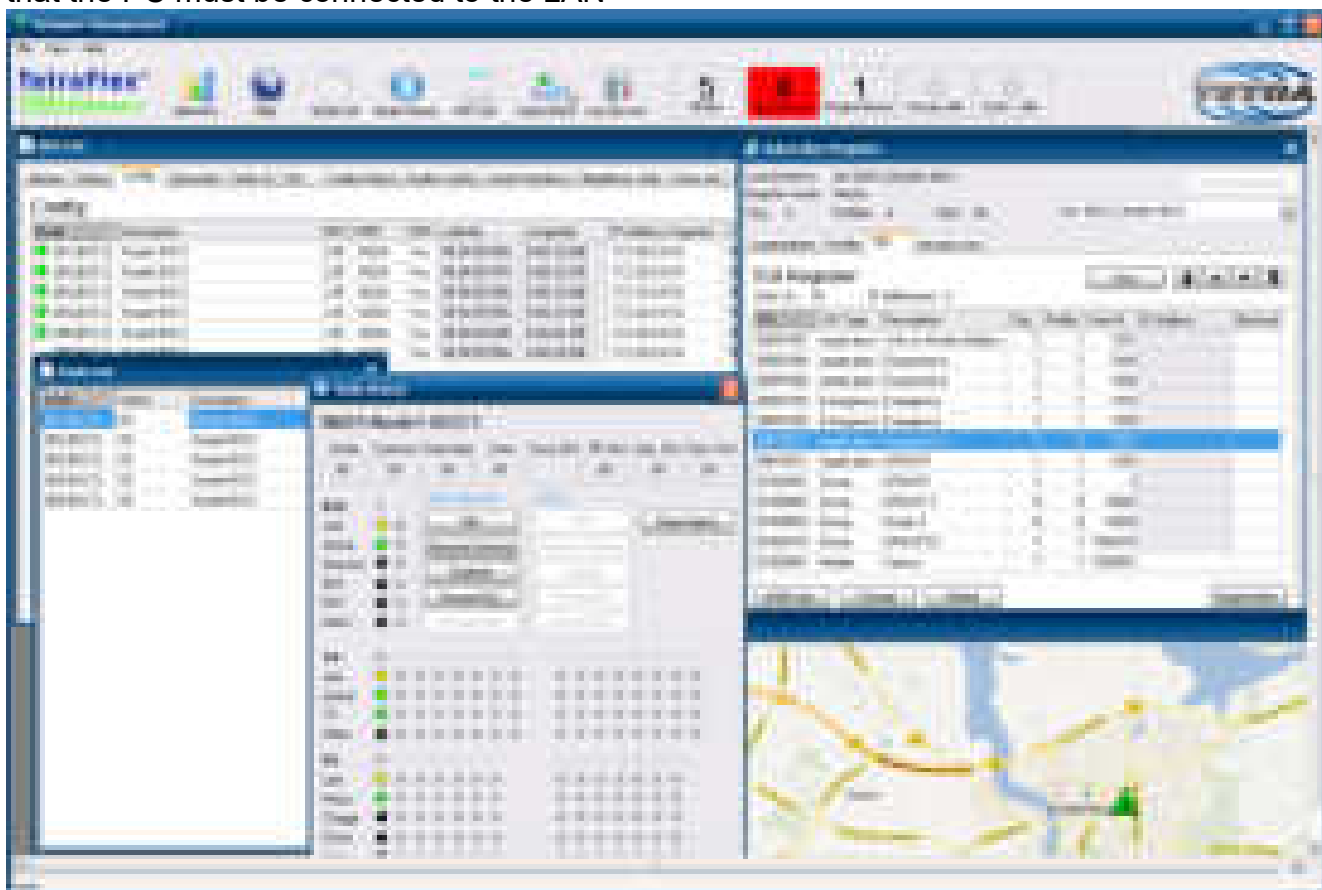


Figure 3-2: Network Management Main Screen

The NM consists of the following components / windows.

### 3.3.2 Toolbar

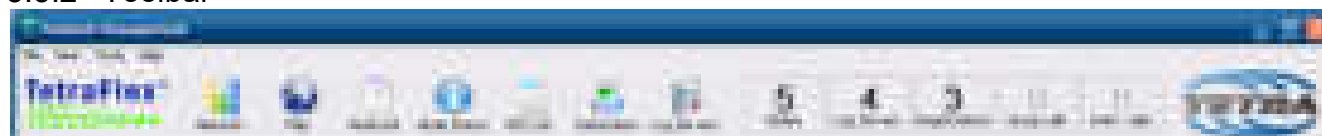



Figure 3-3: NM Toolbar

The toolbar is divided in to two areas

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- Command Line. Refer to section the next section
- Graphical tools. Refer to section 3.3.4

### 3.3.3 NM menu



Figure 3-4: NM command line

The command line has 4 selections:

- File
- View
- Tools
- Help

#### 3.3.3.1 File

Selecting File, two menus appear

- Options

Selections available under the Options menu

- Network



**Figure 3-5: Network**

The options menu allows the choice of Local IP, Multicast group IP and multicast port number. For multicast settings, please refer to the Multi Site IP networking manual.

The Local IP must always be set to the LAN IP (default).

- TetraOM

Specifies the path to the Tetra OM application



**Figure 3-6: TetraOM path**

- LogClient

Specifies the path to log client application

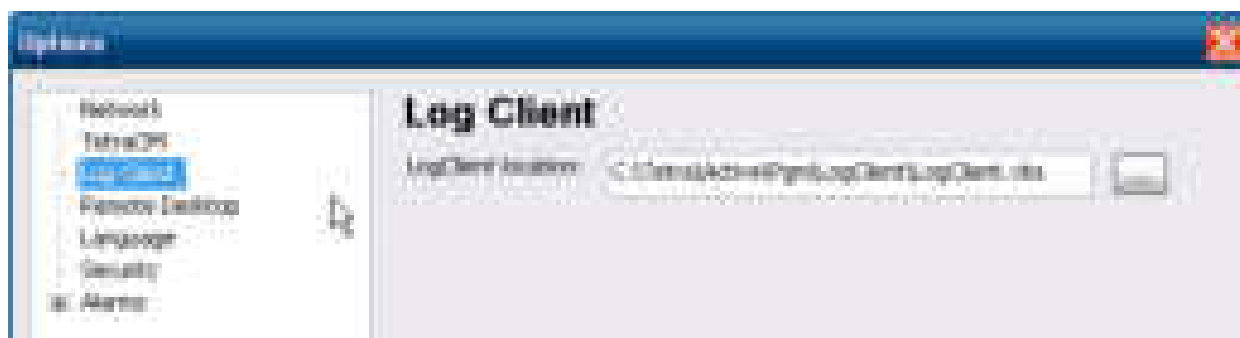


Figure 3-7: Log Client path setup

- Remote Desktop

Allows configuration of the Remote Desktop



Figure 3-8: Remote desktop setup

- Language

When enabled in the dongle, various languages can be selected for NM. Default is English.

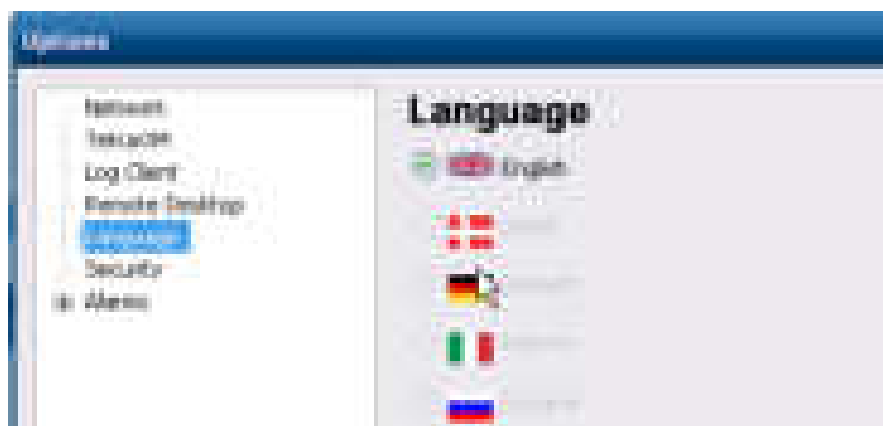


Figure 3-9: Language selection



- Security

Two security settings that allow or disallow users to make changes in System Parameters and Subscribers from NM

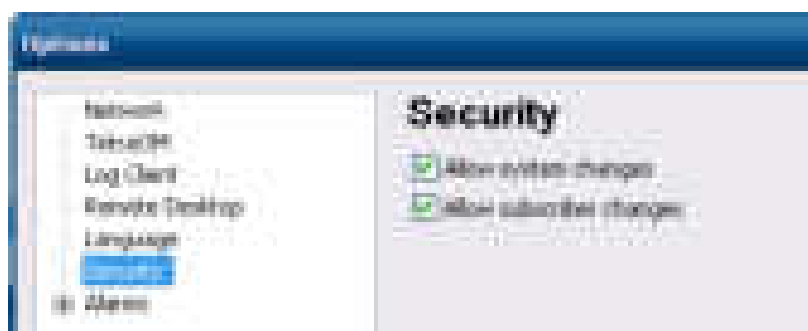



Figure 3-10: Security setting

- Alarms

Configuration of the wav files to be played when an alarm is present in NM



Figure 3-11: Alarm sound configuration

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- Exit – Shuts down the application

### 3.3.3.2 View

The View option allows cascading of windows and selection/deselecting of the status bar in the bottom of the main window

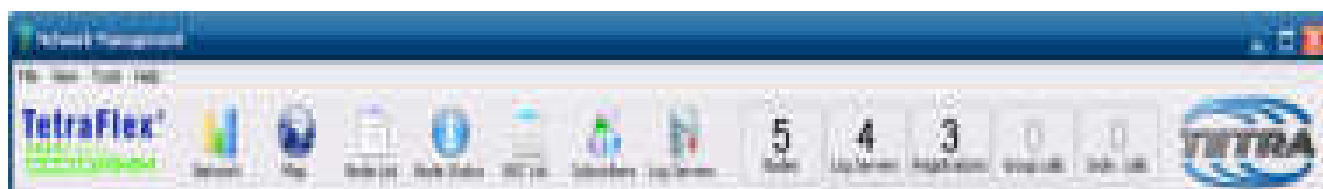
### 3.3.3.3 Tools

The Tools option allows clearing alarms on all nodes

### 3.3.3.4 Help

General information regarding the NM version number and link refers to [www.damm.dk](http://www.damm.dk).

## 3.3.4 Graphical tools for fast Access and information overview



**Figure 3-12: Application select and alarms**

The Graphical tool for fast selection has 7 access icons and 5 notifications

NOTE: the Node, Map, and Status windows are linked. This means that pointing to a node in one of the windows automatically changes the window to show the information's for chosen node.

### 3.3.4.1 Notification Icons

Four information icons are present on the graphical tool bar.

- Nodes\*                      Number of nodes presently active
- Log Servers                Number of Log Servers attached to the system
- Registrations            Number of registered units on system
- Group calls                Numbers of on-going Group calls
- Indv. Calls                 Numbers of on-going Individual calls

When moving the mouse to the Nodes field the actual status is shown:



- |                                  |  |
|----------------------------------|--|
| <input type="radio"/> Missing    | Numbers of nodes with a missing alarm                    |
| <input type="radio"/> Two Active | Numbers of nodes where 2 BSC are active at the same time |
| <input type="radio"/> No Active  | Numbers of nodes where no BSC are active                 |
| <input type="radio"/> L3 Blocked | Number of level 3 blocking alarms present                |
| <input type="radio"/> L2 Alarm   | Number of level 2 non-blocking alarms present            |
| <input type="radio"/> L1 warning | Number of level 1 warnings present                       |
| <input type="radio"/> Ok         | Number of nodes that are ok, without alarms              |


If one of or more Alarms are present the Nodes field turn into red and the alarm sound alerts. A yellow field indicates that one or more warning is/are present.

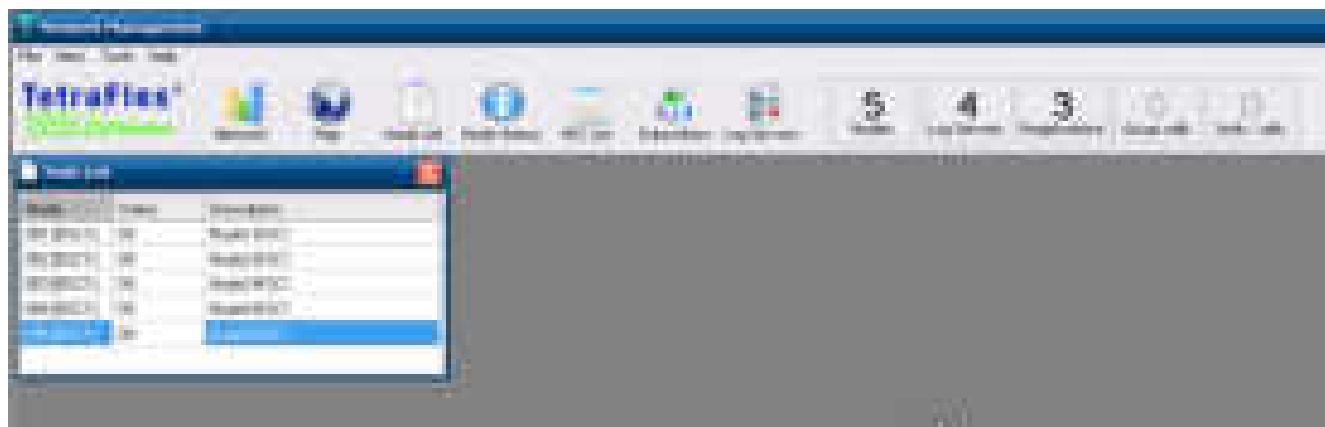
When right click on the Nodes status you get a dialog to handle alarms:



- |                    |  |
|--------------------|--|
| Acknowledge all:   | This acknowledges all alarms in the system   |
| Unacknowledge all: | This unacknowledges all alarms in the system |
| Clear alarm:       | Clear all latched alarms in the system       |

### 3.3.4.2 Selection Icons

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### 3.3.4.3 Nodes

The node window shows the general status and description of all nodes in the system. When Left Mouse Click is executed on a node line, the Node Status window displays the chosen node. Redundant BSC's are not shown in the Node list but in the Node Status window and the BSC list window and the following commands are applicable for the redundant BSC as well if present:

If Right Mouse Click is executed on a node line in the Node List window, a new menu appears with several options:

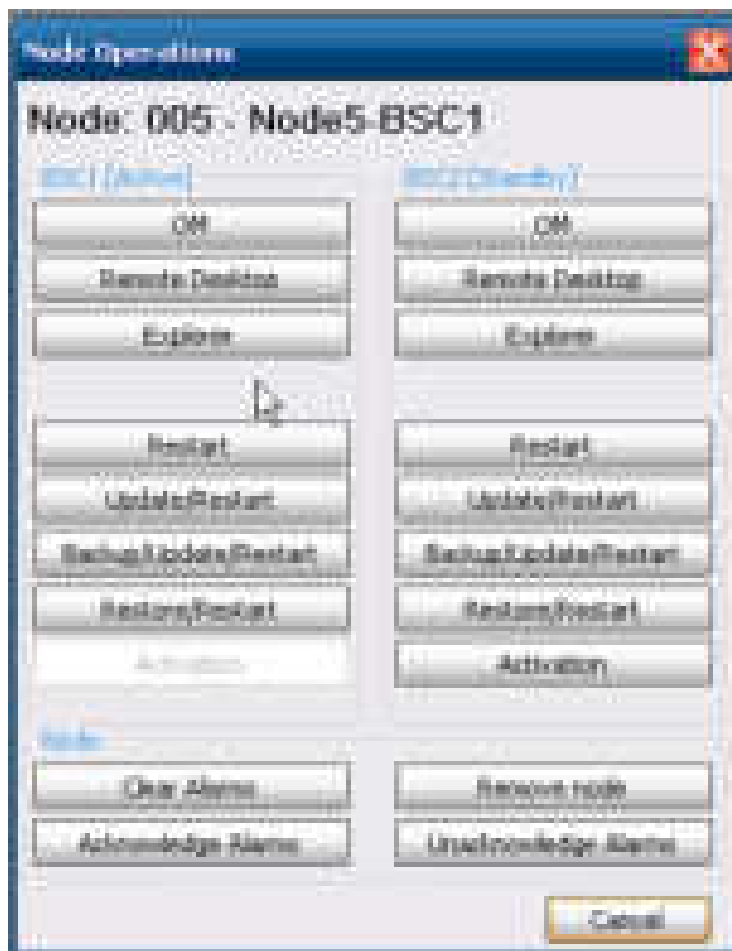


Figure 3-13: Node options showing Active and Standby BSC

- **OM** Start the TetraOM application
  - **Remote Desktop** Start a remote Desktop session of the node
  - **Windows Explorer** Starts Windows explorer with the address of the node
  - **Restart** Restarts the node
  - **Update/restart** updates the node with new SW previously deployed (\*) to the...\Tetra\Update library and restarts the node
  - **Backup/Update/restart** Backs up the node and the updates the node with new SW previously deployed (\*) to the ...\\Tetra\Update library and restarts the node
  - **Restore/restart** If Backup/Update/restart has been performed, this option will return to the configuration before the update was performed
- (\*) The software must be deployed to the C:\Tetra\Update folder in the right sub folder e.g. C:\Tetra\Update\Pgm for updating the C:\Tetra\Active\Pgm folder. Delete all previous version from the C:\tetra\update folder before updating.

- **Activation** Sets the node to Active
- **Remove node** If a node is deleted, but still active, the node will reappear in the list after a short time.
- **Clear alarms** Latched alarms may be cleared
- **Acknowledge** The alarm sound is shut off
- **Unacknowledge** Alarms Alarm Sound is turned back on

#### 3.3.4.4 Status

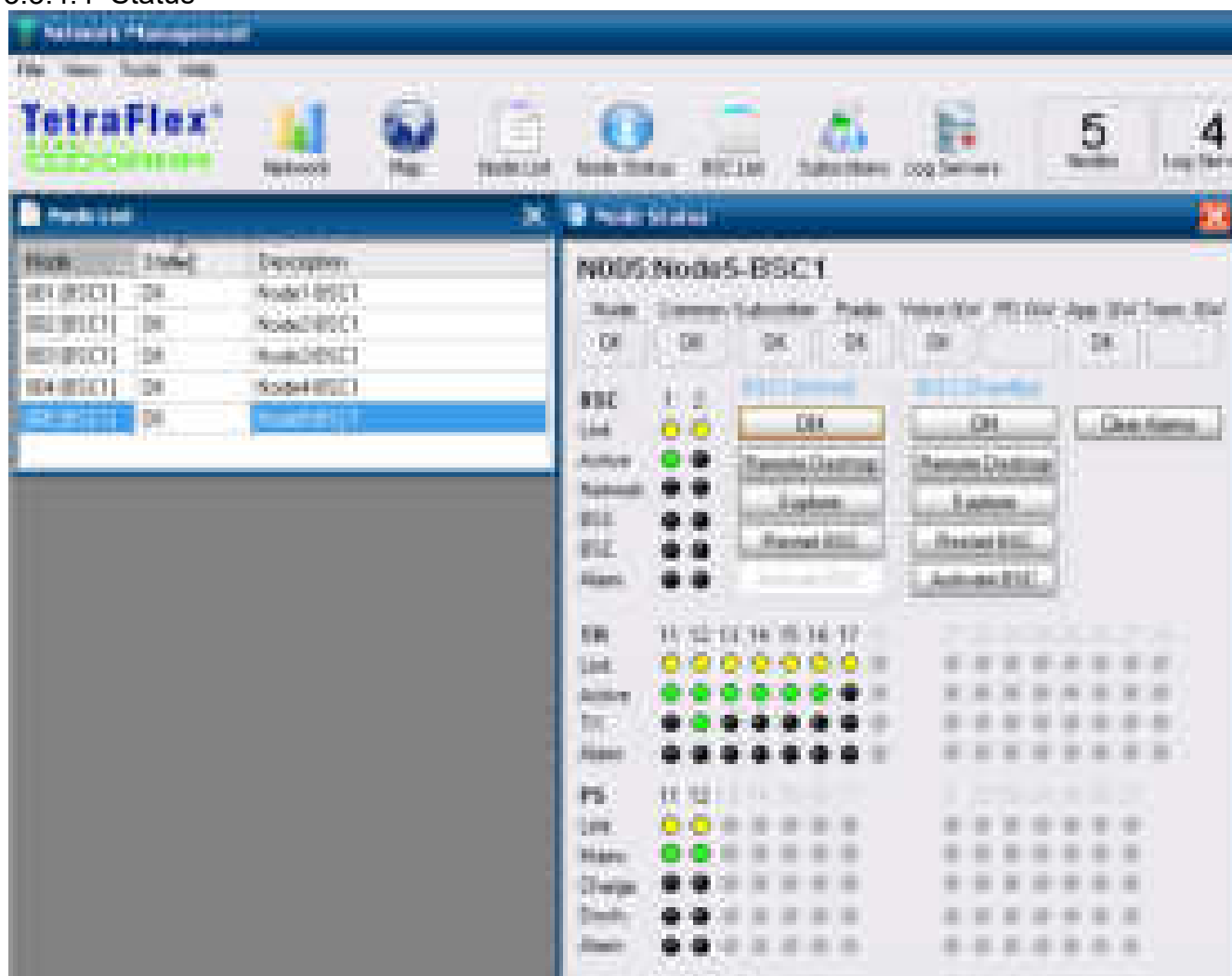



Figure 3-14: Status

The Status window shows the status and alarms for the node chosen in the Node List.

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By pressing the specific buttons the window also allows direct connection to (please see the explanation in the previous chapter)

- TetraOM application
- Remote Desktop
- Windows Explorer
- Restart of the BSC.exe
- Clear alarms

If a standby (Redundant) BSC.exe is present:

- Restart of Standby BSC.exe
- Activation of Standby BSC.exe

#### 3.3.4.5 Map

If connected to the internet, the map window will show Google Map with GPS positions of all registered nodes.

If the internet connection is not present, the map window will be inactive, but the system will continue working as defined.

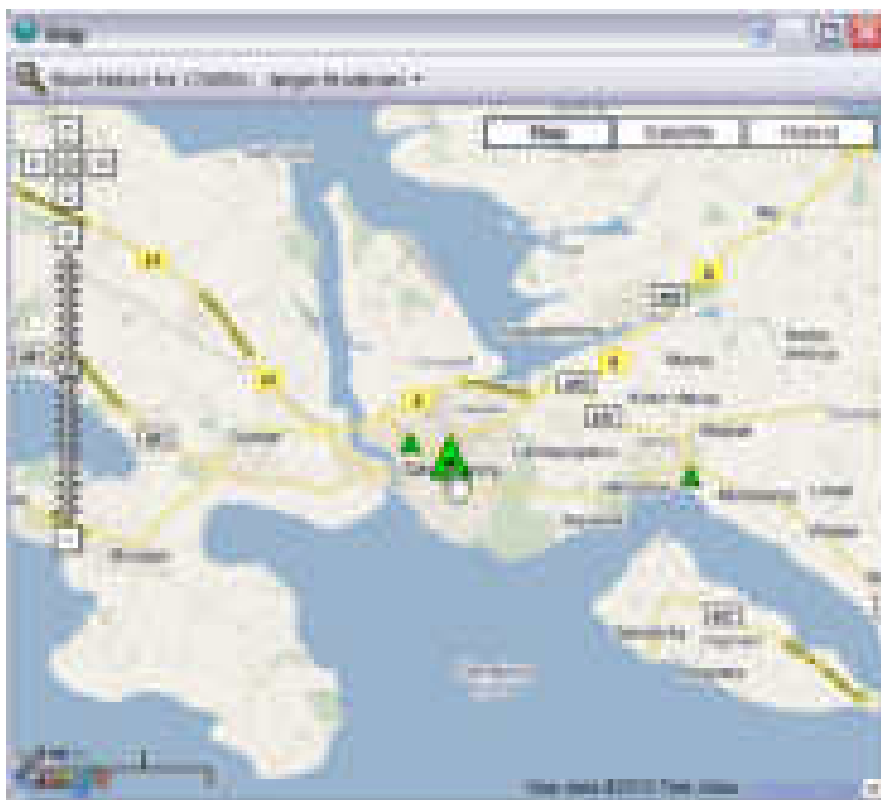



Figure 3-15: MAP

When moving the Mouse to a node position, the Node information of the selected node is shown

The selected node will be displayed as 

If an alarm is present the node symbol will turn into Red (alarm) or Yellow (warning)

### 3.3.4.6 BSC list

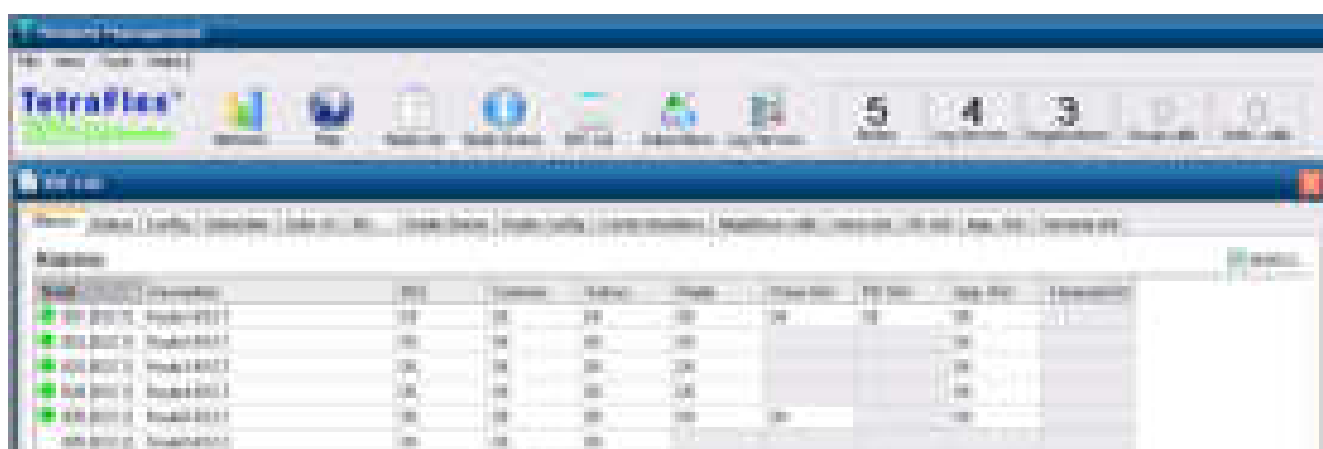



Figure 3-16: BSC List

A number of information regarding the node may be chosen by the tabs in the top of the window. Information that are not grayed out may be reconfigured by selecting the appropriate fields using right or left mouse button.

 This setting allows seeing and changing the BSC that is not active e.g. Redundant BSC

 A green LED indicates a running BSC with no alarm and a BSC without a LED is not active (e.g. Redundant BSC).

 A red LED indicates an alarm condition

#### 3.3.4.6.1 Alarms

Indicates whether an active alarm is present on a node and which component(s) the alarm applies to. The alarm can be Acknowledged and Unacknowledged by right clicking on the applicable field.



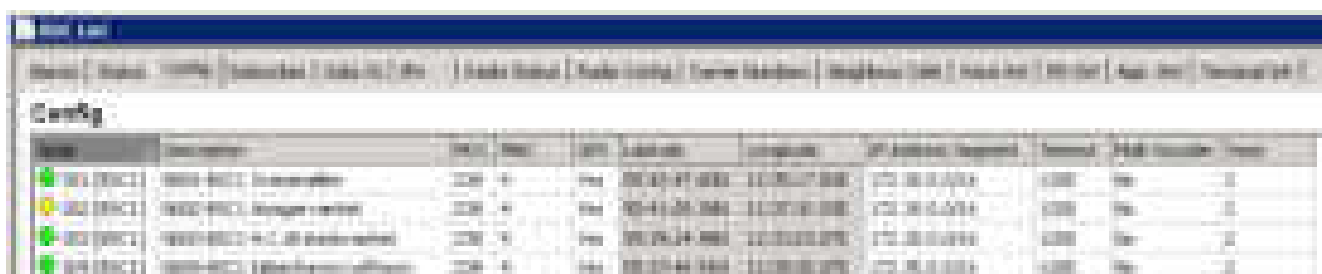
### 3.3.4.6.2 Status

Right mouse click on the node description of a specific node allows a change of the node description.

Status selection also shows information's regarding:

- HW type
- Software Version
- Dongle date limit
- Activation time
- Number of nodes
- Numbers of Log servers
- Last msg. – Last messages received date and time

### 3.3.4.6.3 Config



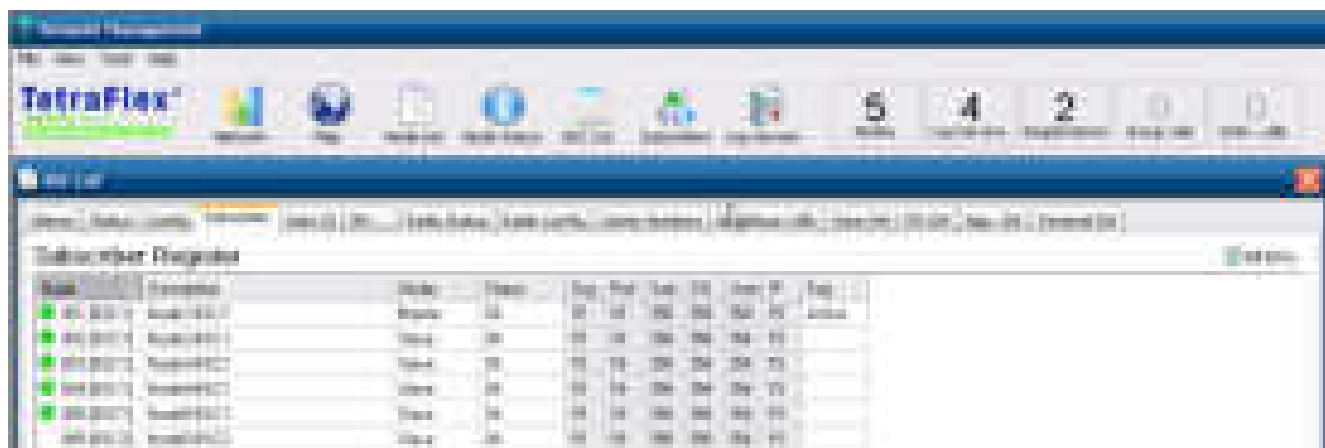
Node	Description	HW	SW	GPS	Latitude	Longitude	IP Address	Port	Terminal	Full Name	Time
1000-0001	1000-0001, 1000-0001	1000	1000	Yes	55.45471000	12.51071000	172.16.0.1001	1000	Yes	1	1
1000-0002	1000-0002, 1000-0002	1000	1000	Yes	55.45471000	12.51071000	172.16.0.1002	1000	Yes	1	1
1000-0003	1000-0003, 1000-0003	1000	1000	Yes	55.45471000	12.51071000	172.16.0.1003	1000	Yes	1	1
1000-0004	1000-0004, 1000-0004	1000	1000	Yes	55.45471000	12.51071000	172.16.0.1004	1000	Yes	1	1

Right mouse click on the following items allows the change of the configurations.

- Description
  - Node description, E.g. In the format
  - “System-Node number-Placement”. This description is collected and saved in the CnfgMain.txt file. This can also be changed via the BSC-GUI.
- MCC
  - Mobile Country Code. Please use the appropriate code for the country where the system is to be installed (saved in CnfgBss.txt)
- MNC
  - Mobile Network Code
  - NOTE: This code must be supplied by the appropriate authorities (saved in CnfgBss.txt)
- GPS
  - If set to “Yes”, the position shown on the map is set by the GPS receiver
  - If set to “No” Manual definition of the position is possible (saved in CnfgMain.txt)
- Latitude

- Manual definition of the position latitude (saved in CnfgMain.txt)
- Longitude
  - Manual definition of the position longitude (saved in CnfgMain.txt)
- IP address Segment
  - The IP address segment used by the Packet Data Gateway to assign an IP to the PC attached to the terminals (saved in CnfgBss.txt)
- Timeout
  - Internode Timeout is the maximum time a call setup takes using the longest delay in the system (can be set from 200ms to 2550ms)
  - Used to extend the node timeout: E.g. when using satellite connections with long delays (saved in CnfgBss.txt).
- Multi Vocoder
  - If set to yes, both Tetra voice codex and G.711 A-law is allowed .
- Voice
  - Initial Voice Buffer Length (Voice Frames) – This field is to avoid jitter e.g. when using End to End encryption adds approx. 60 ms delay pr. voice frame added (default factory setting is 2).

#### 3.3.4.6.4 Subscriber



By right click the Mode-field in the subscriber tab the subscriber register mode type (Master, Slave and Stand-alone) will be chosen (saved in CnfgBss.txt):

Mode:

**Master** – Used on the node where subscribers will be maintained. The encryption Key Register must reside on this node. A redundant BSC must be set to the same mode as the Active BSC. Only one node can be Master at a time and changing the subscribers are only allowed from this node

**Slave** – All other nodes in the system

**Stand-alone** – For test and installation purposes

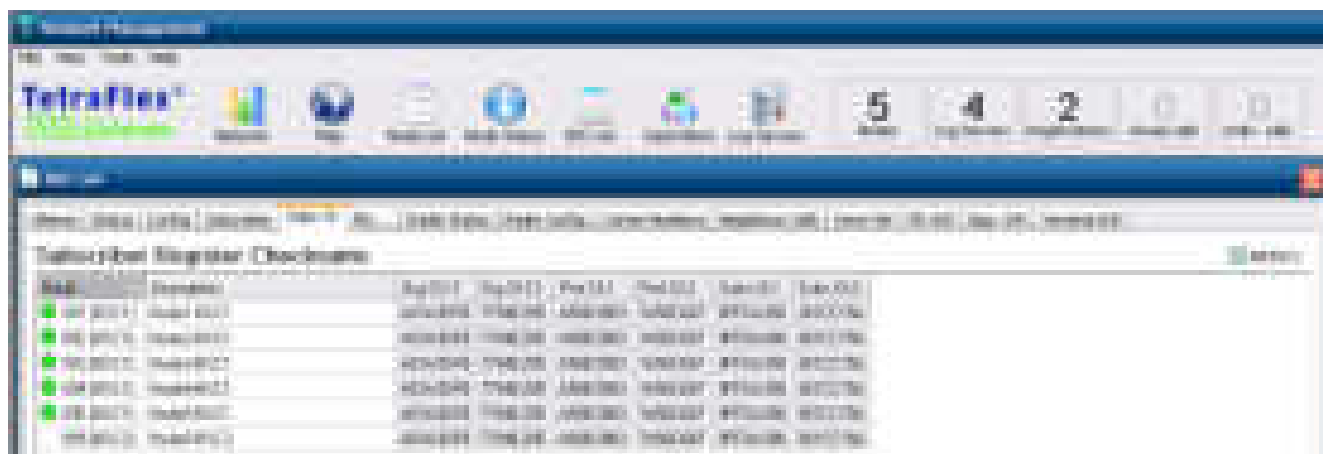
Key:

- Activation of the Security Key Register

Further information in grayed out fields refer to the count of the different subscriber types present in the subscriber register.

To see the non active BSC e.g. Redundant BSC the **All BSC's** option must be set.

#### 3.3.4.6.5 Sub. Chk

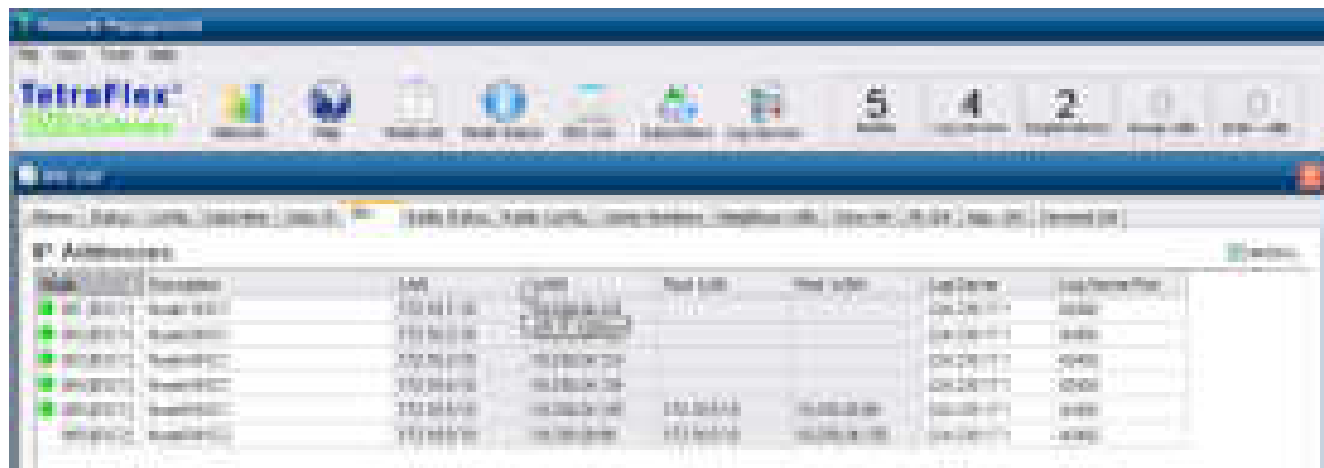


Org Ckx	Prof Ckx	Subs Ckx
00000000	00000000	00000000
00000000	00000000	00000000
00000000	00000000	00000000
00000000	00000000	00000000
00000000	00000000	00000000
00000000	00000000	00000000
00000000	00000000	00000000
00000000	00000000	00000000
00000000	00000000	00000000
00000000	00000000	00000000

Shows the two distinct checksums calculated for the Organization (Org Ckx), Profile (Prof Ckx) and Subscriber registers (SubsCkx). If the checksums of all nodes are equal the subscriber registers for all nodes are synchronized.

To see the not active BSC e.g.. Redundant BSC the **All BSC's** flag must be set.

### 3.3.4.6.6 IP's



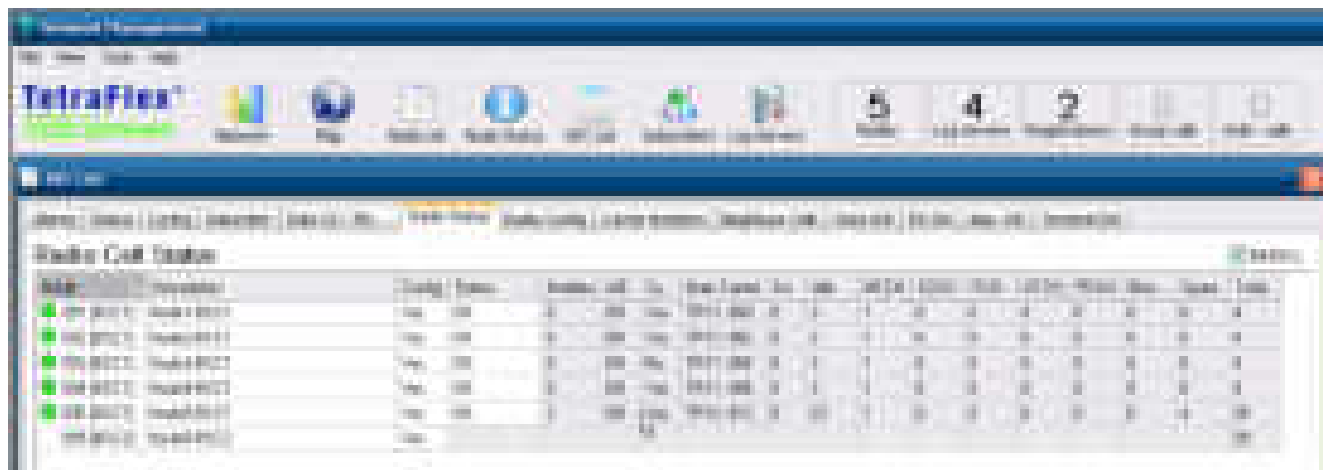
Right mouse click on the following items allows change of the configurations.

- Log Server
  - Log server Multicast control (receiving) IP address (default 224.239.17.1)
  - Log Server Multicast port (default 42400)

The following is information only (please see the chapter BSC\_GUI to make changes)

- LAN
  - LAN IP address
- WAN
  - WAN IP address
- Red. LAN
  - Redundant LAN IP address
- Red. WAN
  - Redundant WAN IP address

### 3.3.4.6.7 Radio Status



Shows the resources used on the nodes

- Config - shows if the Radio cell(s) are configured or not. By right click on the field the radio cell (s) can be set to configured Yes and No
- Status – Shows the actual status – By right click you may acknowledge an unacknowledged alarm
- Mobiles - Number of mobiles presently registered at the node
- MCCH – Main Control Channel (by right click you can see the appropriate frequency)
- AIE – Air interface Encryption off/on
- Sync – Neighbor Cell Synchronization. Shows Yes or No depending on the Sync. setting in Radio Config (see next chapter)
- Srv - Service level – (not enabled at the moment always 0)
- Idle - Number of idle channels (Timeslots)
- MCCH – Active Main Control Channel count – number of control timeslots used
- SCCH - Secondary Control Channel Count – numbers of sec. control timeslots used
- ITCH - Individual Traffic Channel Count – numbers of timeslots used for duplex calls
- GTCH - Group Traffic Channel Count- numbers of timeslots used for simplex calls

- PDCH - Packet Data Channel Count-numbers of timeslots used for packet data
- Block - Number of blocked channels (timeslots)
- Spare - Number of Spare channels (timeslots)
- Total - Total Number of channels (timeslots)


A button allows the view to shift between All Nodes and Active Cells

### 3.3.4.6.8 Radio Config



Allows configuration of the different radio parameters (per node or system). Right mouse click on the following items allows change of the configurations.

- Config – Transmitter configured Yes or No. Can be set to No I no radio node.
- BS Norm – TR antenna output power (normal power setting)
- BS Red - TR antenna output power with reduced power. Activated with Reduced. Power input on BSC (digital input 8).
- AIE - Air Interface Encryption Off or On
- AIE - Air Interface Encryption activated Yes/No
- Sync - Handover settings. Auto/Yes/No. Auto means: automatically sync. setting e.g. GPS sync. Sync. must be enabled on each node to make seamless handover.
- SCCH - Setup of 1 to 3 secondary control channels (SCCH)
- Fallback - System sends fallback information to the MS. If set to Yes (and Depending on the MS programming) this can be used for the MS to decide to change to a different node that has full service available even if the RSSI level is lower.
- MS PWR - Maximum Mobile Station TX power allowed
- RX Lev - Minimum Mobile Station RX access level before leaving a node. During initial scanning, the MS scans for downlink signals and takes this value from the broadcast. Then it checks if the received downlink signal is above this value before it registers to the node. If during the operation the received downlink signal drops below this level, it leaves the node again without any deregister signaling, and it goes into scanning and checks for a node with better signal.
- Access - Radio access parameter -53dBm to -23dBm. This, to reduce the MS output power depending on how close it is to the radio node. The ETSI defines it like

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this:  $P = \text{MIN} ( \text{MS\_TXPWR\_MAX\_CELL}, \text{ACCESS\_PARAMETER} - \text{RSSI} )$  This means that a) the MS never chooses an output power above MS\_TXPWR\_MAX and b) the output power depends on the downlink signal strength RSSI in combination with ACCESS\_PARAMETER. The idea is simple: If the MS is close to the BS, it can reduce its output power. ACCESS\_PARAMETER defines how much it can reduce it.

Example: MS\_TX PWR = 30dBm, ACCESS = -30dBm  
MS is far away from the radio cell, RSSI=-105dBm.

$P = \text{MIN}(30\text{dBm}, -30\text{dBm} - (-105\text{dBm})) = \text{MIN}(30\text{dBm}, 75\text{dBm}) = 30\text{dBm}$  MS transmits full power.

MS is very close to BS, RSSI=-55dBm.

$P = \text{MIN}(30\text{dBm}, -30\text{dBm} - (-55\text{dBm})) = \text{MIN}(30\text{dBm}, 25\text{dBm}) = 25\text{dBm}$  MS transmits with reduced power.

The value of -53dBm maximizes the effect of power reduction:  
 $P = \text{MIN}(30\text{dBm}, -53\text{dBm} - (-55\text{dBm})) = \text{MIN}(30\text{dBm}, 2\text{dBm}) = 2\text{dBm}$  MS transmits with very reduced power.

The value of -23dBm minimizes the effect of power reduction:  
 $P = \text{MIN}(30\text{dBm}, -23\text{dBm} - (-55\text{dBm})) = \text{MIN}(30\text{dBm}, 32\text{dBm}) = 30\text{dBm}$  No power reduction yet.

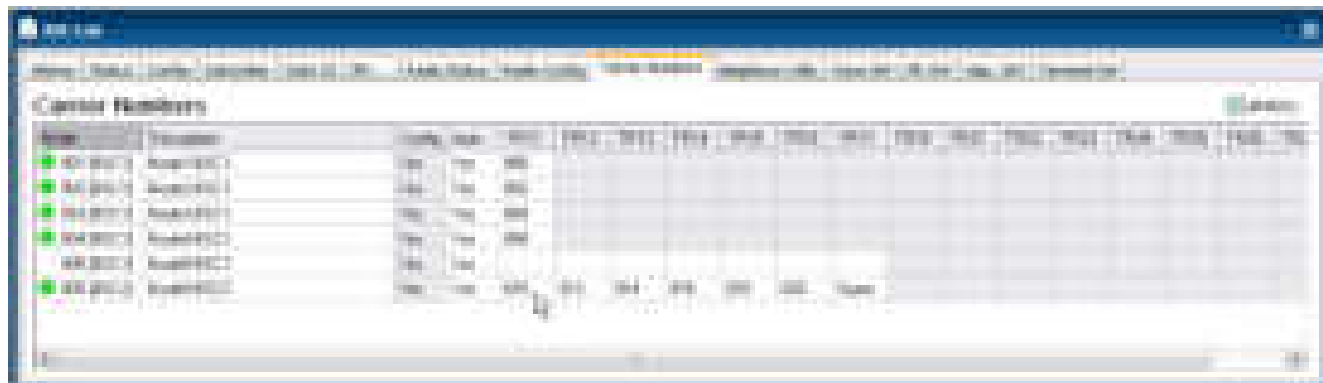
- RDT - Radio Downlink Timeout: This it is a measurement of the downlink quality. The higher the RDT value is, the longer the MS stays on a channel with bad quality. Factory setting middle value (1152TS).
- SRT - Slow Reselect Threshold above fast (Factory setting 10dB)
- FRT - Fast Reselect Threshold (Factory setting 12dB)
- SRH - Slow Reselect Hysteresis (Factory setting 10dB)
- FRH - Fast Reselect Hysteresis (Factory setting 10dB)

The parameters **SRT**, **FRT**, **SRH** and **FRH** are for network planning and are defining the behavior of MS cell reselection in a multi node system. The parameters are explained in details in the ETSI EN 300 392-2 is chapt. 18.3.4.4 "Ranking of neighbour cells" And 18.3.4.5.x "Criteria used during cell reselection":

Unless there are troubles with MS cell reselection the factory settings should not be changed.

- Sub. Class - Subscriber Class (Class 1-16 , default all class present). These parameters can be programmed in the MS to match the bit pattern of a radio cell to obtain a preferred radio cell to connect to.

### 3.3.4.6.9 Carrier Numbers



- Auto – Auto convert primitives and frequencies – “Yes” the freq. and carrier number go together – “No” the freq. and carrier number can be set independent of each other.

By right click in one of the TRxx carrier number columns the TR Frequency Configuration window comes up:



- Spare – Preferred to set to Normal TR operation or TR Hot spare witch in case of a TR fault will switch to the spare TR (with the same Freq. settings)
- RX frequency – Receive Frequency setting \*
- TX frequency – Transmit Frequency setting \*
- CarrNo – Carrier Number Allows configuration of the carrier number on the node. The carrier number is related to the frequency band selected in the radio configuration menu. E.g. FreqBand: 400Mhz and Carrier number: 800 gives Tx freq. = 420,00 Mhz ( $800 \times 25\text{kHz} + 400\text{Mhz} = 420\text{Mhz}$ )
- Band - Base frequency band
- Offset - Frequency offset (default 0 kHz)
- DuplSpace - Duplex spacing (default 10 Mhz)
- Rev – No: Definition of standard (TX highest) or Yes: Reverse ( TX lowest) operation



\*) If the auto convert flag is set, then only freq. which are derivable from Tetra primitives are allowed (follows Carrier Number).

#### 3.3.4.6.10 Neighbor cells

Configure the neighbor cells as auto (recommended for small systems covering a uniform area) or manual (recommended for larger systems or small systems covering a line, ex, a highway or a railway etc).

Right mouse click on the following items allows change of the configurations.

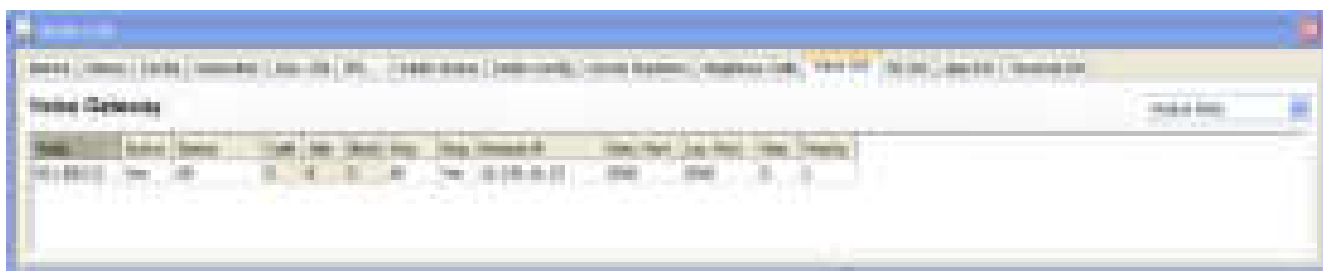
- Mode
  - Change between “Auto (All cells)” and “Selected cells only”
- N1 to N16
  - Neighbor cell setup for the specific node

The following is information only

- Active
  - Activation status of the cell


The drop down Active Radio cells / All nodes changes between display of active nodes only, or both active and not active nodes

#### 3.3.4.6.11 Voice GW



Right mouse click on the following items allows change of the configurations.

- |             |  |
|-------------|--|
| • Active    | Activation of GW (yes or No)                             |
| • Org.      | Gateway organization number that are allowed             |
| • Reg.      | Selection if GW should register at the SIP device or not |
| • Remote IP | IP address of SIP device                                 |

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- Rem. Port                      Remote port number. Default 5060
- Loc. Port                      Local port number. Default 5060
- Max.                            Restriction of simultaneous calls. Must be equal or less than defined in the dongle
  
- Priority                        Priority of Voice GW calls (0-15)

The following is information only:

- Status                        Status of GW functions. By right mouse click you can also acknowledge and unacknowledge alarms
- Call                            Number of active calls
- Idle                            Number of free GW
- Block                        Number of blocked GW

The drop down box “Active GWs” / “All nodes” changes between display of active nodes only, or both active and not active nodes. See also section 2.12 *Voice Gateway* for Voice Gateway configuration.

#### 3.3.4.6.12 SIP Setup

This setup describes the configuration needed to setup the system for SIP operation

The PABX samples are shown for the Innovaphone IP800, but may be any SIP compatible device. Please consult the user manual and technical staff for the device in question.

The TetraFlex system needs at least one Voice Gateway configured on any node available to operate with a PABX.

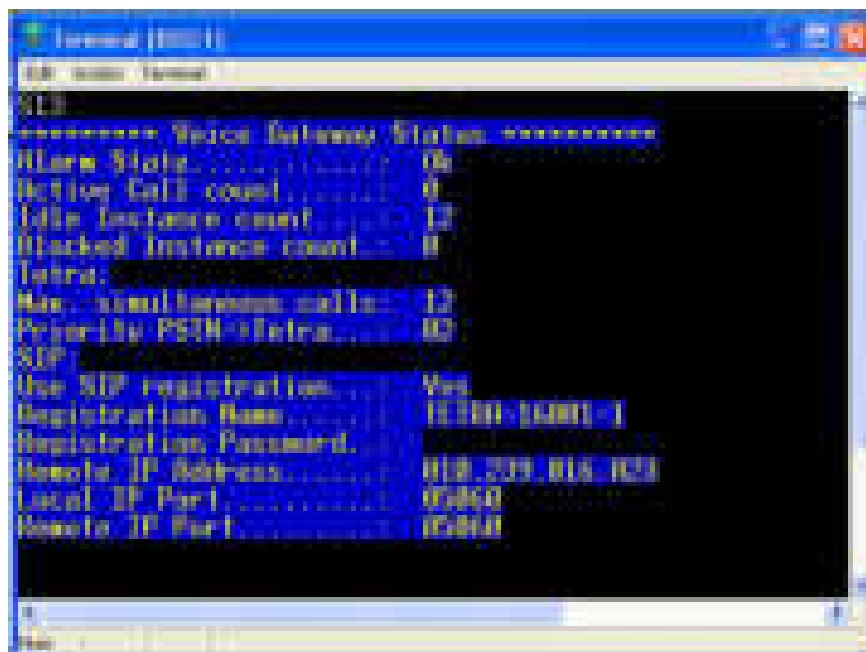


Figure 3-17: OM command S13 - Voice Gateway Status

To configure a Voice Gateway, use the NM application or use the TetraOM as described here (SIP registration name and password can only be set by OM commands):

- The SIP registration name (Alias) must be unique and can be generated by the OM command **"S73/NAME/<SIP registration name>"**. e.g. **"S73/NAME/TETRA-16001-1"**. You can also set registration name with the BSCGui-BSS VoiceGW. The name must be entered as the SIP Alias name into the PABX as well.
- The SIP registration password is optional and can be generated by the OM command **"S73/PASSWORD/<password>"**. e.g. **"S73/NAME/"** (blank means no password). You can also set the Password with the BSCGui BSS VoiceGW. The password must be entered into the PABX as well.
- The Voice GW must be assigned a node number to attach to. This can be setup in NM - Subscriber register in the various profiles where PABX access is wanted or by using the TetraOM command **S21/"Profile No"/VGNODE/"x"/"Node Number"** Where x is 1 for primary GW and x is 2 for alternate GW.
- SIP registration must be set to YES, use NM or TetraOM command **S73/REG/+**
- Remote IP address is the IP of the Voice GW (e.g. IP800). Use NM or TetraOM command **S73/IPADDR/xxx.xxx.xxx.xxx**
- Voice GW must be activated. Use NM or TetraOM command **73/CNFG/+**
- Organization – can be set to allow all or some organization to make call to through the Voice GW.



- All – all organizations are allowed
- If you specifies an organization ex. 1 only this is allowed
- B- number prefix, The Org. number for the subscriber is set in front of the dialing number so that the PABX can route this according the org. number.

#### 3.3.4.6.13 PD GW



Note: Use of Packet Data GW's must be set in the Node Dongle.

Right mouse click on the following items allows change of the configurations.

- Active - Gateway activated (can be deactivated by right clicking)
- Status – Right click to acknowledge or unacknowledge alarms
- RIPv2 – “Yes” RIPv2 is used – “No” Static routing is used
- Mobiles – Information field that shows actual numbers of active mobiles with packet data communication.

A drop down box allows the view to shift between All Nodes and Active Cells

For details on the Packet Data configuration please see section 2.13 *Packet Data Gateway*.

### 3.3.4.6.14 App GW



Name	Description	Config. Status	Conn. Max	Streams Max	Timeout	Discr.
App GW (1)	App GW (1) - Gateway 1	Yes	10	10	10	Yes
App GW (2)	App GW (2) - Gateway 2	Yes	10	10	10	Yes
App GW (3)	App GW (3) - Gateway 3	Yes	10	10	10	Yes
App GW (4)	App GW (4) - Gateway 4	Yes	10	10	10	Yes

Note: Number of application GW's must be set in the Node Dongle and an API dongle must be present in the client PC. DAMM Dispatcher application uses the application GW and uses one connection. To run the Dispatcher a Dispatcher dongle must be present in the PC where the dispatcher is running.

Right mouse click on the following items allows changing the configurations.

- Config - Gateway configured (can be deactivated by right clicking)
- Status – By right click - alarms can be acknowledged
- Conn. Max - Max connection count, can be changed by right click on it up to the max. in the dongle. One Dispatcher connection is one connection.
- Streams max. – Max. number of circuit streams for all connections on the Application gateway
- Timeout – Connection timeout in minutes.
- Discr. – Discreet listening enables or disables discreet listening on the Application gateway e.g. used in the dispatcher.

The following is information only

- Conn. - Active connections
- Streams – Active streams
- Version -Protocol version (the API used must be with the same version)

A drop down box allows the view to shift between All Nodes and Active Cells

For details of the API configuration please see section 2.14 Application Gateway for setup of the gateway. For details about the API itself, please refer to the .h document and to the API tool box application.

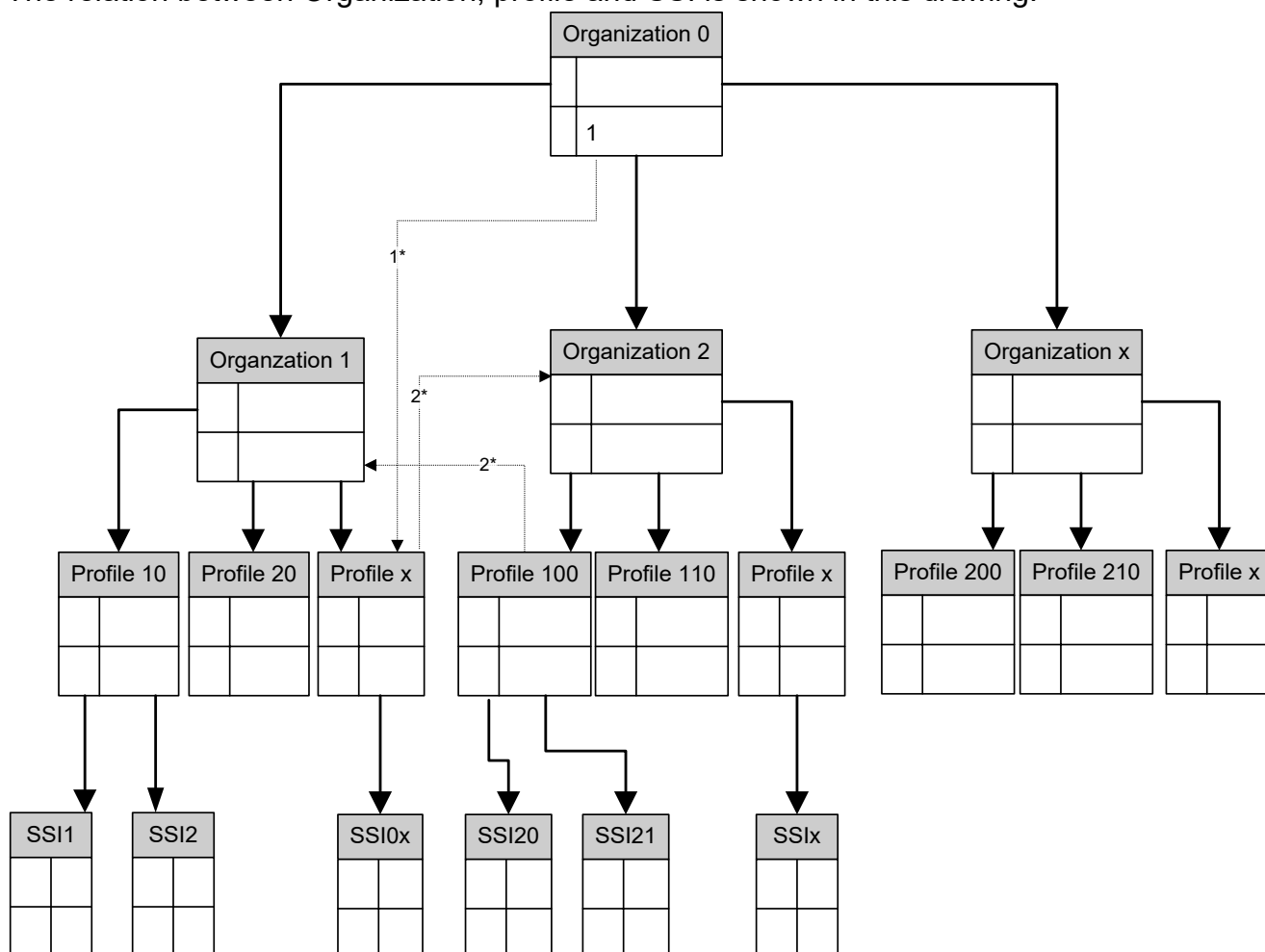
### 3.3.5 Subscribers

#### 3.3.5.1 Subscriber definition

The subscriber window is divided into 4 parts

- Organization (Maximum 1000 organizations)
- Profile (Maximum 2.000 profiles standard and 10.000 in optional enhanced ver.)
- Subscriber (Maximum 20.000 subscribers and 150.000 in Optional enhanced ver.)
- Sec. Key (Security Key Update)

The relation between Organization, profile and SSI is shown in this drawing:



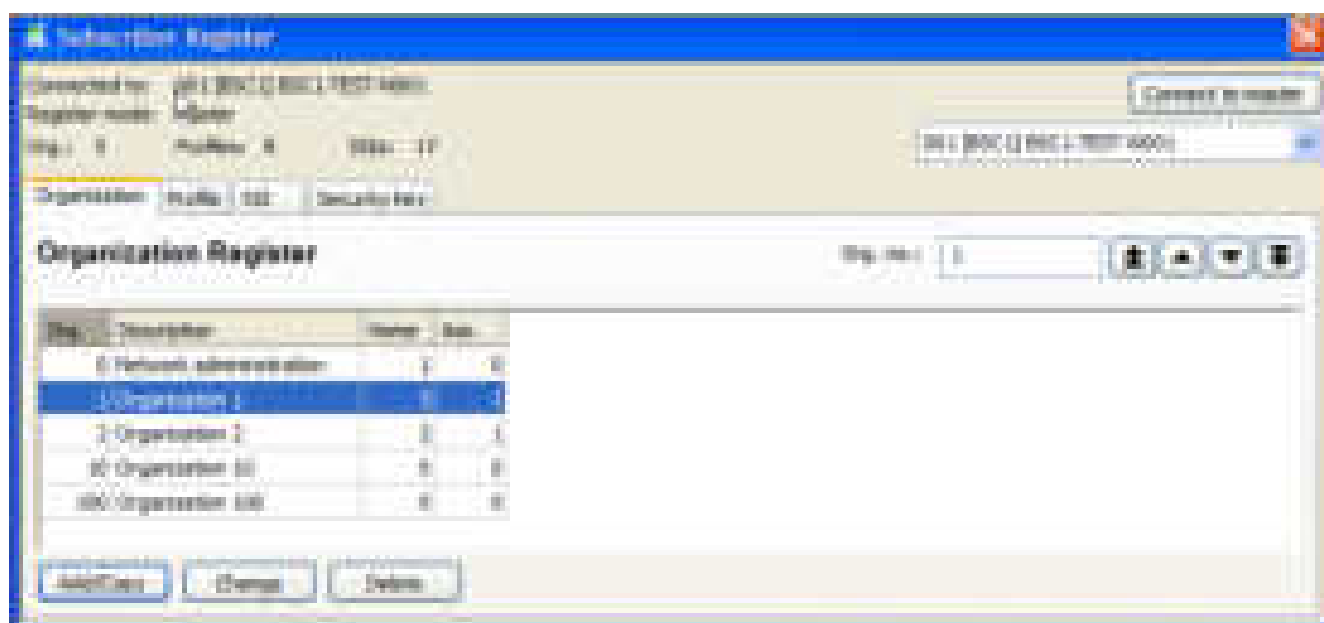
A SSI is related to one Profile and a profile is related to one Organization.

1. A Profile can also be connected to org 0.
2. A profile can also be associated to different organization (see "Profile" - "Associated organizations").

### 3.3.5.2 Organization

The TetraFlex® System enables several organizations to share one TETRA Network as each of these organizations can use the services as if they were the sole user of the network. The radio users, groups, and call rights within each user organization can be controlled independently.

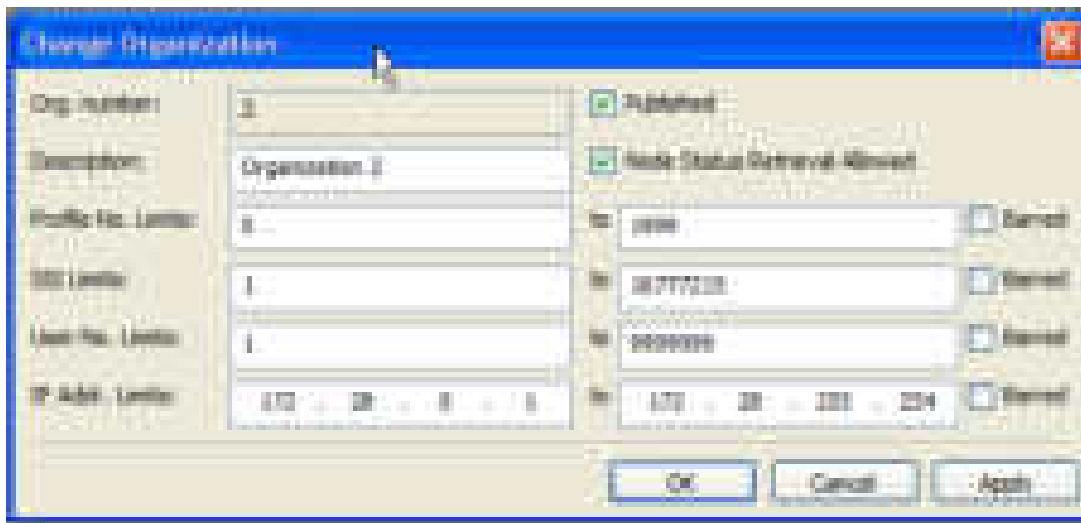
Organization 0 is intended for the network operator and this Org. can “see” all other organizations. It is also possible to connect Profile/SSI to org. 0, but this should be used for network administration purpose only or as the “master” or “Home” organization.



The main window allows the user to Add/Copy a new organization, change an existing organization or delete an organization.

Add/Copy and Change functions are similar except that in the Change function the organization number cannot be accessed.

By double click on an organization or push the button “Change” the Change Organization dialog comes up:



- **Org. Number:** The number of the organization. This must be unique and at least org. 0 must always be present. If connecting an API Application or the Dispatcher to org. 0 it is possible to change all org. settings from this application.
- **Description:** Is a free text field for organization description
- **Published:** If checked the organization is published towards all API applications and the Dispatcher even if they are not a member of this organization. API applications and the dispatcher always get the organization properties for the organization they are connected to.
- **Node Status Retrieval Allowed:** If checked the Node status can be shown on a API application and the Dispatcher
- **Profile No. Limits:** If barred is checked, no profile can be generated from an API application or the dispatcher. Existing profiles can always be edited. New profiles must be within this range.
- **SSI Limits:** If barred is checked no SSI can be generated from an API application or the dispatcher. Existing SSI can always be edited. New SSI must be within this range.
- **User No. Limits:** If barred is checked no user no. can be generated from an API application or the dispatcher. Existing User no. can always be edited. New User no. must be within this range.
- **IP Addr. Limits:** If barred is checked no IP address can be generated from an API application or the dispatcher. Existing IP addresses can always be edited. New IP addresses must be within this range.



### 3.3.5.3 Profile

It is recommended to use intervals in the profile number series e.g. 100, 110 ... 200, 210, and so on, as profile number. This will make it possible to create sub-profiles if needed.

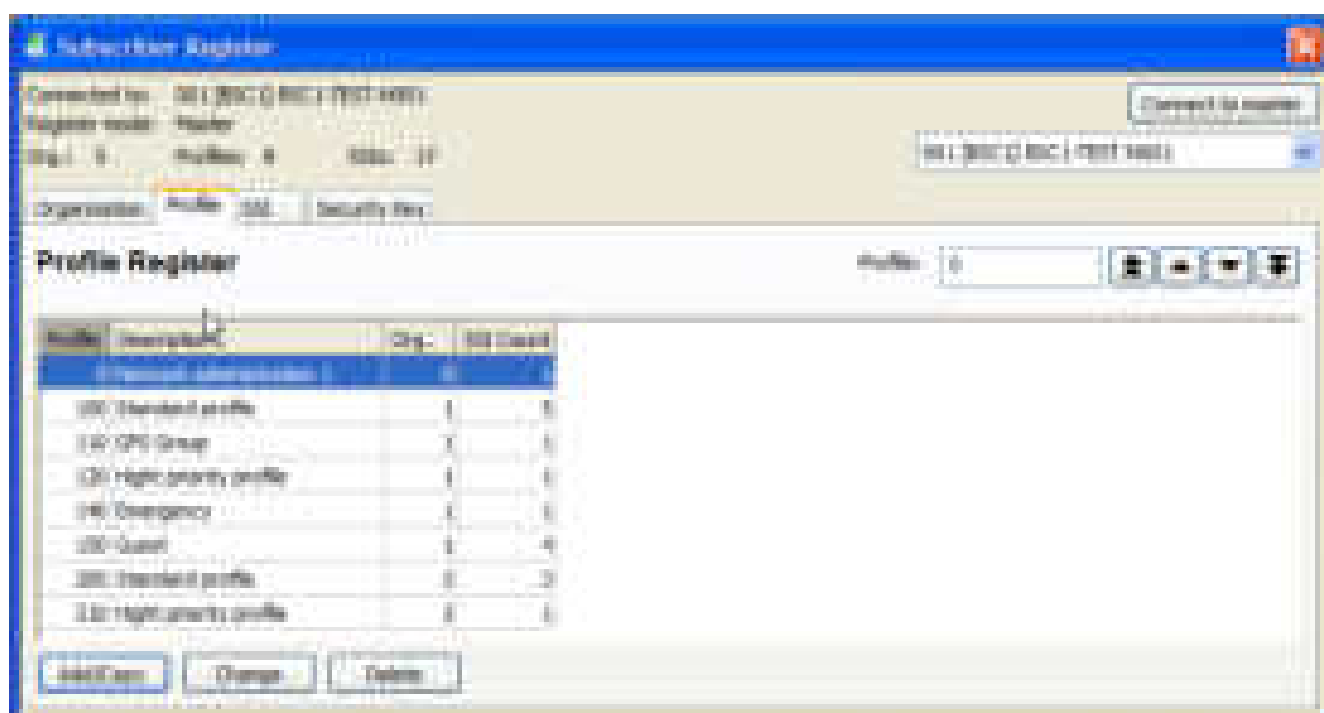
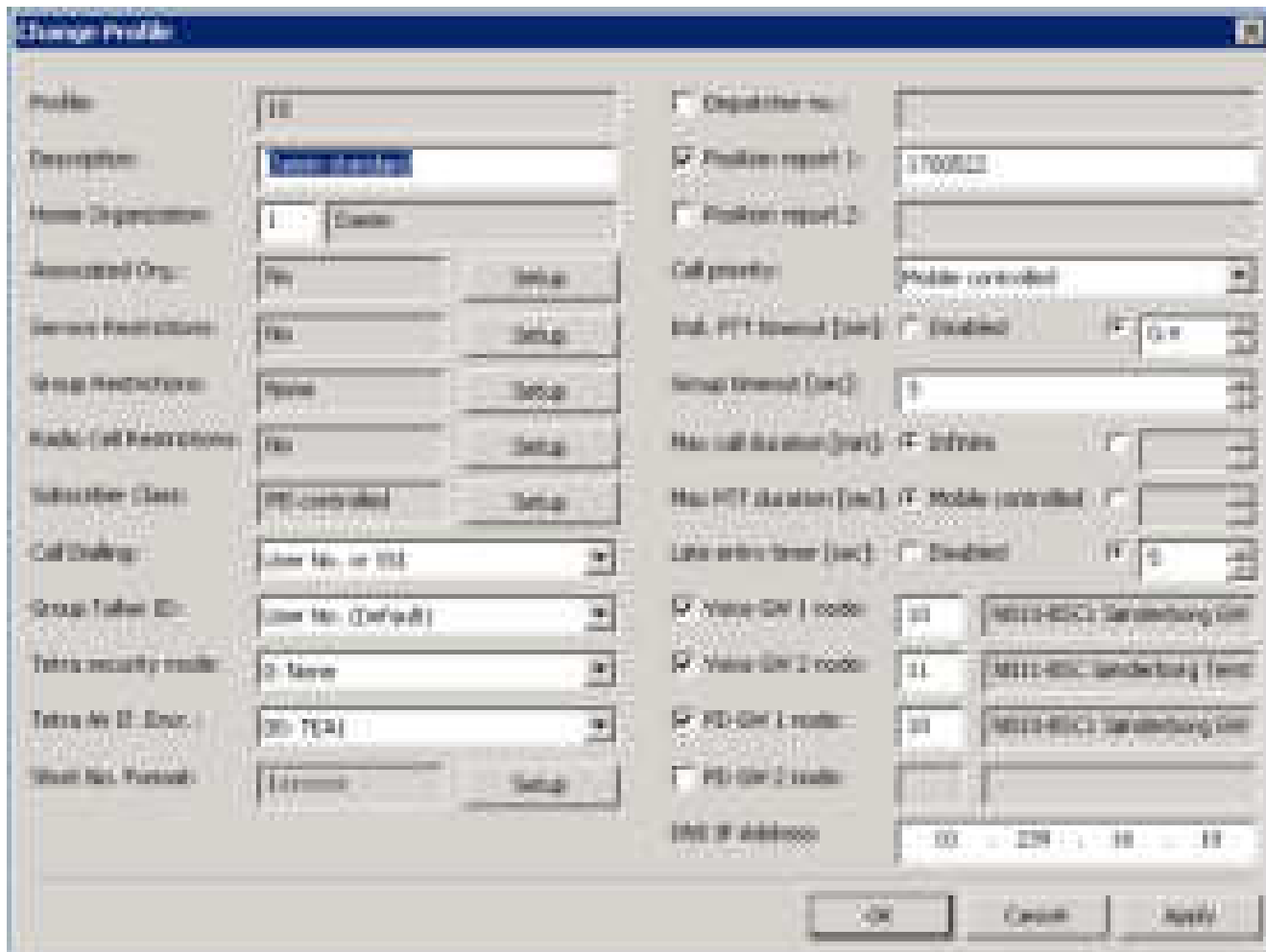


Figure 3-18: Subscriber Profile

The main window allows the user to Add/Copy a new profile, change an existing profile or deleting a profile.

Add/Copy and Change functions are similar except that in the Change function in the profile number cannot be accessed



**Figure 3-19: Subscriber profile configuration**

The following configurations are possible

- **Profile number**

The number assigned to the profile and used by the subscriber setting a reference (only valid in the Add/Copy function)

- **Description**

The logical profile name related to the profile function.

- **Home Organization**

The organization number is a 3-digit number and is recommended as default to be the first 2 digits of the 4-digit Profile number. E.g. org. 01 -> profile 0100...0199, org. 02 -> 0200..0299, but there is no binding and is free to organize in the way your organization needs.

The Organization number 0 has the meaning “All”, and can be used in Profiles for system administrators or for all Profiles in systems without Organization division.

- Associated organizations

Organizations associated with each other will allow calls between the associated organizations.

Association must be done mutually in both organizations

- Service restrictions

Option to restrict the services for a given profile regarding Mobile, Dial-in and application behavior. The restrictions are active when the “Active service restrictions” field is checked.

The Allow field can be Yes, No or CAD (Dispatcher decide if the call shall pass - Call Authorized by Dispatcher).

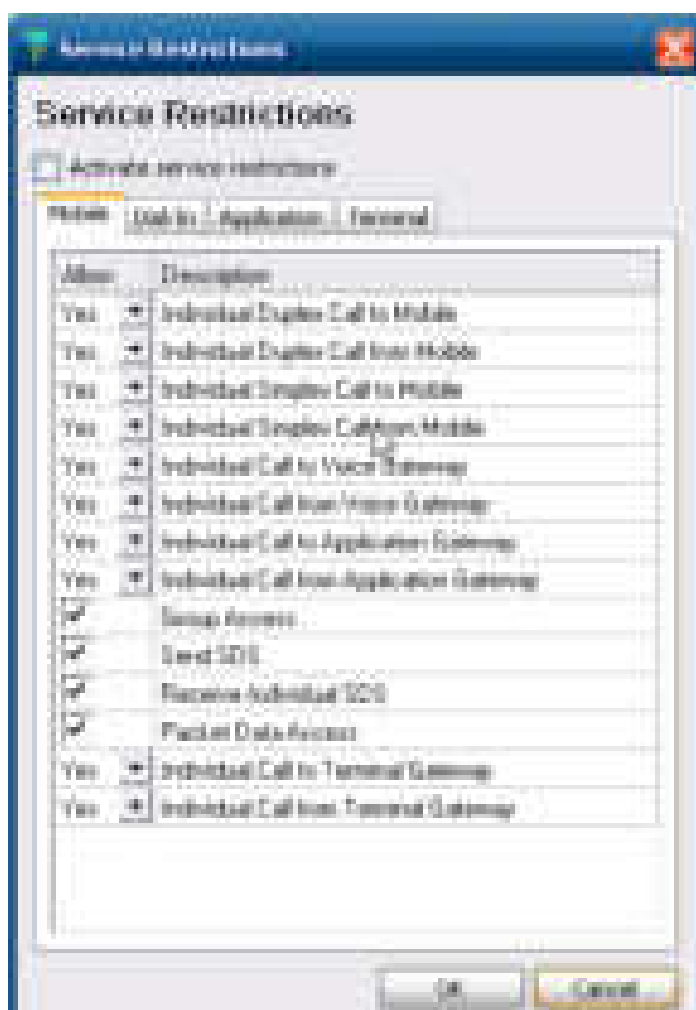
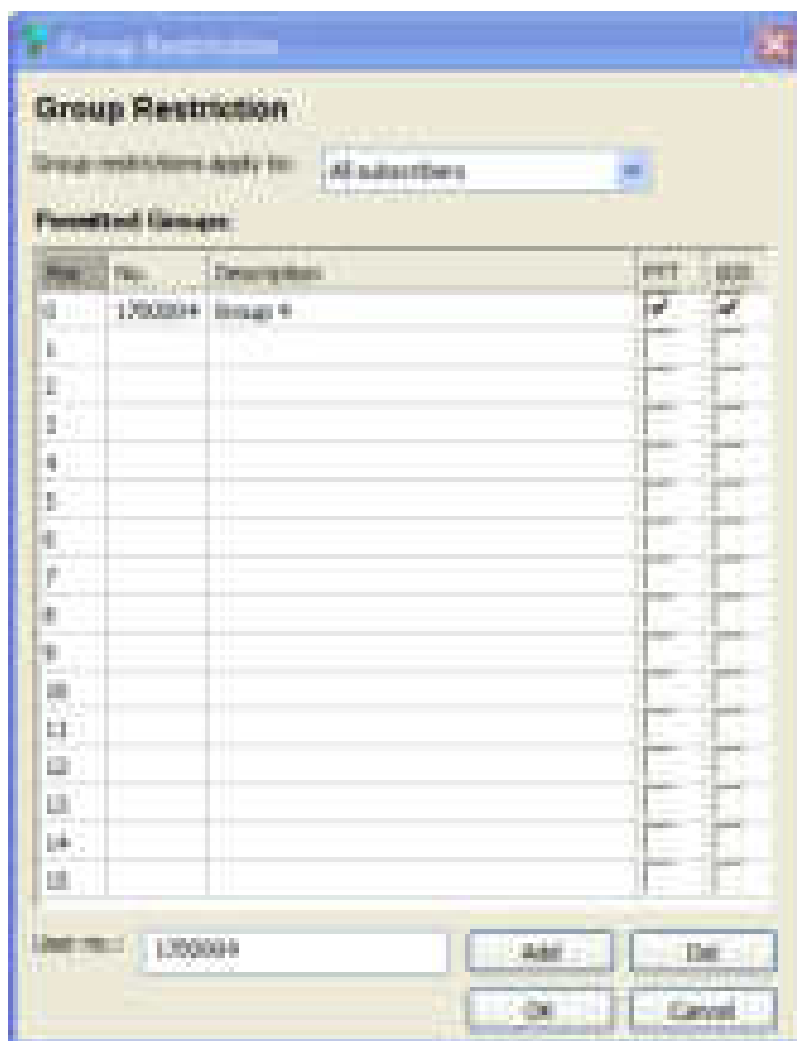


Figure 3-20: Service restrictions

- Group restrictions

Definition of PTT and SDS restrictions related to the groups in the profile



The “Group restrictions apply to” can be set to *None* (no restriction) *All Subscribers* and only *Dial-in Subscribers*.

If set either to all Subscribers or Dial-in Subscribers only groups in the list can be accessed in the organization the profile belongs to.

- Radio cell restriction

Radios belonging to this profile are allowed to attach the checked nodes

This restriction is only active when the *Activate radio cell restrictions* check mark is set. The *All Nodes* button toggles between active nodes and all nodes.



Figure 3-21: Radio cell restrictions

- Subscriber class

Definition if subscriber class is mobile controlled or defined in the profile

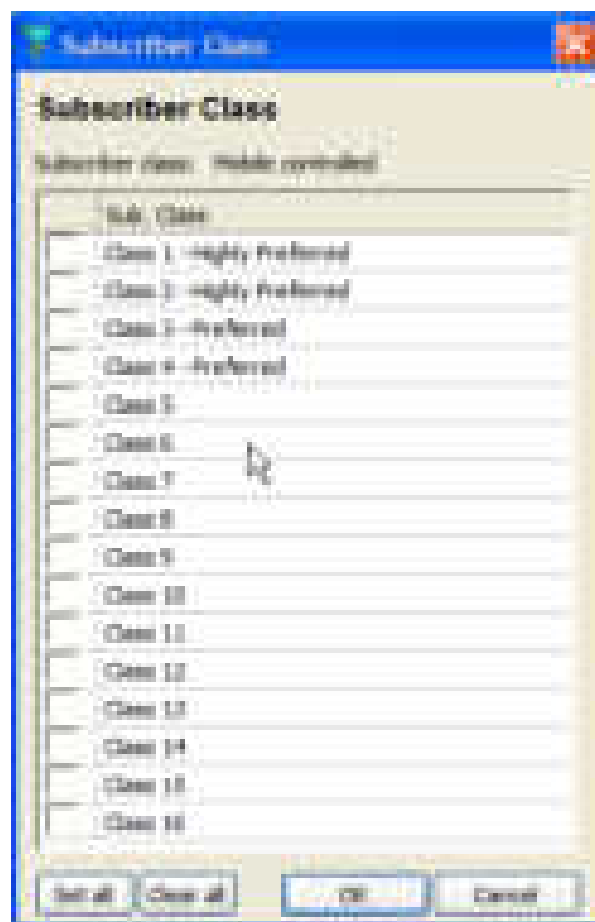



Figure 3-22: Subscriber class

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It is possible to set 16 bits in the subscriber class field of the node. 1st bit signaling support of class 1, 16th bit signaling support of class 16. Bit 1 and 2 are signaling "highly preferred", 3 and 4 are signaling "preferred", rest is "normal". Having all 16 bits set will allow any MS to attempt registration.

The purpose is to have MS registering only with radio cells with matching subscriber classes. I.e. a MS with class 16 - will only try to register with a cell supporting class 16. If a MS has class 2 and class 16 it will prefer a cell with class 2 support before looking at cells with class 16 support.

A MS has a subscriber class programmed. If in the profile setup "MS controlled" is selected, it is the MS's programming that decides about which nodes the terminals will try to attach to.

If defined in the profile, the MS will receive notification from the node about a new set of subscriber classes to work with.

If defined in the profile, the shown options apply

- Call dialing

Determines whether calls uses the SSI programmed into the terminals or may use either SSI or user numbers defined in the subscriber register.

- Group talker ID

Can be selected for certain brands of terminals to display group caller ID correctly

- Tetra Security mode

Selection of the applicable security mode



**Figure 3-23: Profile security mode**

- Tetra Air Interface Encryption (AIE)

Selection of the applicable Tetra Encryption Algorithm.

TEA1 and TEA3 are by default delivered with the system, but is dongle controlled.

TEA2 is only delivered upon presentation of a valid permission to use this TEA

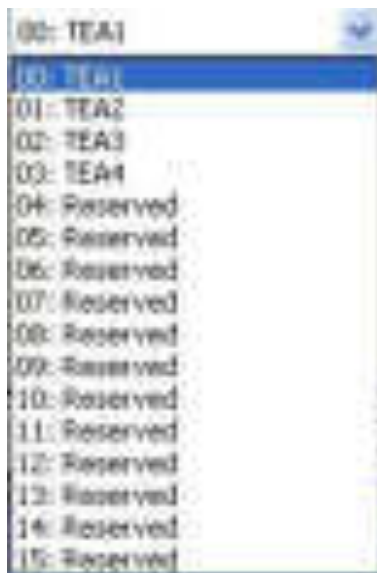


Figure 3-24: TEA details

- Short No. Format


Enabling user short number for the profile and definition of short number



Figure 3-25: Short number details

Example shows that the short number is 6 digits with 1 preset  
E.g. 234598 place a call to 1234598

- Dispatcher number

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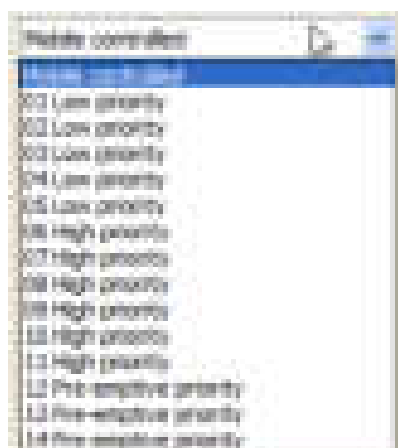
Number of the dispatcher which must be used for an instance error report, Dispatcher controlled PSTN call requests (CAD) etc.

- Position report 1 and 2

User Number of the Dispatcher where position report from a Terminal Gateway client like the TetraFlex Android Client is sent to. It is possible to define two Dispatcher user number one for Position report 1 and one for position report 2. Positions report from the Terminal Gateway is not send as a SDS like the positions report from a Tetra Radio, but is send on the control channel each time the BSC is requesting a registration update from the Clients that are connected.

- Call Priority

The call priority for all SSI belonging to this profile  
May be selected for 1 to 14 or set to mobile controlled (mobile programmed priority is in use)




01 is the lowest priority and 14 is the highest (priority 15 - pre-emptive can be programmed in the radios and are used for alarms). Pre-emptive priority means that the call will take over a timeslot already in use in case of all timeslots are occupied.

Call priority is used inside the SwMI to “compare” the importance of a new call, while some other calls (or packet data transmissions) are ongoing on some timeslots. As long as timeslots are available, the Call priority is ignored and the call is established.

If a new call is initiated while all timeslots are occupied, the active timeslot with the lowest priority will be searched and compared against the new call’s Call priority. If the new Call priority is pre-emptive (i.e. Call priority  $\geq 12$ ) and higher than the ongoing call’s priority, pre-emption takes place and the new call will be established on that timeslot after the old call is completely released. Otherwise, the new call request will be queued in the call queued section (visible in the OM display, see S12/TS).



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If more than one call is queued and a timeslot gets available, the call with the highest priority will be chosen from the queued list.

In addition to this SwMI internal usage of the Call Priority, the Call priority is also sent towards the called mobile/mobiles. It can be used there for display purposes (i.e. special sign and alerting tone for Emergency calls), and it can be used for deciding how to handle a second call, if the mobile is active in a first call (see e.g. the attached description of Sepura mobiles and TTR001-12 Service Interaction).

Note that the number of queued calls is limited to a hardcoded limit (current limit is 2 queued calls).

Note that the requested PTT priority from the uplink can be overwritten by the requesting MS's profile and/or by the called group's profile via the NM/OM.

**Timers** – Timers are mainly used to restrict unwanted time consuming use of timeslots

- Indi. PTT timeout (individual PTT calls timeout)

The timeout for using the PPT for individual call. Can be Disabled or selectable from 1 to 25 minutes

- Group Timeout

Time from last PTT is released to group call shut down.

Selectable from 0 to 20 seconds

0 sec. is valid, but use with care as this could increase load on the MCCH

- Max Call Duration

Maximum duration of the call before shut down

Infinite or Selectable from 1 to 250 minutes

- Max PTT duration


Maximum time of the PTT

Mobile controlled or selectable from 2 to 250 seconds

- Late entry timer

Disabled or selectable from 1 to 60 seconds. This means a radio can join a group with a late entry to an ongoing group call selectable from 1-60 seconds.

Voice GW Setup:

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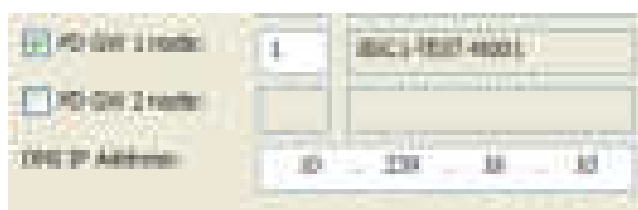
Voice Gateway connection node number



- Voice GW 1 node is the Primary node and Voice GW 2 node is the redundant node

See section 3.3.4.6.11 for Voice GW setup and test

Packet Data GW Setup:



PD GW connection node

- PD GW1 is the Primary node and PD GW 2 is the redundant node

See section 3.3.4.6.13 for Voice GW setup and test

DNS IP address


Used by Packet Data setup.

If used, the DNS IP address must point to a DNS server within the network to which the system is connected. It cannot point to a DNS server on e.g. the internet.

#### 3.3.5.4 Subscriber Common settings

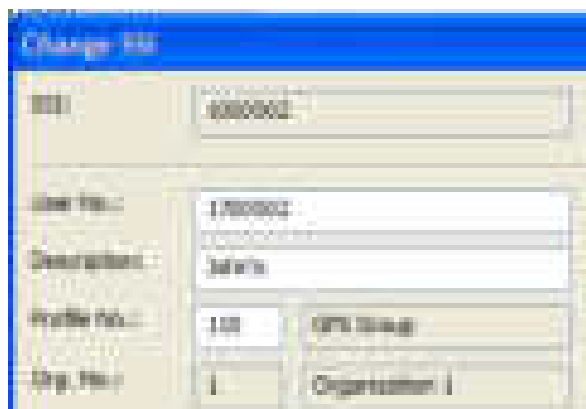
The subscriber definition fields are dependent on the type of subscriber selected in the *SS/ type* field:

- SSI Type  
Mobile

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Group  
 Application  
 Dial-In  
 Emergency  
 Terminal (for future use)  
 Personal (for future use)

The following fields are the same for all types of SSI's:



- SSI
 

This is a unique subscriber id - typical the number programmed into the terminal or the number defined for dispatcher or a group. The SSI number must always be assigned to a subscriber and the system doesn't allow using the same SSI number more than one time. The field will be marked yellow when trying to type in the same SSI number twice.
- User Number
 

The unique user number assigned to the subscriber. The user number can be used instead of the SSI number to address a subscriber. The system doesn't allow to using the same user number more than one time. The field will be marked yellow when trying to type in the same SSI number twice.
- Description
 

The description of the SSI. This is a text and it is optional to use.
- Profile number

The profile number of which the subscriber is a member. The profile description (if there is any) is automatically shown when the profile number is entered. Only existing profile numbers can be used.

- Organization number  
Automatically shown when profile number is entered. The organization description (if any) is automatically shown when the profile number is entered.

#### 3.3.5.4.1 Mobile subscriber

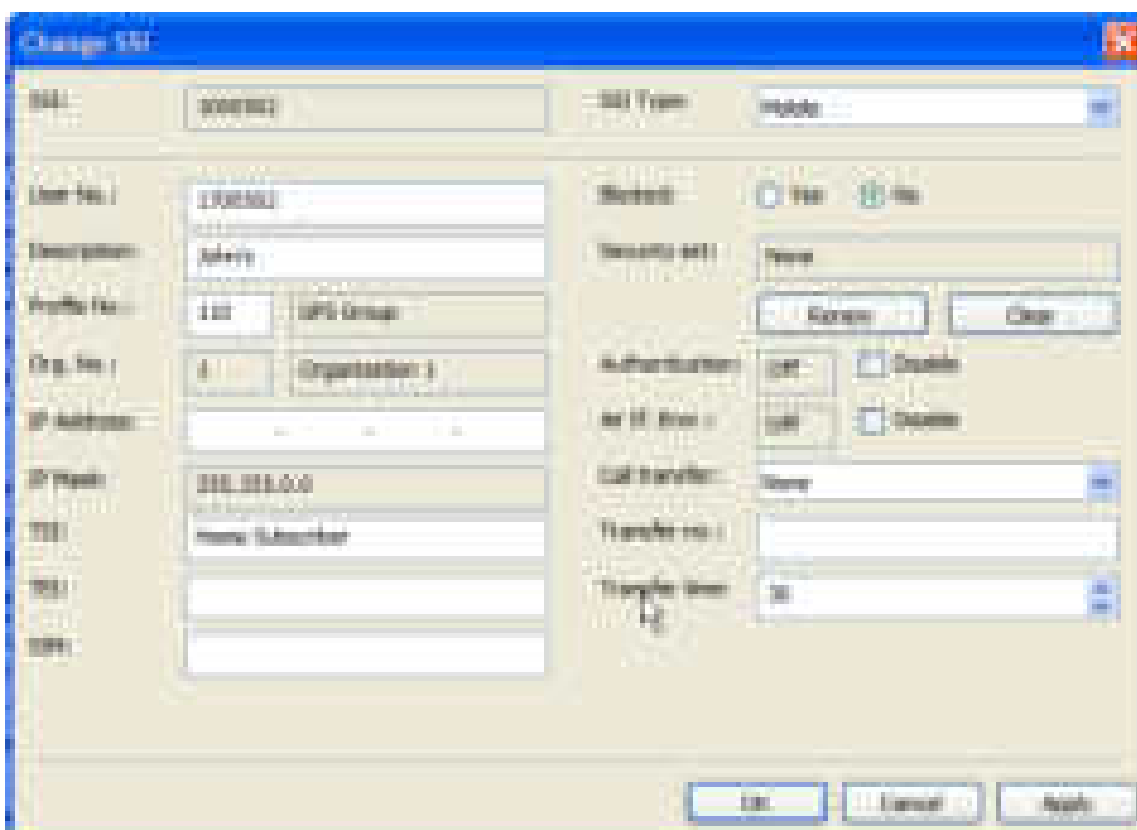


Figure 3-26: Subscriber details

- Blocked  
Select to block the radio access to the infrastructure (Temporary disable)
- IP Address

If packet data is used, the IP address assigned to the terminal. In the terminal itself the IP address must be set to 0.0.0.0

- IP Mask
 



Display field – shows the Subscriber IP Address segment used for packet data, predefined via TetraOM, BSC-GUI or Network Management
- TSI Tetra Subscriber ID (Prepared for future use, not active in this version. Only home subscriber can be added)
 

Is composed from MCC: MNC: ISSI  
 This field allows a terminal not belonging to the network to be added without having to reprogram the terminal. The terminal is assigned an ISSI and user number in the normal manner.  
 If not used, TSI will display “Home Subscriber”
- TEI
 

If authentication is used, the correct TEI for the terminal must be entered  
 It is highly recommended always to use the correct TEI. This will avoid redefining the whole subscriber register in case that authentication is activated at a later time.
- SIM
 

SIM number for SIM authentication
- Blocked
 

Restrict the mobile from attaching to the system
- Security set
 

Date and time for last security set update for this subscriber  
 May be  or  using the appropriate buttons
- Auth.: and Air If. Encr.:
 

These fields show the actual status. In case either one is assigned as optional, the function may be selected or deselected by removing or setting the disable options
- Call transfer
 

Selection of call transfer type



**Figure 3-27: Call Transfer details**

- Transfer number

The number to which the call is transferred

- Transfer time

The time to transfer if not using the unconditional setting

#### 3.3.5.4.2 Group subscriber

##### Additional fields in group subscribers

- Group Text

If the subscriber is a group subscriber, the field will be available for entering the Group Text

This text will be transferred to the group list in the terminals if the group is assigned as a DGNA group

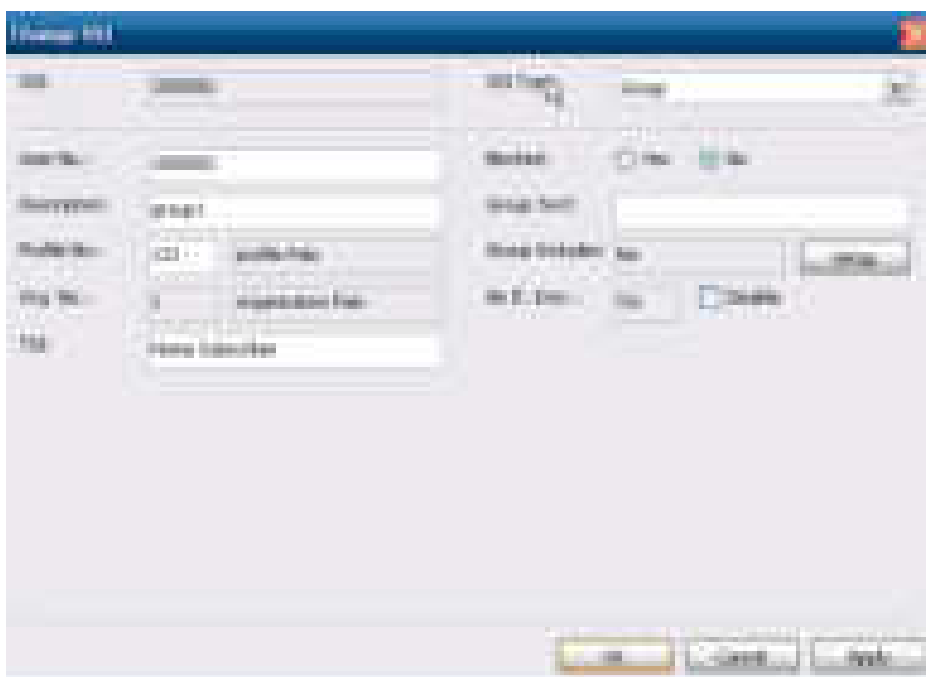
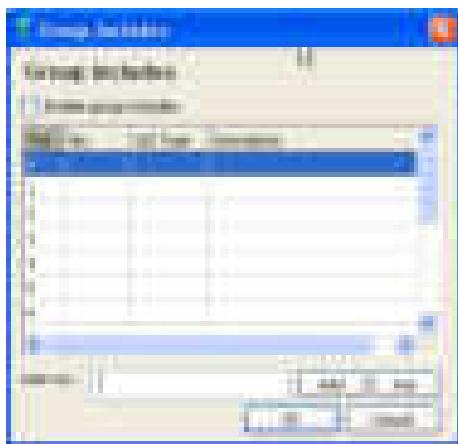


Figure 3-28: Group subscriber

- Group includes

Option to include other user numbers in the group



**Figure 3-29: Group include**

Group include means having possibility to establish a layer of groups so to speak.  
Example:

Group 1 Ambulance  
Group 2 Police  
Group 3 Disaster management

Group 3 is set up with group include on Group 1 and Group 2

Function will be:

Group 1 PTT is heard in Group 1  
Group 2 PTT is heard in Group 2  
Group 3 PTT is heard in Group 1, Group 2, and Group 3. Members in Group 1, Group 2, and Group 3 can answer. When call times out, Group 1 and 2 can no longer hear each other.

So group include is a sort of temporary connection of the included groups, where the connection is triggered from the including group.

### 3.3.5.4.3 Application subscriber

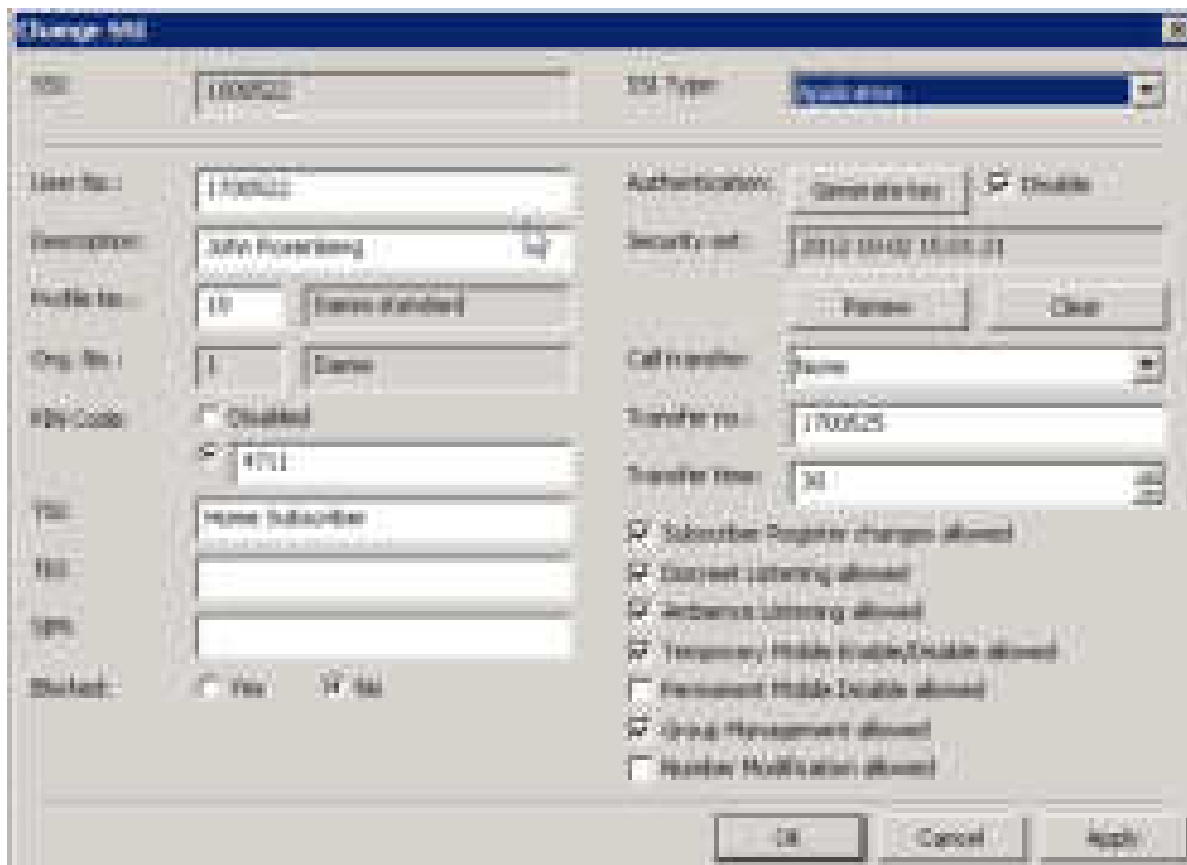



Figure 3-30: Application subscriber

- Pin Code
  - PIN disabled: No Pin requested
  - PIN entered: Pin must be entered or defined in the configuration file from the API / dispatcher connection before it is allowed to connect.
- Authentication
  - Generate key – this function generates an Authentication key that can be used for authenticate an API client or Dispatcher on the TetraFlex network. The generated key must be send from the Dispatcher / API client when trying to connect to TetraFlex. When **Disable** option is active the authentication key is not needed for connection. The **Renew** function renews the distributed key sets. This should be updated at regular intervals. For more information se chapter Authentication and Encryption 3.4. The **Clear** functions clears the authentication code
  -
- Subscriber Register changes allowed.:



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Selects if the subscriber register can be changed/edited from the API client / Dispatcher

- Discreet listening allowed.:

Enables / Disables discreet listening on individual calls from the API client /Dispatcher. Dongle license must be present

- Ambient listening allowed.:

Enables / Disables ambient listening from the API client /Dispatcher (ambient listening makes it possible to open the microphone and transmitting on MS without pushing PPT and without transmission indication on the MS). Dongle license must be present

- Temporary Mobile Enable /Disable allowed.:

Temporary enabling / disabling of MS from the API client /Dispatcher

- Permanent Mobile /Disable allowed.:

Permanent disabling of MS from the API client /Dispatcher.

**Warning: This is a non-reversible function; the MS cannot be enabled again without sending it to the manufacturer**

- Group Management allowed.:

Groups can be managed from the API client /Dispatcher. This is used for DGNA

- Number Modification allowed.:

Used for “sending on behalf of” ex. if an API application receives a call from a MS and the number of the MS should be shown for the receives instead of the number of the API application.

#### 3.3.5.4.4 Terminal subscriber

A terminal subscriber is used for connecting a TetraFlex Client (DAMM Application running on Android devices) or a Group Bridge (DAMM application running on Windows devices).

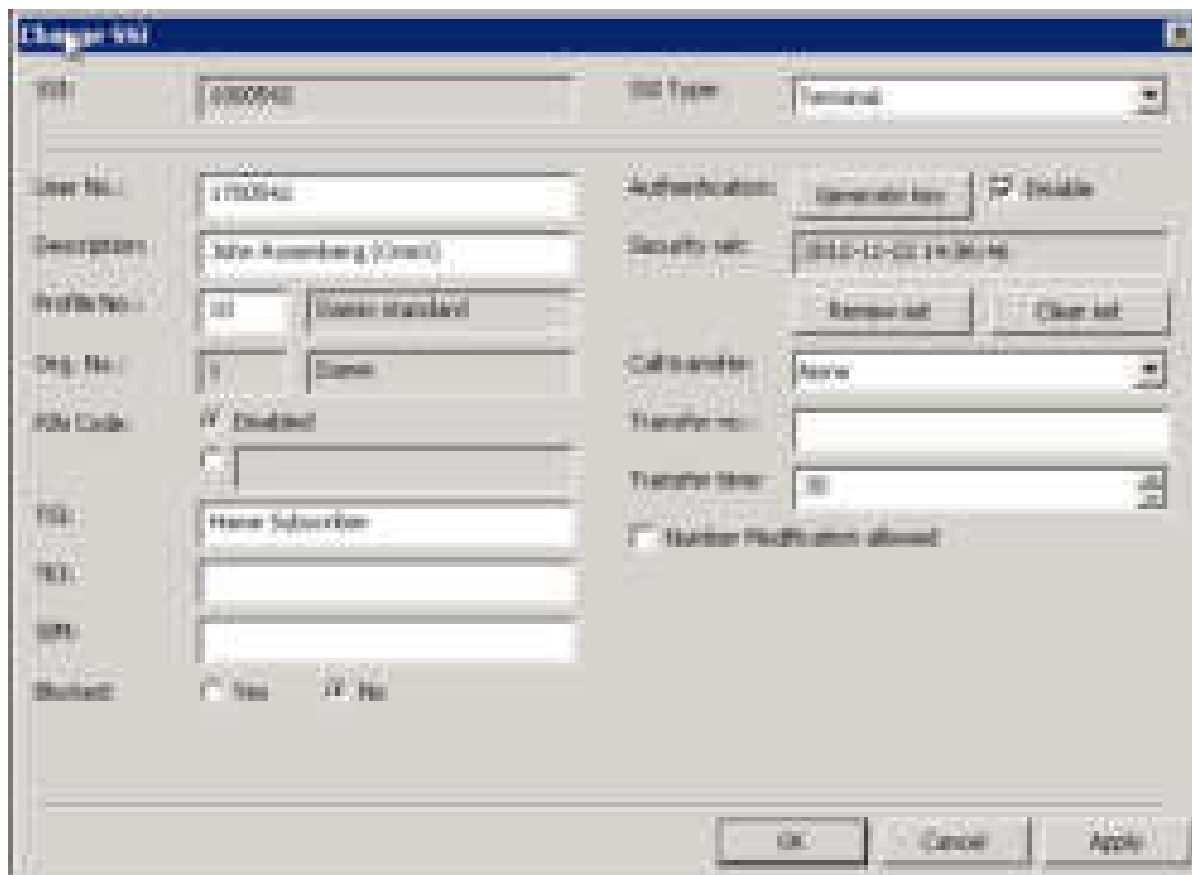
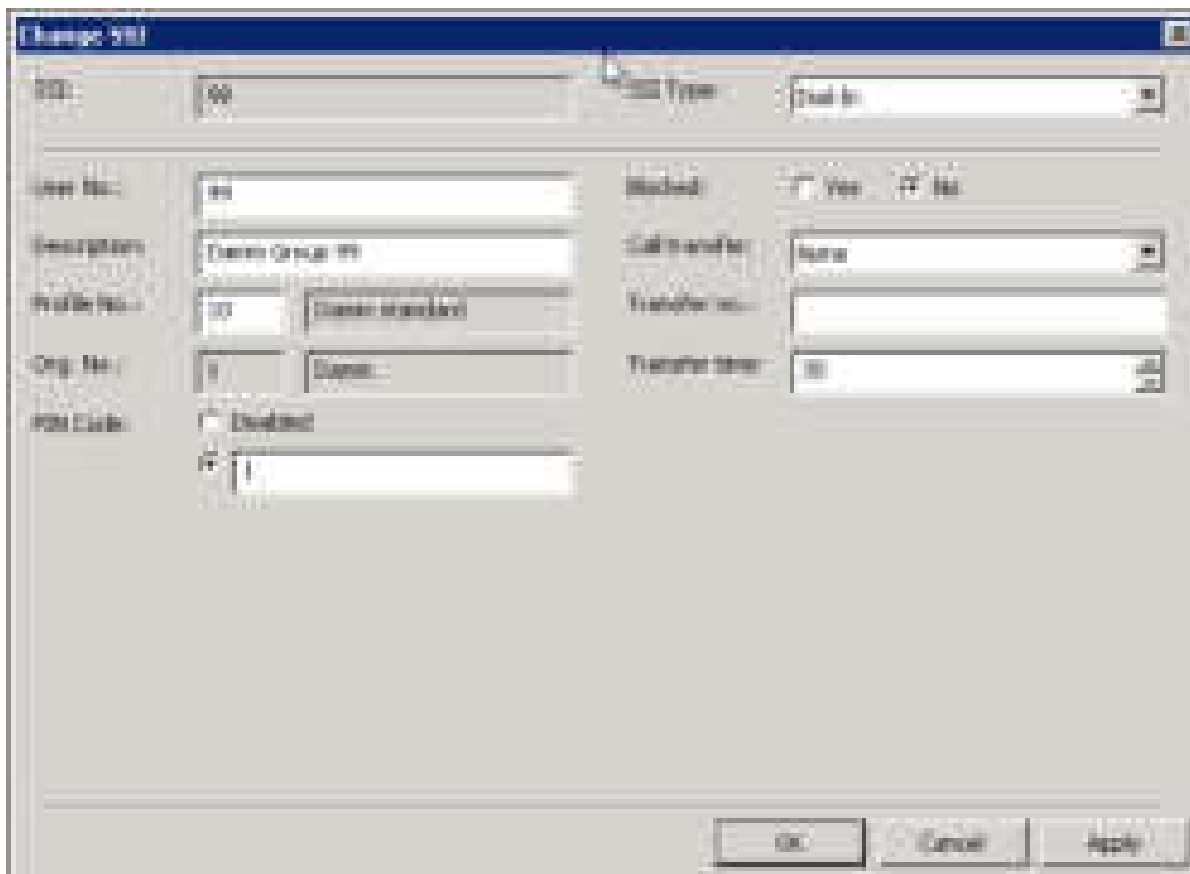


Figure 3-31: Terminal subscriber

- Pin Code
  - PIN disabled: No Pin requested
  - PIN entered: Pin must be entered in the TetraFlex Client or Group Bridge before they are allowed to connect.
- Authentication
  - Generate key – this function generate an Authentication key that can be used to authenticate a TetraFlex Client or a Group Bridge on the TetraFlex network. The generated key must be entered and stored in the TetraFlex Client or Group Bridge. When **Disable** option is active the authentication key is not needed for connection. The **Renew** function renews the distributed key sets and should be updated at regular intervals. For more information se chapter Authentication and Encryption 3.4. The **Clear** function clears the authentication code
- Number Modification allowed.:

Used for “sending on behalf of” e.g.. if a Group Bridge receives a call from a MS and the number of the MS should on the receiving MS instead of the number of the Group Bridge.

### 3.3.5.4.5 Dial-in subscriber



The dial in SSI is an internal number used to access groups through the Voice gateway and to show an identity for the group users.

E.g.: A user with Dial-IN SSI 99 makes a PABX dial in to Group 1700003:


Dial 700000	Damm PABX (Answering machine)
Dial 1700003	Damm group 3 (Answering machine)
Dial 99	Dial-In number

Now the PABX user can make a PPT group call or a Voice detect group call and is identified as "99" on the Tetra terminals.

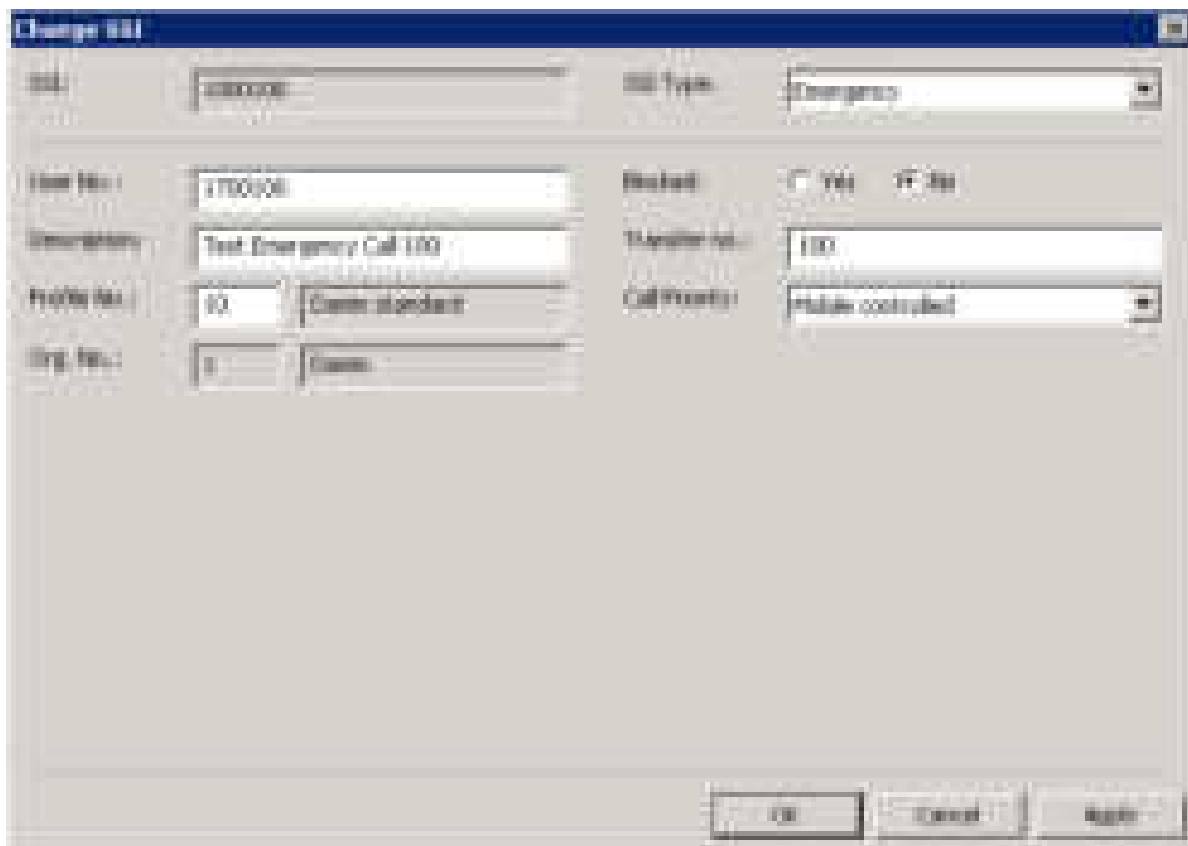
**PIN Code** – If using a PIN code the Dial-In user is prompted from the Answering machine to enter the PIN-code before he can make the group call.

The PIN-Code options are:

- Disabled – The use of PIN Code is disabled no PIN code is needed.
- The PIN code can be from 1 to 999999999

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#### 3.3.5.4.6 Emergency subscriber



The Emergency Subscriber is used for Transferring a Tetra Call to the Voice Gateway or another Tetra Subscriber responsible for Emergency e.g. sending it to the public 112 (911) or a another number used for Emergency.

- Transfer no: The number that the Tetra call shall be transferred to e.g. 112.

### 3.3.5.5 Security Key

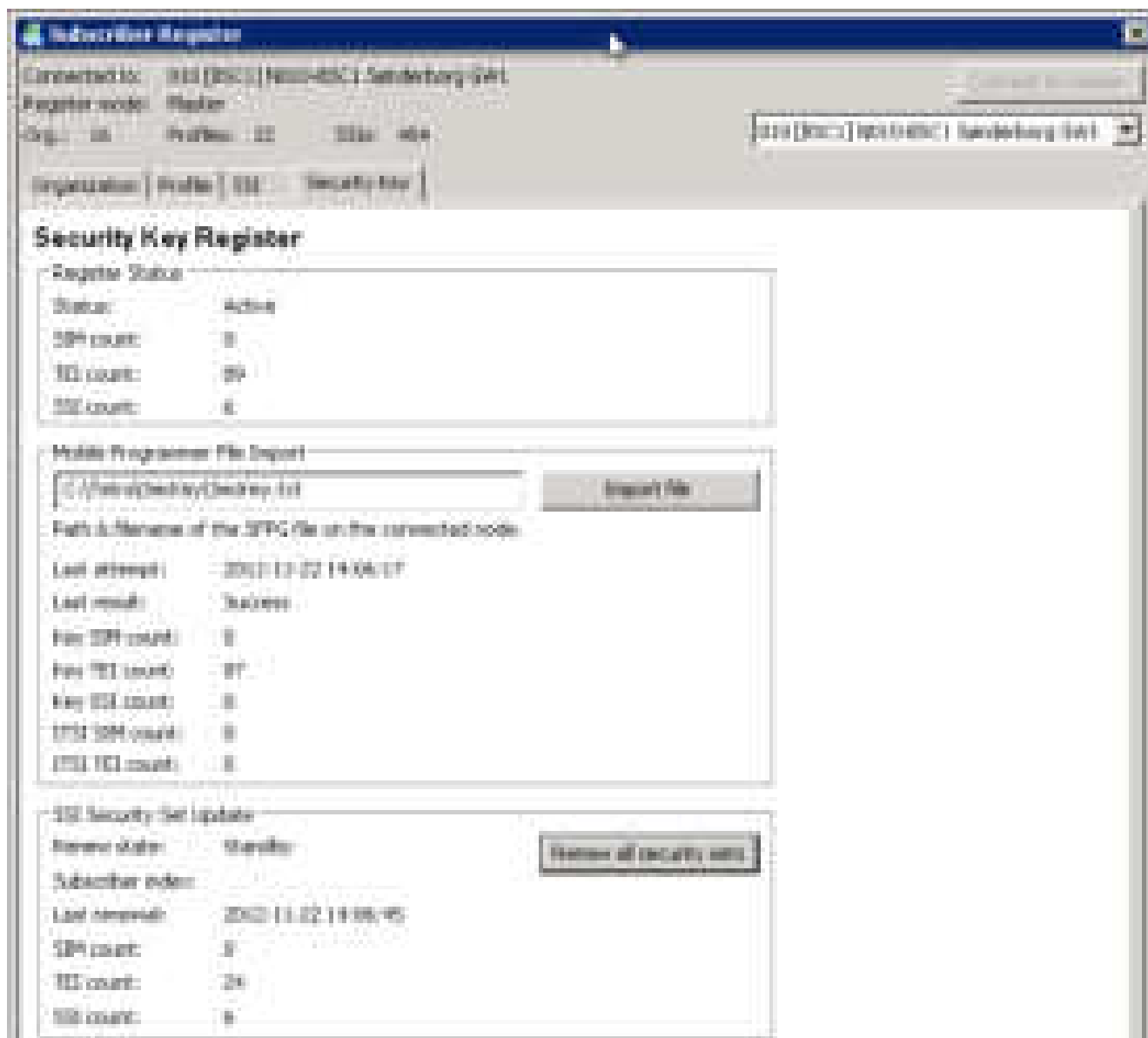



Figure 3-32: Security Key

Displays information regarding the Security Key Register. The key register must be enabled on the Master node. Can be set in NM from the BSC list – Subscriber - Key

- Status – Shows if the key register is enabled.
- SIM count – the numbers of SIM numbers found in the subscriber register
- TEI count - the numbers of TEI numbers found in the subscriber register

**Mobile programmer file import** Allows import of a security key file generated from the terminal programmer.

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By pressing the **Import file** button the file name that is in the import field will be read into the key register. The directory and file name can be any valid name.

After an import the Import history is updated

- Last attempt – The date for the last import of security keys
- Last result – result of last import attempt
- Key SIM count – numbers of SIM numbers found
- Key TEI count - numbers of TEI numbers found
- SSI count – numbers of SSI numbers found

### SSI Security Set update

Pressing the **Renew all security sets button** all security sets will be renewed. This allows the update of all security keys simultaneously, as opposed to the single subscriber update which is valid for the subscriber only.

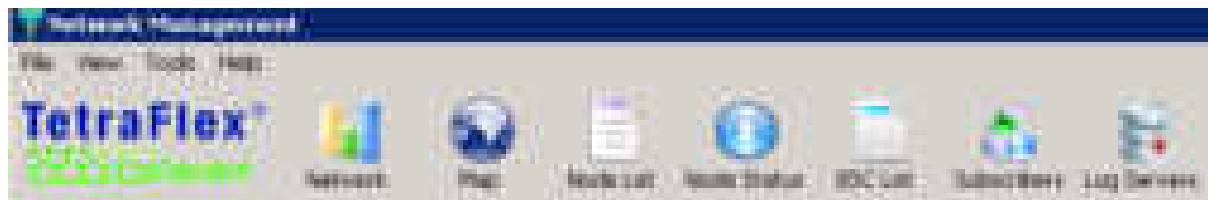
The result of the renewal is shown below:

- Last renewal – date for last renewal of the security set.
- SIM count – numbers of SIM numbers found that matches.
- TEI count - numbers of TEI numbers found that matches
- SSI count – numbers of SSI numbers that matches

These keys will then be encrypted, using the hidden encryption key programmed in the dongle and the key sets generated.

### 3.3.6 Log Servers

The Alarm state, Status and IP addresses of the Log Server(s) that are attached to the system can be shown by clicking the Log Servers icon:



Log servers Alarm overview:




Log servers Status overview:



Log servers Status overview:




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When Right click the LogSrv fields you get the Log Server Operations dialog:



- |                        |  |
|------------------------|--|
| ○ Log Client           | Start the Log Client                                   |
| ○ Remote Desktop       | Starts the Remote Desktop Client                       |
| ○ Explorer             | Starts Windows Explorer                                |
| ○ Acknowledge Alarms   | Acknowledge log server alarms                          |
| ○ Unacknowledge Alarms | Unacknowledge log server alarms                        |
| ○ Remove line          | Remove LogSrv line e.g. if a Log server is not running |



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## 3.4 AUTHENTICATION AND ENCRYPTION

### 3.4.1 Description

This section describes in detail the function of the Security Key Set used for authentication and encryption.

Only the method is described, for further information regarding the Subscriber Register, BSC, distribution of subscriber data etc. please consult the relevant manual sections.

### 3.4.2 Definitions

K	The key value file generated by the terminal programmer. File is in plain text and contains key value associated to TEI
Dongle Key	The secret key programmed in the Node Dongle. The Dongle Key is enabling the key register in the subscriber register
K <sup>1</sup>	The Security Keys derived from the K file and placed in the key register
Security set	The distributed key sets. Should be updated at regular intervals

### 3.4.3 Description


The key file produced by the terminal programmer (K) is read in to the system and is encrypted using the Dongle Key and placed in a key register (K<sup>1</sup>).

This key register is now “protected” by the dongle key.

This means that if the key register is moved to another node, the Dongle key must be moved as well.

The content of the key register (K<sup>1</sup>), decrypted with the dongle Key, and the TEI or SIM reference value is used to produce a security set (Derived keys) which is placed in the Master Subscriber Register and distributed to the Subscriber Register on the other nodes as SSI + Security Set. After this the TEI / SIM reference is essentially no longer used.

When updating the Security Set, the K<sup>1</sup> key and the SSI is used to generate a new distributed Security Set.

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**Figure 3-33: Key principles**

#### 3.4.4 Backup

It is essential that the K values are kept at a safe place that means to place the programmer key file in a safe place.

Backup should always consist of at least:

- Master Subscriber Register
- Key Register

#### 3.4.5 Restore

If the node containing the Master Subscriber register is isolated or removed, the system will continue to work as usual except that new terminals cannot be added to the Subscriber register.


When using encryption/Authentication it is recommended to wait adding subscribers until the node containing the Master Subscriber Register is available again.

Alternatively it is possible to assign another node as Master Subscriber register and add the subscribers to this register.

After adding subscribers, the Key File (K) is read into the Subscriber Register as described previously.


This will create a new Key Register on this node containing the K' values for the new terminals.

The disadvantage of this is that when the Security Sets must be updated, both nodes must be updated, so this method is NOT recommended

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In case the node containing the Master Subscriber Register is totally lost or an exchange or change of node for some other reason is preferred, then all Key Files (K) can be read in again on the new node using the dongle Key belonging to this node, and the key sets updated.

This node is now containing the Master Subscriber Register and Security Key register.

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## 3.5 DISPATCHER

### 3.5.1 General Description

The Core of the Dispatcher is the TetraFlexApi.dll. It contains all the core elements to be able to connect an Application to the TetraFlex® system. As standard, the TetraFlexApi.dll is delivered with a GUI (Graphical User Interface). This provides the complete Dispatcher Application.

The TetraFlexApi.dll contains a fully documented API (Application Programming Interface) TetraFlexApi.h file which allows the DAMM supplied GUI to be replaced with other GUI applications provided from third party vendors. Thereby applications with other features and in other languages are very easily implemented without any need to touch the core interface to the system.


The TetraFlexApi.dll is delivered with a DAMM License Dongle to permit the use. DAMM dispatcher from V7.30 and ahead requires a dispatcher entry in the dongle to be able to start. Dispatcher from V7.40 and ahead requires a Microsoft .NET Framework and MS SQL Compact database to be installed. This is valid for the DAMM dispatcher only, not for any third party application.

The TetraFlexApi.dll is intended to be used on a Windows XP or Windows 7 platforms.

Any Node (Base Station, Gateway node etc.) of the TetraFlex® system can have an Application Gateway activated, and each gateway can handle several simultaneous application connections. The connection from the application to the system is done with standard IP protocols (TCP/UDP) to the external (WAN) side of the node, and the application can be located anywhere provided a standard IP connection to the node's external WAN side is possible.

The TetraFlexApi.dll configuration includes a list with one or several IP addresses of Application Gateways. The TetraFlexApi.dll will scan through the list and try to register with the first IP on the list, if found the scan is stopped, otherwise an attempt to register with the next IP entry in the list is made (like a mobile scanning through its frequency list). The registration occupies an SSI position. A PIN-code Authentication is added to prevent other applications to register with same SSI. This allows redundant gateway connections and allows the application to be moved to new locations without any reconfiguration.

The TetraFlexApi.dll supports a.o. to display the DAMM Dispatcher Phonebook with all subscribers belonging to its own Home Organization and all Associated Organizations. The phone book is an extract from the TetraFlex® subscriber register which is automatically uploaded to the dispatcher using its own dedicated multicast address. This means that the home organization subscriber register can be maintained from the dispatcher provided access has been granted in the subscriber register. Dispatcher functions include Individual-, Group- and Broadcast calls, monitoring of all active calls including individual simplex and duplex calls, sending and receiving SDS, adding DGNA

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groups, performing discreet and ambience listening etc. Additional features are planned to be added in coming releases. For further information regarding future features, see the Feature List description released with the TetraFlex® package and placed in the C:\Tetra\Active\Doc directory

The TetraFlexApi.dll will at registration check for correct protocol version. When the TetraFlex® system software is updated with new features on the Application Gateway, the TetraFlexApi.dll will also be updated and shall be installed at the GUI applications.

The TetraFlexApi.dll will be fully backward compatible, which means that older GUI applications can use a newer version of TetraFlexApi.dll.


### 3.5.2 TetraFlex® Dispatcher Functionality

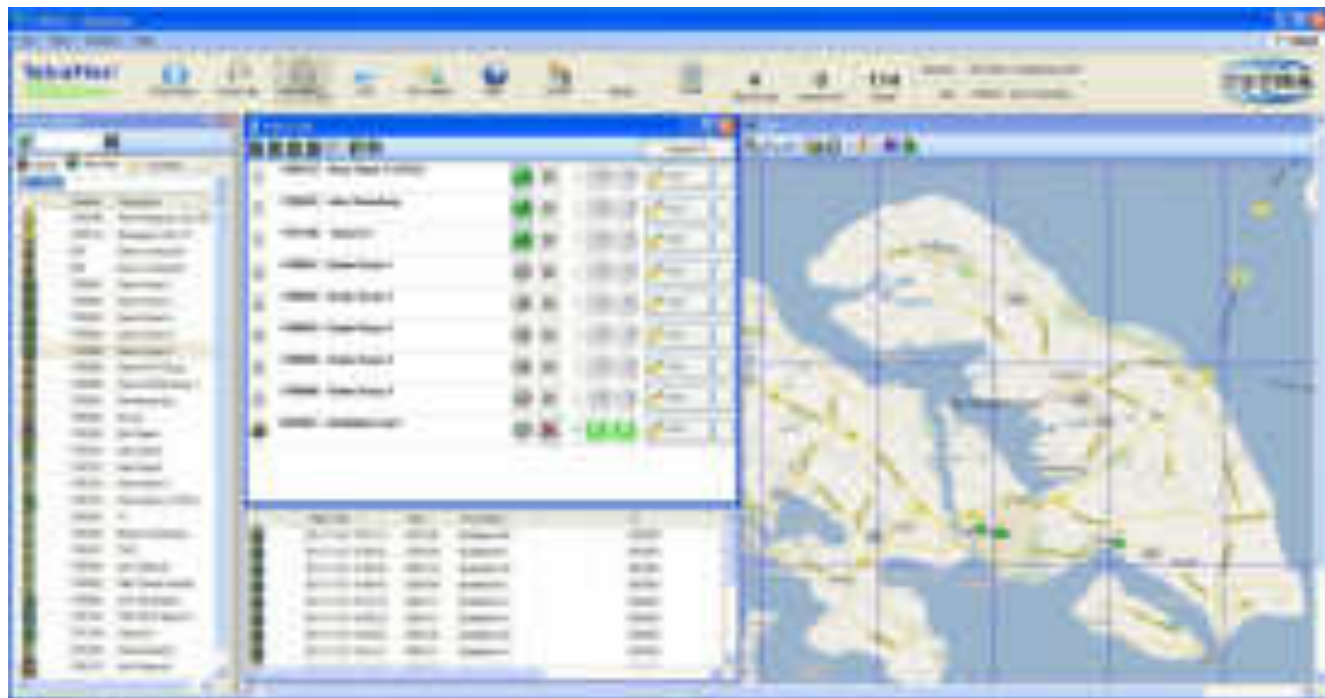
The Dispatcher application is developed to run on a Windows XP or Win7 platform. To launch the Dispatcher application the following things are required:

- IP connectivity to an Application GW on the IP backbone network.
- Hardware dongle with API client and DAMM dispatcher enabled.
- A valid Dispatcher SSI and user number defined in the subscriber register
- A valid PIN code (optional) defined in the subscriber register
- Organization 0 (Zero) defined in the subscriber register, also if this is organization is not in use

Furthermore the dispatcher requires that Microsoft .NET framework and Microsoft SQL Compact to be installed on the Dispatcher PC

When the Dispatcher application is launched the main window appears

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**Figure 3-34: Dispatcher Main window**

From the toolbar it is possible to open the Phonebook-, Voice Calls-, SDS-, Position-, File Transfer-, DGNA-, Nodes- and the Config views. Notice that the dispatcher connection information is provided as well. Double click on the “Missed Call”, “Unread SDS” and “Node” icons will open the respective windows in case they were closed down or bring the windows to front in case they are open.




**Figure 3-35: Dispatcher Tool Bar**

### 3.5.3 Views



### 3.5.3.2 Dispatcher Configuration

The dispatcher configuration selection opens a window with 5 tabs. Configuration may also be entered using the configuration icon 


#### 3.5.3.2.1 Audio



Figure 3-38: Dispatcher Configuration

The audio tab allows configuration of the Speaker and Microphone settings for the different call types and alerts. If the PC that operates the dispatcher, has more sound devices, it is possible to redirect the sound for the different call- and alert types to the individual sound devices.



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- Test button- Each call- and alert type has its own test button that can be used for testing the in and output.
- Windows Volumes button - Gives an overview of which Windows sound devices is active in Windows. If a device is adjusted to 0 dB a red alert comes up to indicate that this device cannot be used for audio input or output.


### 3.5.3.2.2 Language



Figure 3-39: Language Setting

The Language tab allows setting of the dispatcher language

NOTE: The selection is dongle controlled, and English is always present with the option to select additional languages.

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### 3.5.3.2.3 Calls



The Calls dialog is used for setting the Master PTT key used, and number of records stored for the Call history.

- Master PTT key – The PC functions key F1-F12 that you want to use for the Master PPT call in the dispatcher. If using the Damm foot switch, F13 has to be selected.
- Call History Max Age – 60 to 518400 min. (360days). The max. numbers of minutes that a call will be showed in the call history database before it will be deleted.
- Call History Max. Size – 20 to 5000 entries. This is the max. numbers of calls that can be stored in the database.
- Call Recording Max. age - 60 to 518400 min. (360days). The max. numbers of minutes a voice call recording will be showed in the call history database before it will be deleted.

Call History max age, call history max. and call recording max age are depending on each other i.e. the lowest setting, will be the numbers of records that are kept in the database.

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### 3.5.3.2.4 Map View

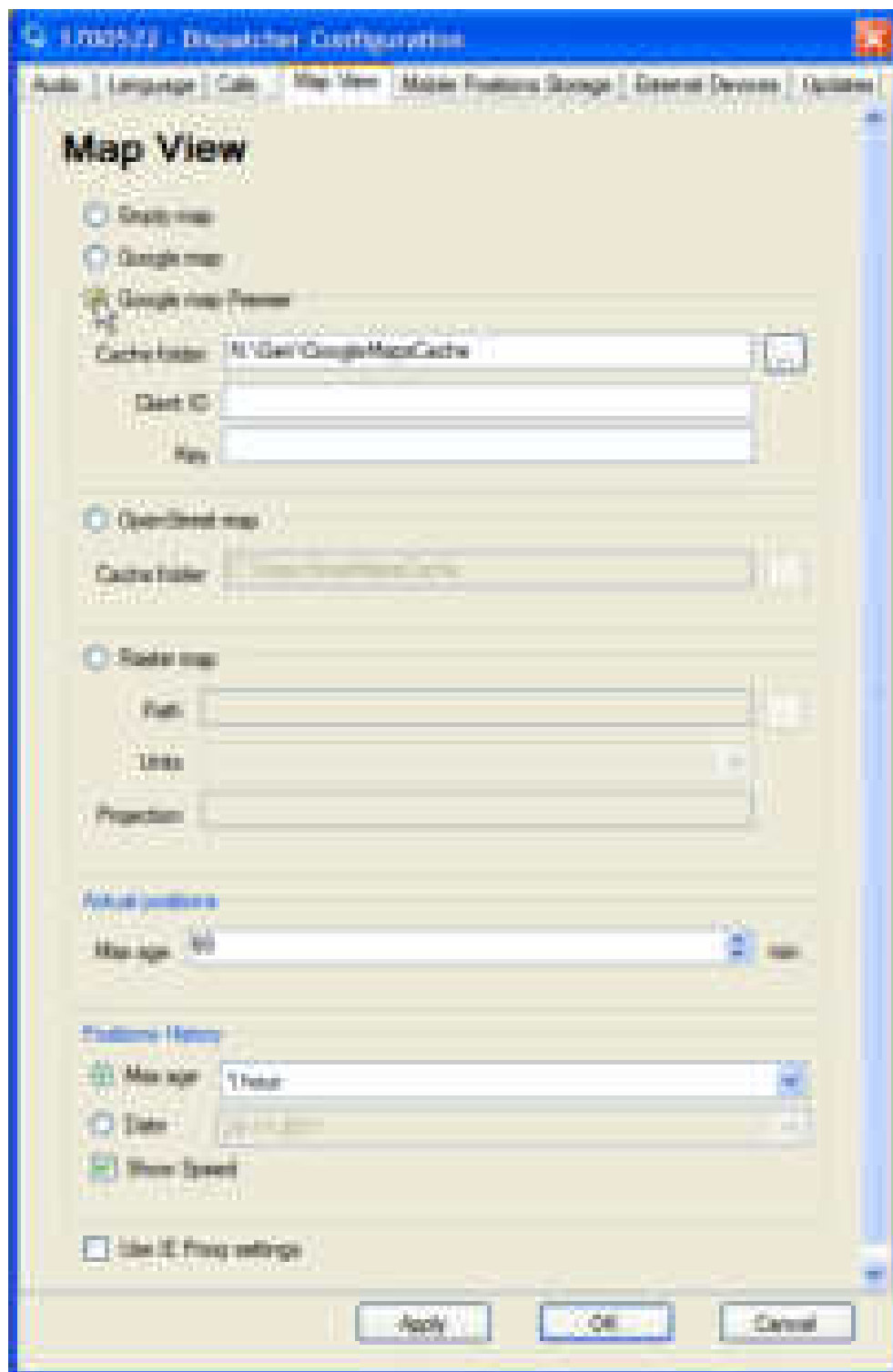



Figure 3-40: Map View (Google)

The Map view has the following options for showing geographic maps with Radio GPS positions and node positions in the dispatcher:


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- Empty map – No back ground maps are shown, this can be used for showing overlay shapes in ESRI format\* in the map view. Empty maps also gives the option to show RSSI measurement and lines between the position history points.
- **Google map** – Standard Google maps. These are like the maps you get when accessing <http://maps.google.com/> and this requires an internet connection to access.
- **Google map premier** – Uses Google maps, but with a more advanced interface to be able to show e.g. RSSI measurement and lines between the position history points on the map. It is possible to cache Google maps to speed up the changing of the maps or zoom in and out on a map. If the Internet connection is broken it is possible to use the cached maps, but with the limitation that areas and zoom levels that are not cached, will not be shown. The **cache folder** is used to define where the cached maps are stored to and retrieved from. It is possible to get a premium Google account that makes it possible to get faster updates of the maps and without limitations of how many maps it is possible to collect. If you have a Google maps Premier license, Login information can be added in the **client Id** and **Key** fields. It is possible to add layers on top of these maps in ESRI shape format.
- **Open Street maps** – Free geographic data. It is possible to show e.g. RSSI measurement and lines between the position history points on the map. It is possible to add layers on top of these maps in ESRI shape format\*. The **cache folder** is used to define where the cached maps are stored and retrieved from.
- **Raster maps\*** – This map format makes it possible to make your own map in GEO TIFF or ERDAS ECW format. In the **Path** field you can select the directory where the GEO Tiff or ERDAS ECW files are placed. If selecting a map in one of these formats the **Units** and **Projection\*\*** fields will automatically be filled in if the map file is provided with this information. If the projection information is not provided in the map file it can be typed in manually. If the projection -or units parameters are not correct you will either get a warning or the map will not be shown correct.

\*) ESRI-Shape format and Raster maps are Dongle controlled and has to be purchased separately.

\*\*) Projection - *A map projection is any method of representing the surface of a sphere or other shapes on a plane. For further explanation refer to [http://en.wikipedia.org/wiki/Map\\_projection](http://en.wikipedia.org/wiki/Map_projection)*

The projection of your maps should be inserted here in the PROJ.4 Cartographic Projections Library format defined by OSGeo. Refer to <http://trac.osgeo.org/proj>

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To find the actual projection the webpage <http://www.spatialreference.org> could be used by selecting ESRI references, the actual ESRI number corresponding to your map and then Proj4.

Example: +proj=utm +zone=32 +ellps=GRS80 +units=m +no\_defs

A description of the different parameters is to be found at:

<http://trac.osgeo.org/proj/wiki/GenParms>

- Actual positions Max age: This is the max. time the actual position of a Radio will be shown on a map after the Radio has deregistered or the GPS signal is lost. The value can be from 1 to 600 minutes.
- Position History Max age: The time frame that the position history will be shown on map. The setting can be from 1 hour to 1 day or you can set the date from where you want to show the history.
- Show Speed: Shows information regarding speed and direction (heading) in the positions history list and detail information on each GPS point on the map
- Use IE Proxy settings: If this is checked online, maps like Google and Open Street view will use the proxy setting of IE to locate a proxy server to get access to the internet.

### 3.5.3.2.5 Mobile Positions Storage

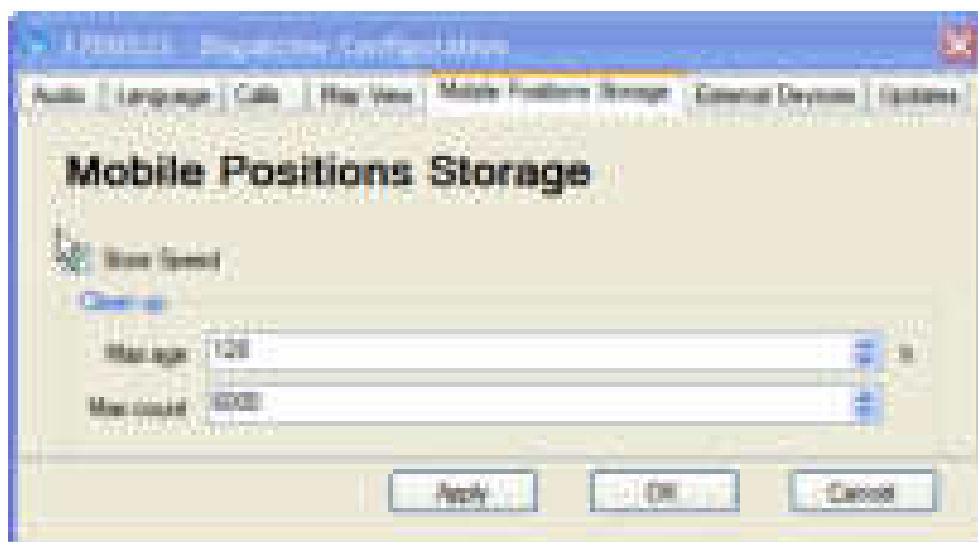



Figure 3-41: Mobile Positions Storage

Shows selections for:

- Speed Stored: The Speed information is saved in the database

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- Clean up. Maximum number of hours (1-700 hours) before the position history is deleted. Max. count is the number of records that can be stored before clean up (20 to 6000). These two settings are depending on each other and it is either the age or the numbers of records that decide when the oldest record will be deleted, whatever comes first.

### 3.5.3.2.6 SDS



**Default Request ack** – If set, the SDS will by default be sent with the Request ack flag set



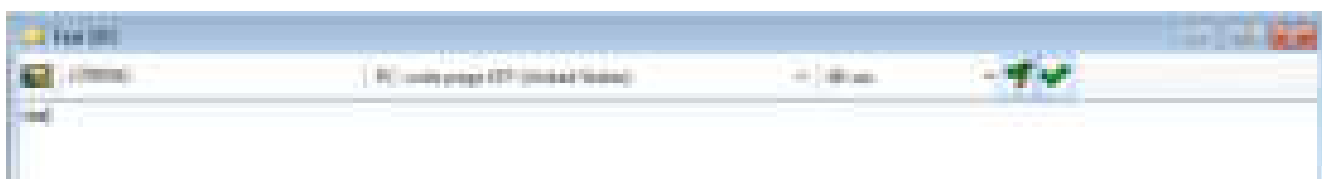
**Default Request consumed** – If set, the SDS will by default be sent with the Request consumed flag set



**Default Text Encoding** – The default text encoding used


**Default Validity** – Can be set from none to 12 days.

Example of the default setting in Text SDS dialog. The default values can be overwritten by clicking in the fields.



### 3.5.3.2.7 External Devices

External devices presently supported is the ADU200 USB input/output box manufactured by Ontrak Control Systems inc. [www.ontrak.net](http://www.ontrak.net)

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Functions available are a contact close (box relay output K0 normally energized) upon an alarm SDS or alarm call to the dispatcher or group monitored by the dispatcher.



**Figure 3-42: Ontrak alarm box**

Please refer to the ADU200 manual for further information

### 3.5.3.2.8 Updates



The Auto updates function will search for newer a Dispatcher version when the Dispatcher is running. I will search either on the share on the node where it is connected to, or on the custom path that that can be set up with this dialog.

- Ignore update: The Dispatcher will not search for new updates.
- Custom path: **Path** is the local or network path that you want to use for update.

The default path from where the dispatcher is installed , will be used except if the Ignore updates flag is set or another Custom path is used.

### 3.5.3.3 Subscriber Register

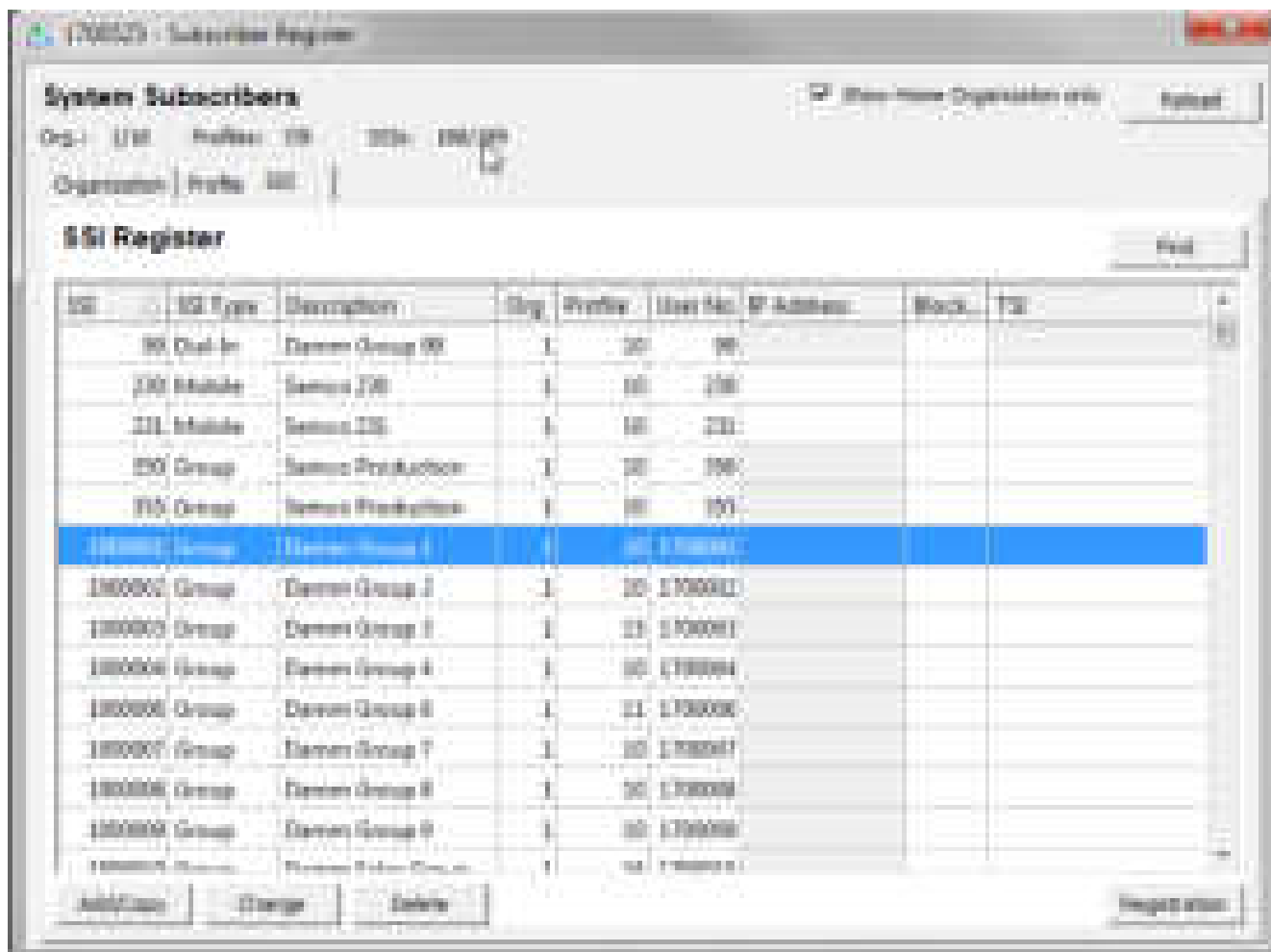


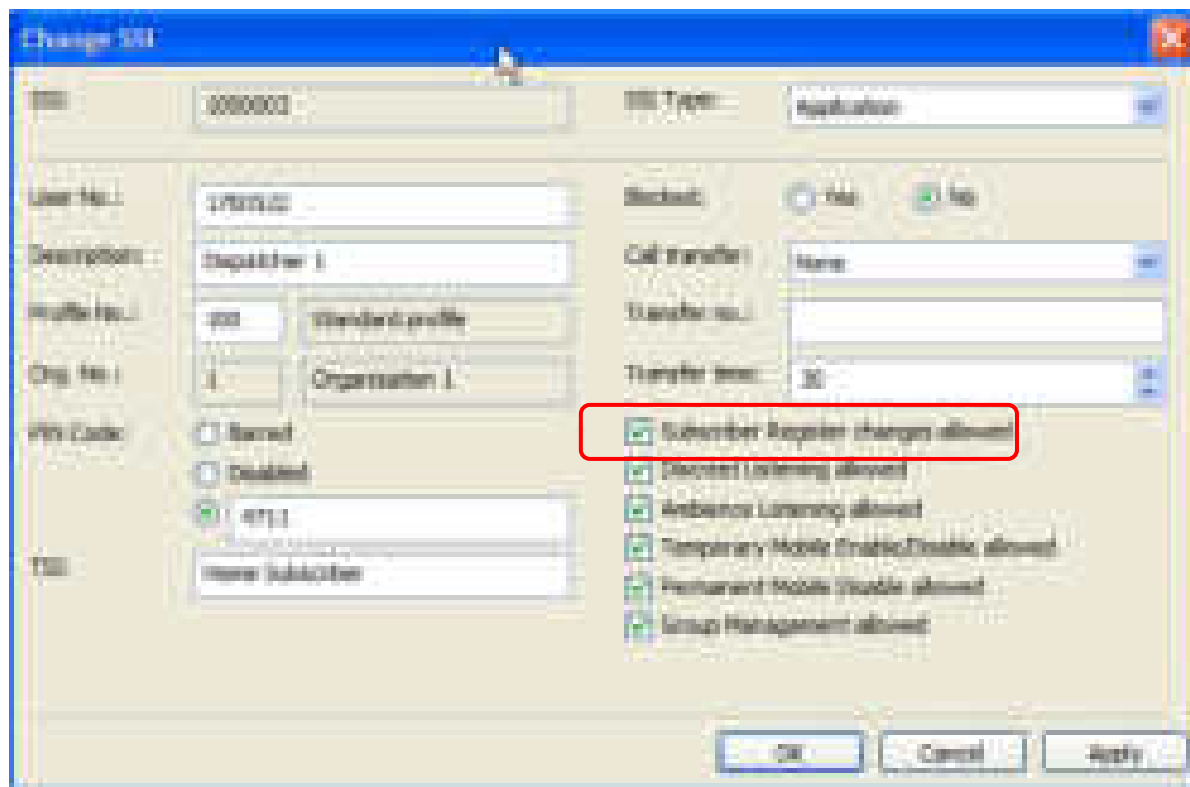
Figure 3-43: Subscriber register

The Subscriber Register is read into the Dispatcher for editing and maintenance. (this is only the case for the profiles, and SSI belonging to the dispatcher's home organization or associated organizations). These can be seen and changed if the "Subscriber Register changes "allowed" flag is set for Application SSI the Dispatcher is connected to (see figure 3-44).

The **Show Home Organization only** check mark toggles between showing all organization or only home organization.

There is no way to set this flag from the Dispatcher if it is not already is set, you have to use the Network Manager to do that.





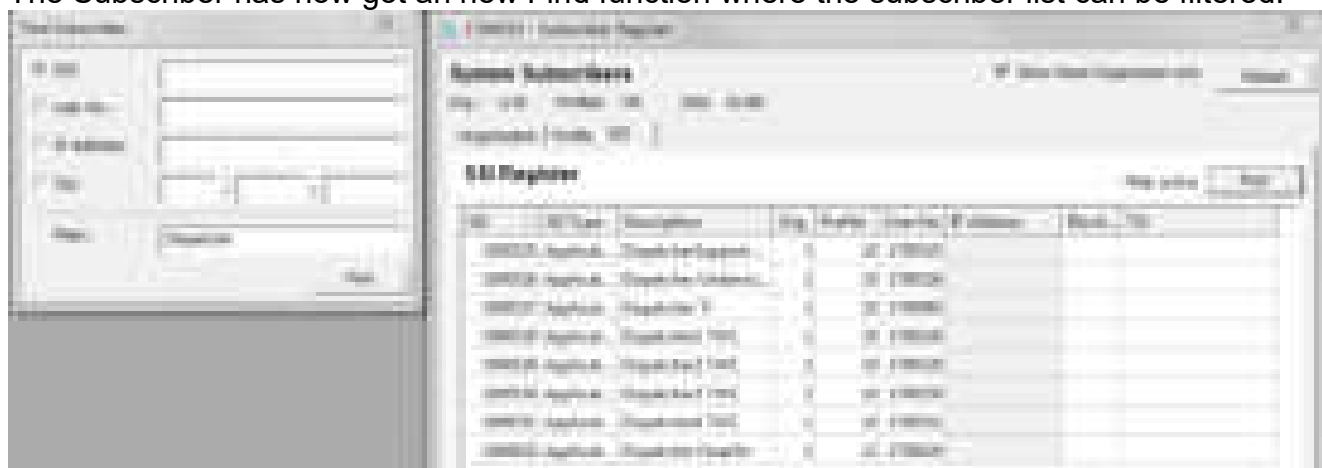
The 'Change SSI' dialog box contains the following fields and options:

- SSI:** 0000003
- SSI Type:** Application
- User No.:** 1750102
- Description:** Dispatcher 1
- Profile No.:** 100 (Standard profile)
- Org. No.:** 1 (Organisation 1)
- SSR Code:**
  - ☐ Barred
  - ☐ Disabled
  - ☒ 4711
- TSI:** New Subscriber
- Backend:**
  - ☐ No
  - ☒ Yes
- Call transfer:** None
- Transfer no.:** (empty field)
- Transfer time:** 30
- Permissions (all checked):**
  - Subscriber Register changes allowed
  - Directed Unlisting allowed
  - Ambience Listening allowed
  - Temporary Mobile (Static/Dynamic) allowed
  - Permanent Mobile (Static/Dynamic) allowed
  - Group Management allowed
- Buttons:** OK, Cancel, Apply

Figure 3-44: Subscriber register change

For more information regarding the Application SSI please see the chapter Network Manager – Subscriber.


The Subscriber has now got a new Find function where the subscriber list can be filtered:



The 'Subscriber Find' window displays a list of subscribers under the 'SSI Register' tab. The table below represents the data shown in the screenshot:


SSI	Description	Org. No.	Profile No.	Status	Back. No.
0000003	Dispatcher 1	1	100	Active	1750102
0000003	Dispatcher 2	1	100	Active	1750103
0000003	Dispatcher 3	1	100	Active	1750104
0000003	Dispatcher 4	1	100	Active	1750105
0000003	Dispatcher 5	1	100	Active	1750106
0000003	Dispatcher 6	1	100	Active	1750107
0000003	Dispatcher 7	1	100	Active	1750108
0000003	Dispatcher 8	1	100	Active	1750109
0000003	Dispatcher 9	1	100	Active	1750110

Figure 3-45: Subscriber find filter

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In this example all subscribers with a description containing “Dispatcher” is shown.

#### 3.5.4 Phonebook functionality




The Phonebook window  is activated from the Dispatcher Tool Bar or from the top bar Views selection. From this panel the Dispatcher is able to initiate various types of calls and send Status and Text SDS's.


The Phone Book contains a list of subscribers belonging to the same Home and Associated Organization as the Dispatcher. This list is provided by the TetraFlex® infrastructure and is obtained via the Application Gateway by means of the dedicated subscriber multicast address.





Figure 3-46: Phonebook

#### 3.5.4.1 Mobile indicators in the phonebook

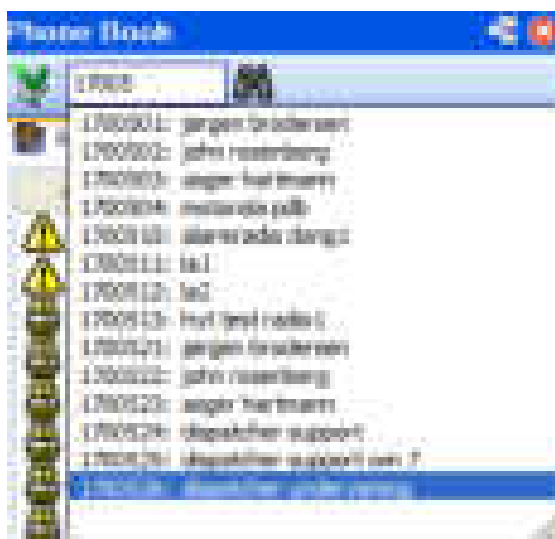
-  Indicates a mobile with a group selected
-  Indicates a mobile with a group active, but not selected in the mobile (scanned group)
-  Indicates a mobile which is not registered to the system

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### 3.5.4.2 Phone book docking

The Phone Book window may be floating or docked either to the left or right edge of the dispatcher window. To dock, use the left or right arrow  in the top bar of the phone book and to float use the floating symbol .

### 3.5.4.3 Phone Book Search



**Figure 3-47: Search dialogue**

It is possible to search for a user number, SSI or name, in the Search field. When double clicking on a subscriber the details dialog is shown. By right click in detail view you can select the call you want to establish.



#### 3.5.4.4 Direct call

When double click on a subscriber in the Phone list you can establish a direct standard (group call if a group SSI, Individual duplex call if an individual SSI etc.) to these subscribers.

#### 3.5.4.5 Call dialog

To manually initiate a call, right click on the desired subscriber (in this case a group)

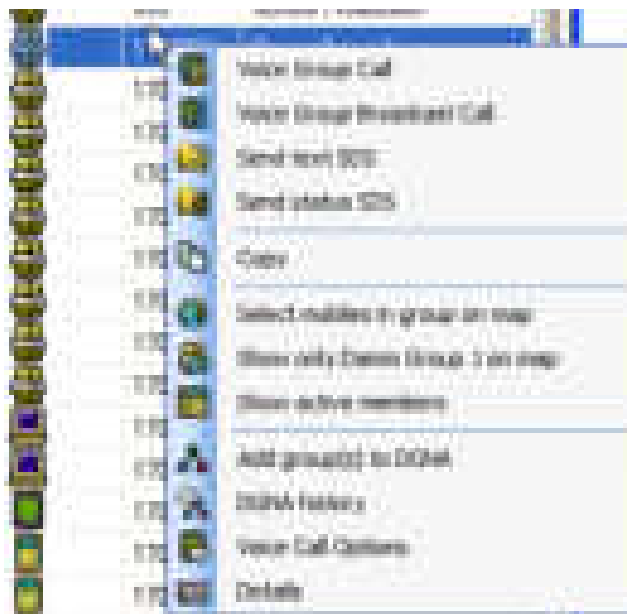



Figure 3-48: Group Call dialogue

Then select the function required



It is possible to change the **Priority** of this call and **Type**.

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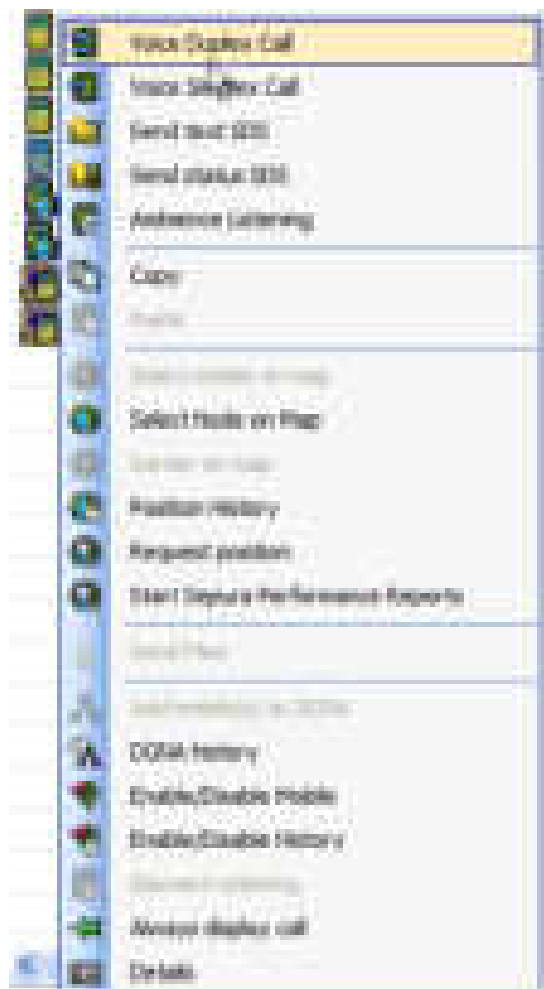


Figure 3-49: Individual Call dialogue

When the desired subscriber is found, right click on the result and select the desired function to be performed from the call dialog

NOTE: Selections may be active or grayed out according to the selected subscriber configuration

#### 3.5.4.6 Show Associated Organizations

When selecting **Associated** from the Phone book menu, the subscribers in Associated Organizations are shown and the functions that you can perform are similar to the Home Organization list



Figure 3-50: Associated organizations

#### 3.5.4.7 Show favorites

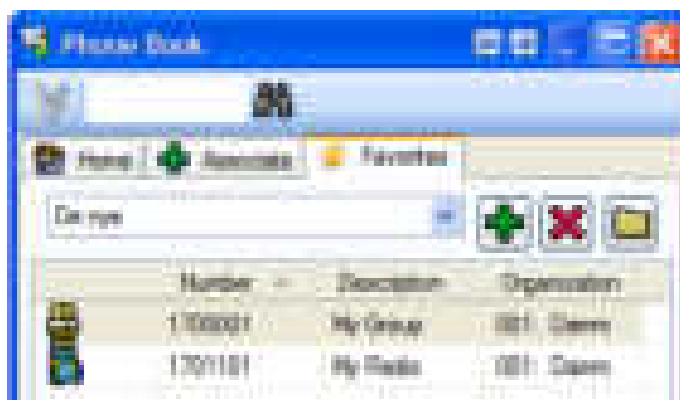


Figure 3-51: Favorites

In favorites, any number reachable from the infrastructure can be entered, this includes Tetra SSI's, PABX/PSTN numbers etc. and the Description can be changed without changing it in the subscriber register.



### 3.5.4.7.1 Show only registered subscribers

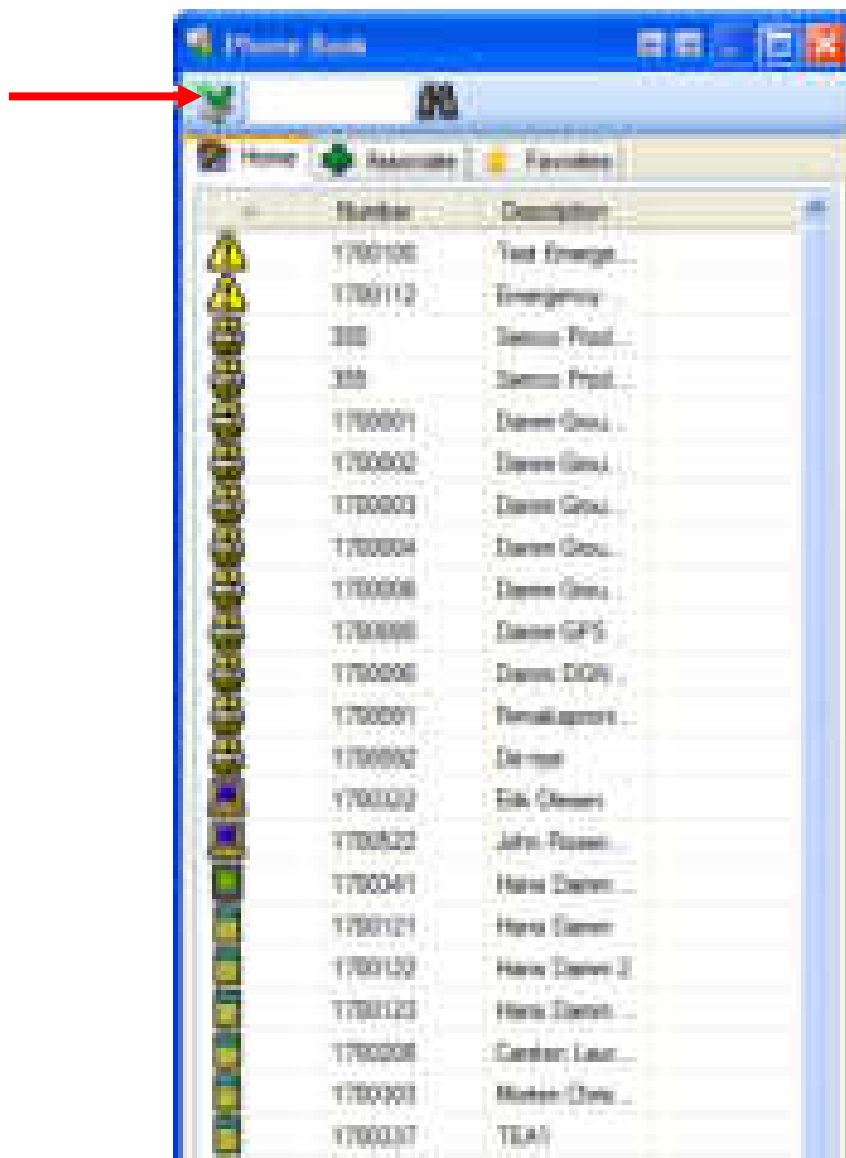



Figure 3-52: Subscriber view

This function allows the view of either all subscribers or only subscribers currently registered at the system. When all subscribers are selected, non registered subscribers will be shown as grayed out.

NOTE: Subscribers which have registered in the system and who leaves without proper deregistration (pulling off the battery, out of coverage etc.) will still show as registered until a proper de-registration has taken place

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### 3.5.4.8 Voice Calls

The Voice Call window can display all ongoing call activity; this includes group calls and all types of individual calls (only if discreet listening option is set in the dongle and BSC settings). All calls are shown in a separate line in the voice call window. The call line includes call information. Any call from and to the dispatcher and any call between terminals is shown with one active call line per call.

The active call line indicates in its title bar whether it is an individual- or a group call, please see [Figure 3-53](#) and [Figure 3-55](#).

In a simplex call, where speech only flows in one direction at a time, the active call line has an active PTT button.

### 3.5.4.9 Subscriber always displayed

For subscribers frequently used, it is possible to transfer the subscriber to the Voice Call window on a permanent basis, making the call more simple (Just press the PTT button)

To do this either drag the subscriber (Group or individual) from the phone book and drop it in the Voice Call window or, for group calls, right click on the subscriber, select “Voice Call Options” and “Always shown”

To remove from the Voice Call window, right click on the subscriber and select “Display only when active”



Figure 3-53: Active Call window with group calls


### 3.5.4.10 Volume control

During active calls, it is possible to adjust the call volume individually for each call. This is done by moving the slider positioned between the LS and MIC icons up or down. While moving, the level change in dB will be shown.

When the specific call is ended, the volume will be reset to 0 dB




Figure 3-54: Call volume control

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#### 3.5.4.11 Master PTT button

The master PTT button allows more calls to be executed simultaneously, like a kind of broadcast.

Selecting a call or number of calls using the field to the right of the standard PTT button, the field(s) will show an  icon indicating that the call has been selected for master PTT.

When the master PTT button is pressed, calls will be made to all selected subscribers.

To revert to a single subscriber PTT when more is selected for master PTT, double click on the desired subscribers' master PTT icon and all other selections will be reset

#### 3.5.4.12 USB foot switch

Master PTT activation can be configured to be executed by means of a USB foot switch (DAMM delivered. For configuration of the foot switch, please refer to the instructions delivered with the switch)


In the main menu bar select "Config → Audio" then go to the bottom of the configuration page and change the Master PPT key settings to the desired value , normally F13 (Default)




Figure 3-55: Active Call window with master PTT

#### 3.5.4.13 Standard PTT Button



The standard PTT button  is shown as a standard windows button with an "open-lock" icon.

The PTT is requested only when the PTT button is pressed. However if the mouse is released over the lock icon then the icon is changed to a "closed-lock"

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icon and the PTT will stay in the requested state until the button is pressed again outside the lock icon.

The PTT can be used also for a duplex call if the microphone is muted . When the microphone is muted, then the microphone is temporary open when pressing the PTT (Dark green icons ).

The temporary muted microphone is shown with a light green icon with a red cross .


#### 3.5.4.13.1 Alternative audio devices

To add audio to a second audio device present and selected in the configuration menu (headset, micro telephone, second sound card etc.) use mouse right click on the audio icon.

Added devices are shown in dark green with a speaker icon inserted .

The audio device is configured from the Audio tab in the Dispatcher Configuration dialog.

#### 3.5.4.14 Audio device error

Errors in assignment of an audio device are indicated by a red configuration icon on the main tool bar . A common reason for this is when the Windows Audio device level is set to 0 or no sound card installed.

During an active call, error icons  will be shown in case the maximum number of voice streams allowed (dongle configured) is exceeded for the call

#### 3.5.4.15 Standard voice call

The voice call window has provisions for fixed display of a group in the window making it faster to select and call the group. A displayed fixed group is indicated by a green pin in the phonebook group icon

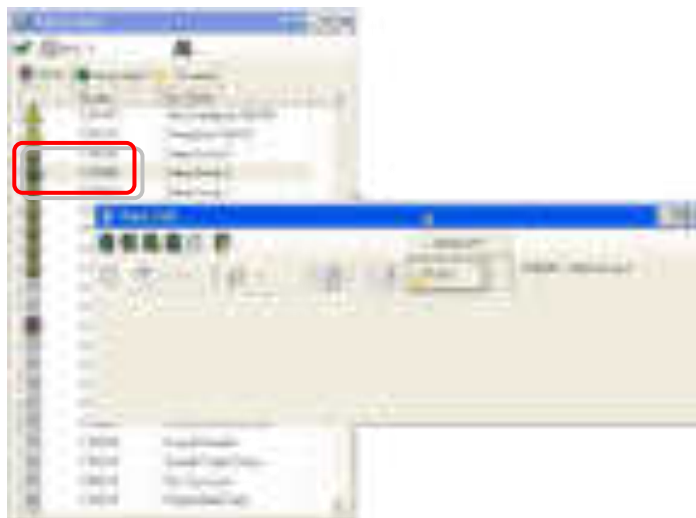


Figure 3-56: Fixed Group Indication

To select fixed groups, right click on the phonebook group and select Voice Call Option

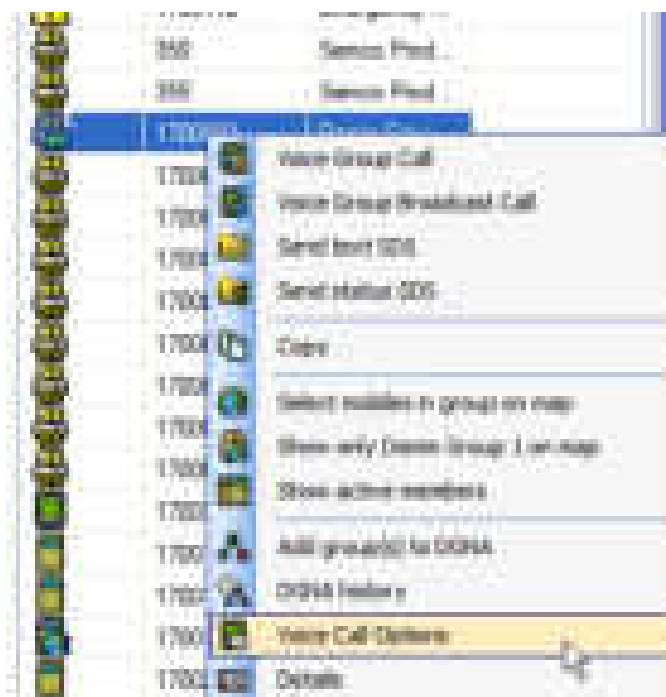

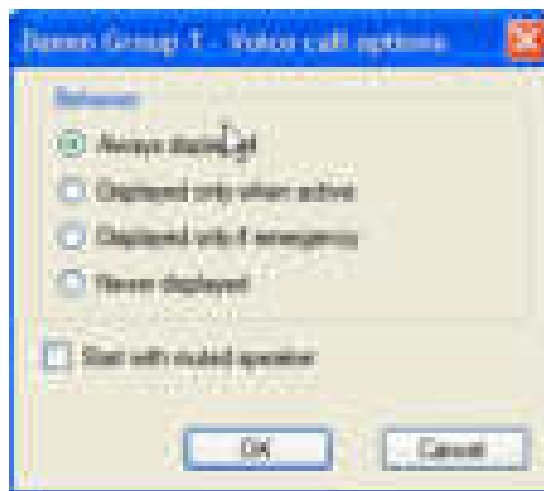


Figure 3-57: Voice call Option

Then select **Always Displayed** in the option menu

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**Figure 3-58: Always Displayed**

To deselect, use the **Never displayed** option or one of the other options.

### 3.5.5 Call Authorized by Dispatcher (CAD)

This service is configured in the subscriber register profile and allows the dispatcher to verify call requests before calls are allowed to proceed. This is a useful service to utilize when radio user discipline needs to be maintained. This service also reduces the amount of radio traffic on a network as only essential work related calls are permitted. However, the frequent need for all communication between terminal users and the time delay experienced in authorizing calls may make this service unacceptable for some user organizations.

Service restrictions may be set up as Yes, CAD or No, where “Yes” will allow the service, CAD requires the dispatcher defined in the relevant profile to authorize the service, and No will disallow the service. NOTE that the restrictions are not active until “Activate Service Restrictions” is selected




Figure 3-59: CAD Service Restrictions

### 3.5.6 Call Merge (dispatching)

This service allows the dispatcher to through connect a calling party to any other subscriber. Just call the desired subscriber and, when connection is established, drag the calling party (using the left user icon) to the new subscriber, drop it and confirm the connection.

This function also allows merging of two ongoing calls



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**Figure 3-60: Call Merge**

### 3.5.7 Receiving Emergency calls

Emergency calls will be indicated in the Voice call window as a red bar containing the standard voice call options.

Also an alarm tone will be played and the ADU200 relay contacts will close. Alarms can be reset by answering / selecting the call



**Figure 3-61: Emergency Call**

In case the call is not answered, the missed call icon in the main tool bar will turn red and a red notification line will be added to the Voice call history window



**Figure 3-62: Missed emergency call**

Double clicking on the missed call icon with missed call window closed, will open up the Voice Call History with the missed call filter activated to enter the corrective action handling.



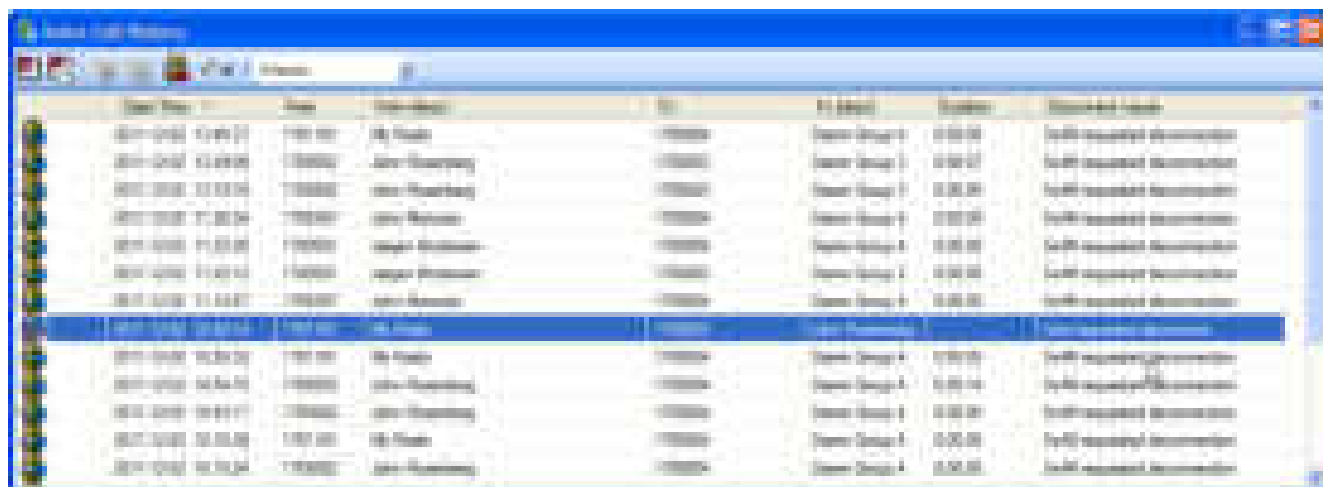
**Figure 3-63: Missed Emergency Call**

The icon will be shown as either answered  or missed 

### 3.5.8 Voice Call History








The Voice Call History logs the call activity of the Dispatcher. In this window it is possible to see the call information. All call activities are time stamped and logged and all responses from the infrastructure are logged as well.






Date	Time	Direction	To	From	Group	Duration
2013-01-04	12:00:00	Incoming	123456	789012	Group 1	0:00:00
2013-01-04	12:00:05	Outgoing	789012	123456	Group 2	0:00:05
2013-01-04	12:00:10	Incoming	123456	789012	Group 1	0:00:05
2013-01-04	12:00:15	Outgoing	789012	123456	Group 2	0:00:05
2013-01-04	12:00:20	Incoming	123456	789012	Group 1	0:00:05
2013-01-04	12:00:25	Outgoing	789012	123456	Group 2	0:00:05
2013-01-04	12:00:30	Incoming	123456	789012	Group 1	0:00:05
2013-01-04	12:00:35	Outgoing	789012	123456	Group 2	0:00:05
2013-01-04	12:00:40	Incoming	123456	789012	Group 1	0:00:05
2013-01-04	12:00:45	Outgoing	789012	123456	Group 2	0:00:05

Figure 3-64: Voice Call History

-  Clears the Voice call History list
-  Clear all voice recording from the dispatcher
-  Playback voice recording. The Icon is grayed if no there is no voice recording on the call history line you have selected.
-  Clear the voice recording on the selected call history line
-  Show / hide group calls
-  Filter for showing All, Incoming, Outgoing and Missed calls in the voice call history list.
-  Selecting the time period shown in the voice call history list (1 hour to 3 month)

In the voice call history list is possible to sort the different columns by clicking in the column header.


By clicking a voice call line it is possible to playback the voice recording, but only on lines with green indication 

### 3.5.9 DGNA

Dynamic Group Assignment (DGNA) is used to send Groups to radios that not already have these groups programmed.

#### 3.5.9.1 Assigning subscribers to DGNA

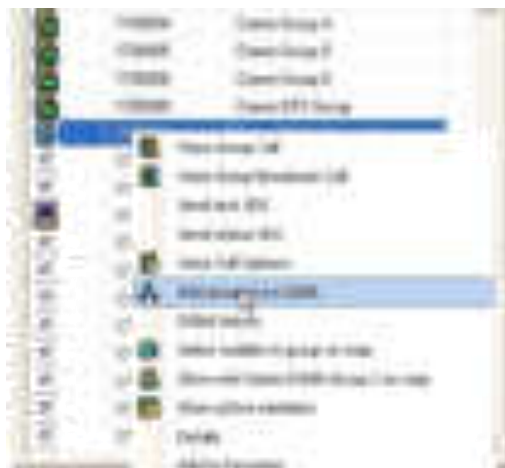
- 1: Right click on a group to be assigned

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- If it is not desirable to assign a group already programmed into the tetra terminals, a new group specific for DGNA should be defined in the Subscriber Register

2: Select function; “Add Group(s) to DGNA”

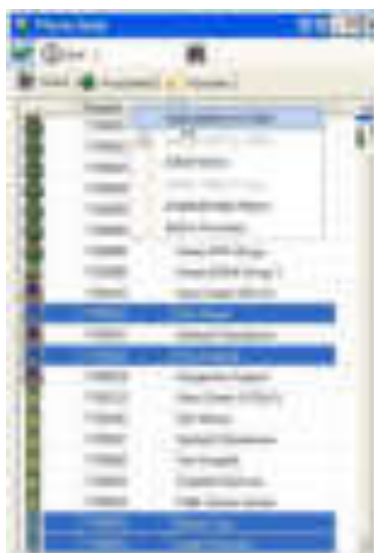
- This selects the parent group for the DGNA



**Figure 3-65: DGNA group Assignment**

3: Right click on a subscriber(s) to be assigned to the DGNA group. More subscribers may be selected by holding down the <Shift> or <Ctrl> keys

4: Select “Add mobile(s) to DGNA”



**Figure 3-66: DGNA subscriber selection**

5: Accept the selection



Figure 3-67: DGNA subscriber Assignment

Alternatively it is possible to drag and drop the selections to the DGNA group window

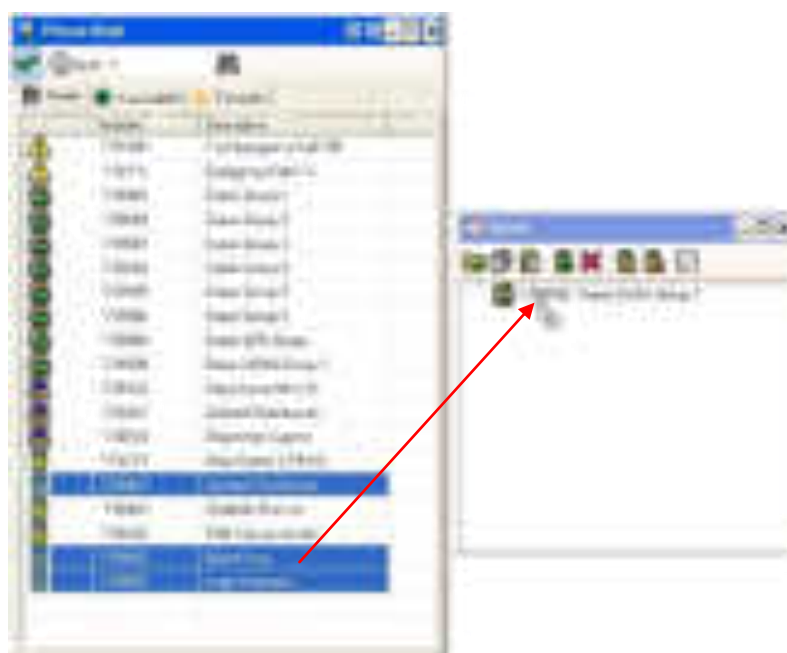



Figure 3-68: DGNA Drag and Drop Selection

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6: Repeat 3 and 4 if more subscribers are to be assigned to the DGNA group

7: After assigning subscribers, the DGNA group is transferred to the mobile by selecting “Assign the parent group to the mobile”

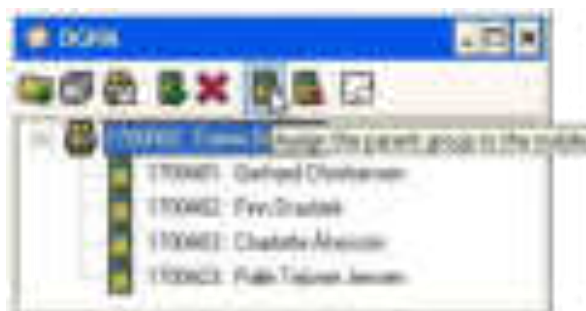


Figure 3-69: DGNA Assignment

### 3.5.9.2 De-assigning subscribers to DGNA


1: Select group or subscriber to be de-assigned and press the  de-assign icon



Figure 3-70: DGNA de-assign



Figure 3-71: DGNA de-assigned terminals

### 3.5.9.3 Showing DGNA history


- Right click on the group or subscriber

- Select DGNA History



Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08

Figure 3-72: Individual Subscriber DGNA history



Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08

Figure 3-73: Group DGNA history

### 3.5.10 SDS Functionality

All outgoing SDS traffic from the Dispatcher is initiated from the Call Dialog which is available in the SDS and Phone Book windows. The predefined Status SDS's in the list are Organization in-dependent, since they are completely transparent to the infrastructure. The predefined Status SDS list is located in a file named StatusSds.txt on the local dispatcher PC.


All incoming SDS traffic to the dispatcher is placed in the inbox; please see [Figure 3-74](#). This includes both text and status SDS's.

An open or closed envelope indicates whether the SDS has been read or not




Tidspunkt	Tidspunkt	Tidspunkt	Tidspunkt
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08
2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08	2013-01-03 15:42:08


Figure 3-74: SDS Inbox

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All outgoing SDS traffic from the Dispatcher are copied to the SDS Outbox, see [Figure 3-75](#). This includes both text and status SDS's. The status of any requested SDS Reports is indicated here by icons.

The types of SDS reports which are supported are:

- **Delivery/consumed Report Request** 

The receiving Terminal shall report when the SDS has been received.
- **Action accomplished** 

The receiving Terminal has opened (read) the SDS.




**Figure 3-75: SDS Outbox**

In the figure above, the left icon shows a SDS send with flag for Delivery- and Consumed Report set.

The figure changes to  when the SDS has been read / consumed

#### 3.5.10.1 SDS details

SDS details may be displayed by right click on the specific SDS message and selecting "Details"

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**Figure 3-76: SDS Details**

### 3.5.10.2 Receiving Emergency SDS

Emergency calls will be indicated in the SDS call window as a red bar containing the standard SDS options.

Also an alarm tone will be played and can be reset by answering / selecting the call



**Figure 3-77: Emergency SDS**


The icons associated with the emergency SDS are:

SDS received 

SDS answered 

### 3.5.10.3 ADU200 emergency alarm box


Please refer to the configuration section 3.5.3.2.7 external devices

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### 3.5.11 Map

### 3.5.12 Detach Map

The map window may be detached from the main dispatcher window and placed anywhere on the PC monitor(s)

This detachment is accomplished by selecting the detach/attach  icon positioned in the upper right hand corner of the map window. To attach again, select the detach/attach icon once more

#### 3.5.12.1 Positioning


The TetraFlex® dispatcher offers GPS positioning

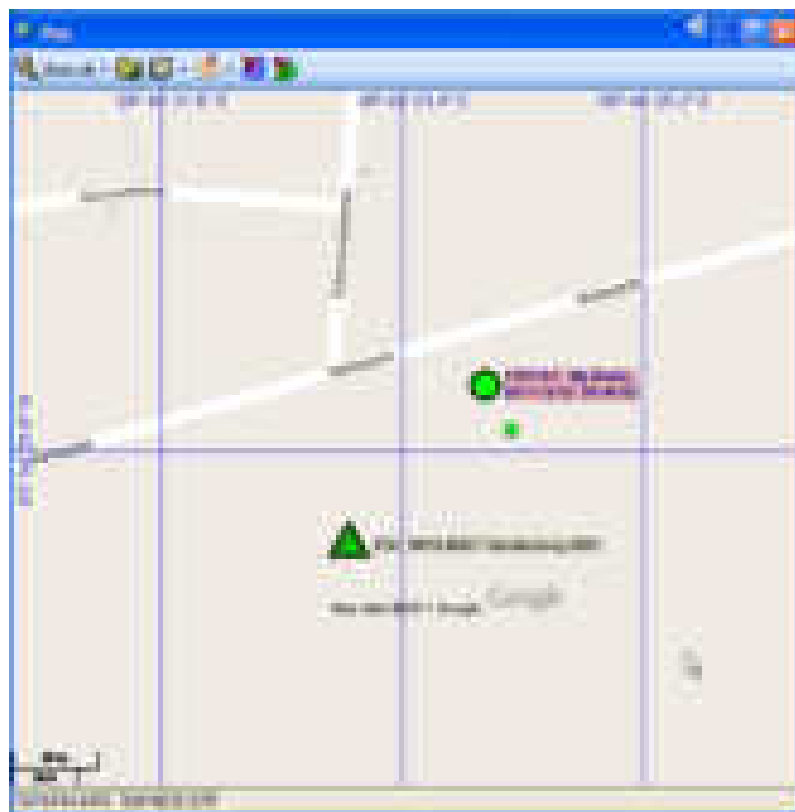
Positions may be shown as a function of automatic positioning information sent from the terminals or as a manual request from the dispatcher. This functionality uses WGS84 map coordinates together with Google Maps or one of the other supported map formats.

It is also possible to add layers in ESRI Shapefile format on top of one of the supported maps (except the standard Goggle map format) e.g..for showing details that are not on standard maps.

Positions are shown as green circles and position history as yellow. When moving the mouse over the circle, the data and time for the subscriber is shown.




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**Figure 3-78: Positioning Google**

To request the position of a subscriber, right click on the phonebook entry and select the option you want:



- Select mobile on map - This highlights the GPS position of the radio on the map with big green circle and subscriber details 
- Center on map – Center the GPS position on the map
- Position History – Shows the Position History window and the historic GPS position on the map as yellow circles
- Request position – This request the actual GPS position from the radio. This could be usefull when the radio has a long scan period for delivering GPS coordinates and you want a position here and now.
- Start Sepura Performance Reports – This function is at the moment only available in Sepura radios and is use for getting the RSSI downlink measurment from the radio.

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### 3.5.12.2 Configuring positioning

At present the TetraFlex® relies on the mobile to send positioning to a group. Any group may be used, but it is recommended to create a specific positioning group. This GPS to Group assignment must be set from the radio programming tool.

The position information SDS from the mobile is send to the group. The dispatcher is as rule “member” of all groups, so the dispatcher will pick up the SDS information, process and show it as a position on the map.


Positioning SDS's are filtered out and will not be shown in the dispatcher SDS inbox

### 3.5.12.3 Overlay file in ESRI map (.shp) format

NOTE: The use of overlay files in ESRI format is dongle controlled.

You can use ESRI overlay maps on top Google premier maps, OpenStreet maps, Raster maps and the Empty map option. Standard Google maps are not supported with overlay maps. The Dispatcher uses a flag in the Dongle in order to enable and disable the ESRI shape file view.

The current used overlay files are saved together with the used map and will be re-loaded when the map view / dispatcher is started again.

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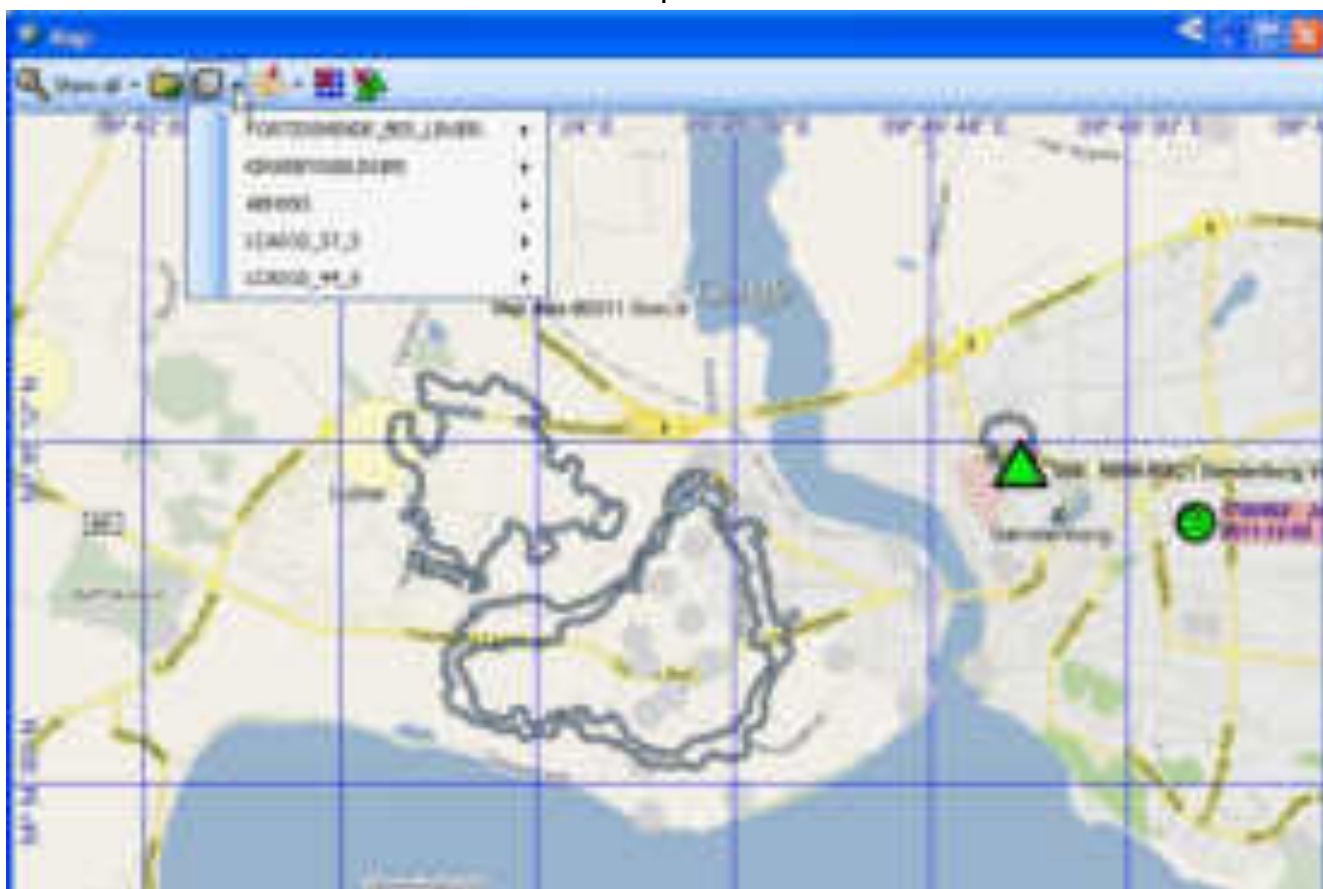


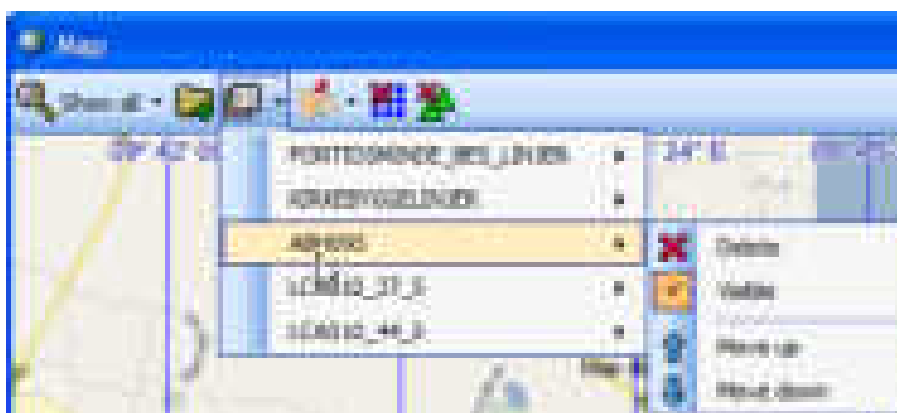



Figure 3-79: Overlay on Google map

To load a new overlay file use the  folder icon. When loaded it will be available in the overlay list .




By Right clicking on the overlay in the menu, you get the possibility to **Delete** them again, make them **Visible** or not Visible and to move the layer up and down (**Move up**, **Move down**) in the different layers on the map e.g. if two layers are overlaying each other you can change which one should be in front.

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#### 3.5.12.4 Other map options

The **Show (all)** menu makes it possible to select what GPS coordinates you want to show on the map:

- Show all – Shows the GPS coordinates for all radios, registered and not registered (not registered are shown with a dark green color).
- Show registered – Shows only the registered radios. If a Radio comes out of coverage, the battery is removed or in another way comes unavailable without de-registering it will still be shown on the map as registered.
- Show history – Shows the historical plot of GPS coordinates for the selected radio.

With the  icon you can change the map view between Road map, Satellite or Hybrid. This option is only available in Google premier maps and on Google standard map (map and satellite).



Toggles between showing grid line on the map and no grid lines (not available on Google standard map)

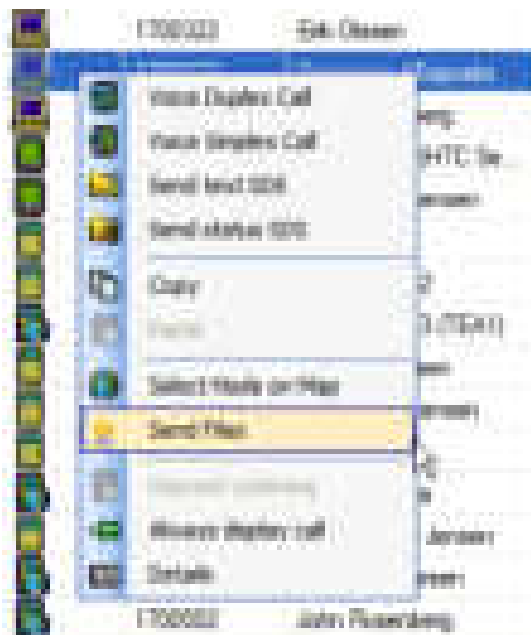


Toggles between showing the nodes on the map or not. (not available on Google standard map)

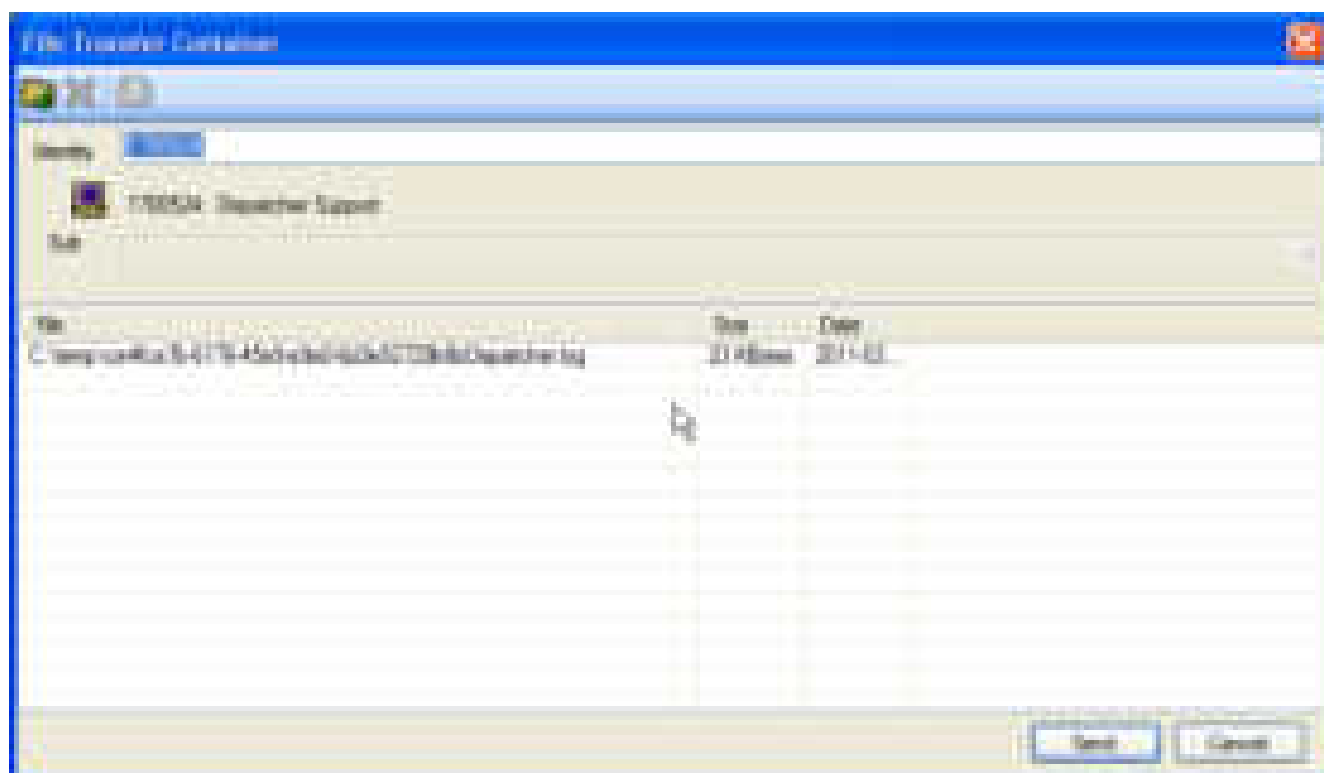



Show / hides lines between history points on the map. (not available on Google standard map)






When selecting Send Files you get the file transfer container:



Here you can either drag and drop the files you want to send from e.g. the file manger or you can use the file menu  to get the open dialog from where you can select the files you want to send.



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## 3.6 LOG SERVER

### 3.6.1 Description

A TetraFlex® Log Server is a network component that can be placed anywhere in the TetraFlex® Network's infrastructure. Once connected, it will automatically start recording the status of all Nodes in the TetraFlex® network, without any configuration. Furthermore it can be setup to log statistics (default, always present), SDS, Call records and Voice Communication, or a combination of these functions (dongle controlled)

The TetraFlex® system supports the attachment of one or more Log Servers to the system. The Log Server is developed to run on a Windows platform.

For single-site and small systems the Log Server can be installed on and run from the BSC412 or BSC421.

For bigger systems the Log Server must run on DAMM Log Work Station or on a DAMM Log Server Station.

### 3.6.2 General Description

#### 3.6.2.1 The TetraFlex® Network and the Log Server


The TetraFlex® network infrastructure consists of TetraFlex® Nodes which are connected through a backbone IP net as illustrated in Figure 3-80  
Log Servers are passive network elements that can be attached anywhere in the infrastructure, only requirement is IP connectivity to the backbone network. When attached the LogServer will automatically be joining a specific log server IP multicast address on which all Nodes send status and call information.

The Log Server is capable of:

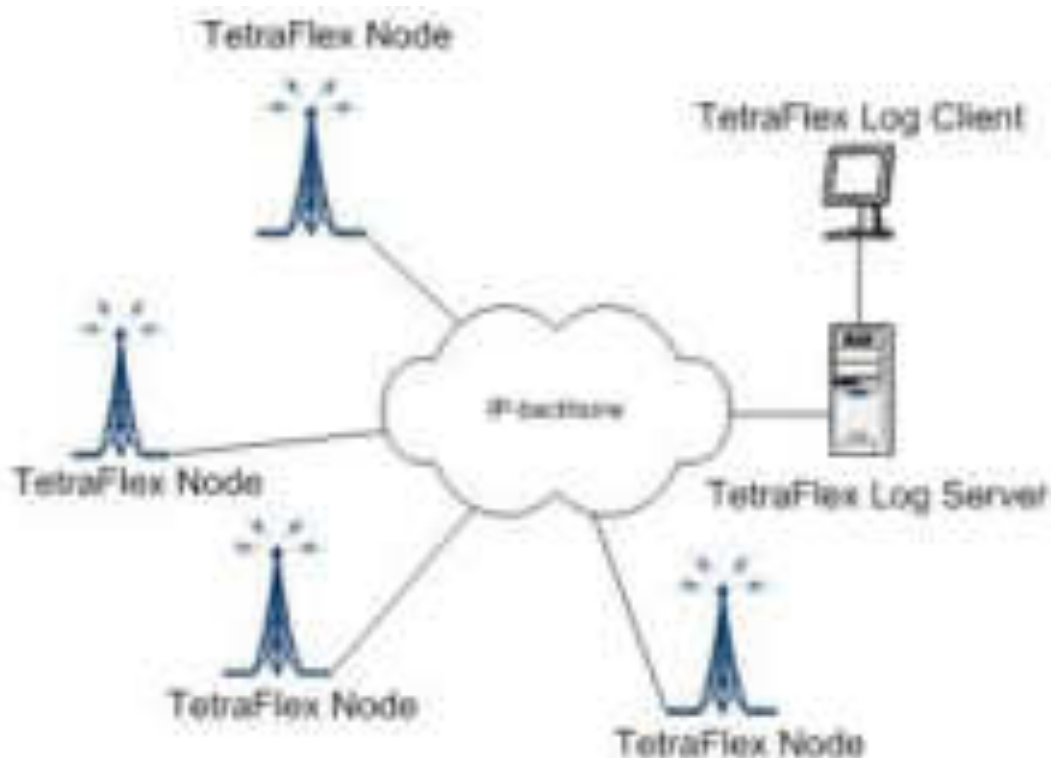
- Logging the status from all Nodes in the TetraFlex® network.
- Logging Call information (Call Data Records) for all mobiles.
- Logging Voice Communication for selected mobiles.
- Logging the mobiles Node location and on/off state for selected mobiles.

The Log Server automatically starts to log the status from the TetraFlex® Nodes. In addition, it can be setup to log all calls (CDR without voice) and SDS on the system, and optionally log Voice Communication and Node location for selected mobiles. The Log Server logs all data to a database, managed by a SQL Server. As an option the log server can also stream log data to an external log program through the Log API.




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In Figure 3-80 TetraFlex® Network with Log Server, the SQL Server and the Log Server are running on the TetraFlex® Log Server machine.




**Figure 3-80 TetraFlex® Network with Log Server**

It is possible to attach one or more TetraFlex® Log Servers to the infrastructure, either on dedicated Log Server machines or on a BSC412 or BSC421, all depending on the network load.

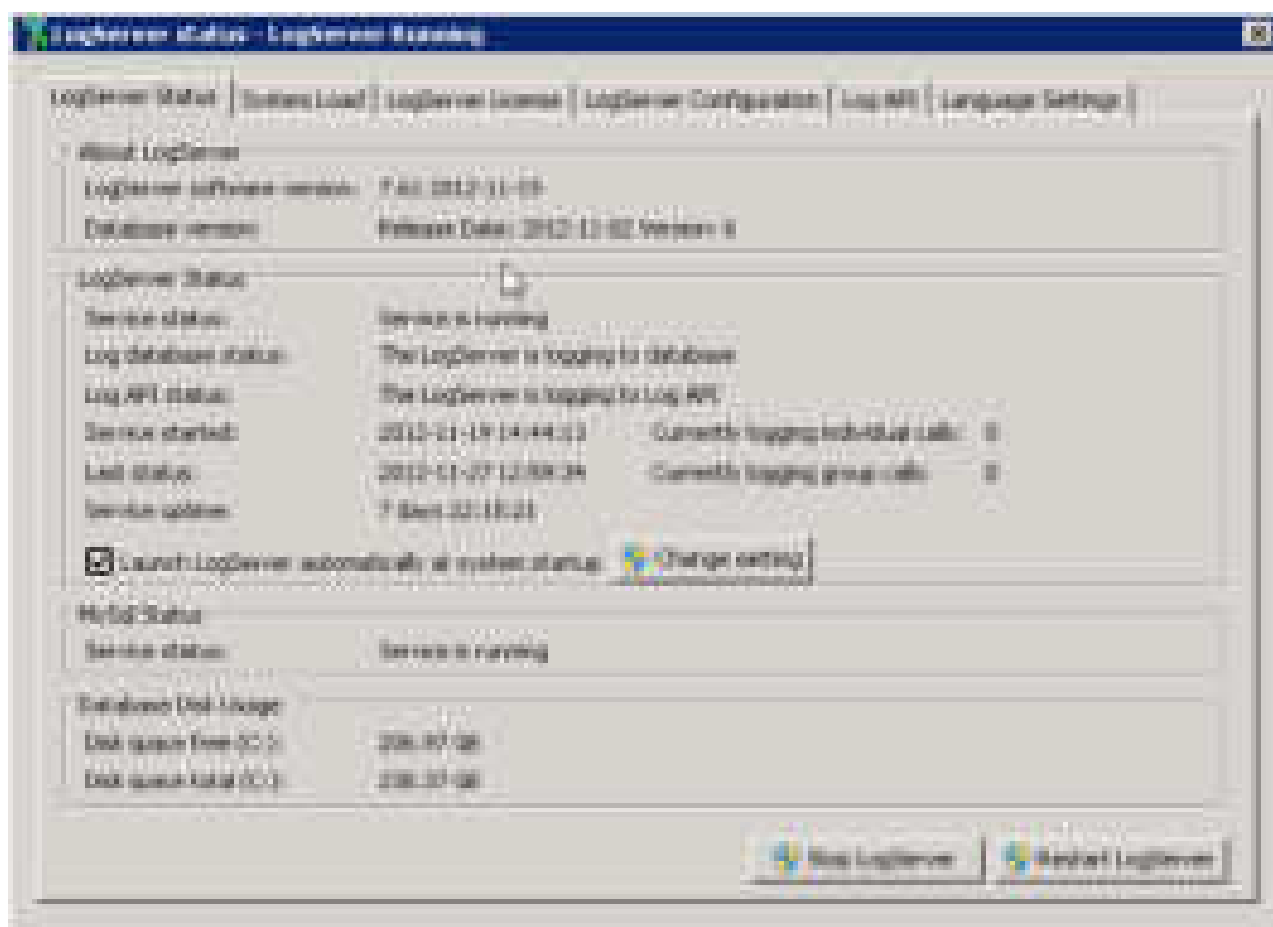
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### 3.6.2.2 Log Server Tray


The log server tray is a user interface for the Log server application and is automatically started as a “tray” application (indicated with a small icon  on the taskbar) when the log server starts.



By right click on the log server tray icon you can select the Log server Configuration:



Please see chapter 2.11.3 Log Server Configuration to find details about the log server tray.

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## 3.7 LOG CLIENT

### 3.7.1 Description

The TetraFlex® Log Client application is developed to run on a Windows XP or Win7 platform or a Terminal Server where multiple users can run their own instance of the TetraFlex® Log Client at a time.

The TetraFlex® Log Client application requires access to the SQL-Server and has the following properties:


- There is no user validation. Dongle configuration controls the level of database query
- Hardware Dongle required.
- It is able to query CDR records from the database for:
  - Group- and individual calls
  - SDS Status
  - SDS TL
  - SDS Data
  - SDS Application

Queries can be made for a specified time interval as well as “Only from”, “Only to” and combination of this.

- Set up query and replay Voice data from the database for voice logged group- and individual calls for a specified call.
- Set up the latest MS Registrations, and also historical registration data for the mobiles.
- Set up to monitor the status of the Tetra network.
- Set up to present statistical data showing the performance of the TetraFlex® Network.
- Set up the Subscriber configuration, meaning setting up which mobiles should be “location and voice logged”, and which groups should be voice logged.
- Set up the logging priority for the selected individual and groups
- It is able to switch database without restart of the application.
- Selecting temporary storage for voice playback files

### 3.7.2 Functionality

When the TetraFlex® Log Client application is launched the main window appears:

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**Figure 3-81: Log Client - Main window**

From the Log Client toolbar it is possible to open the Statistics-, CDR-, MS Reg.-, Status- and the Settings view.

Note that the title bar indicates which SQL Server and database the application is connected to.

### 3.7.3 Statistics View

The Statistics view has six tabs

On the statistics window of each tab it is possible to right click to open the configuration dialogue. The configuration dialogue also includes export options

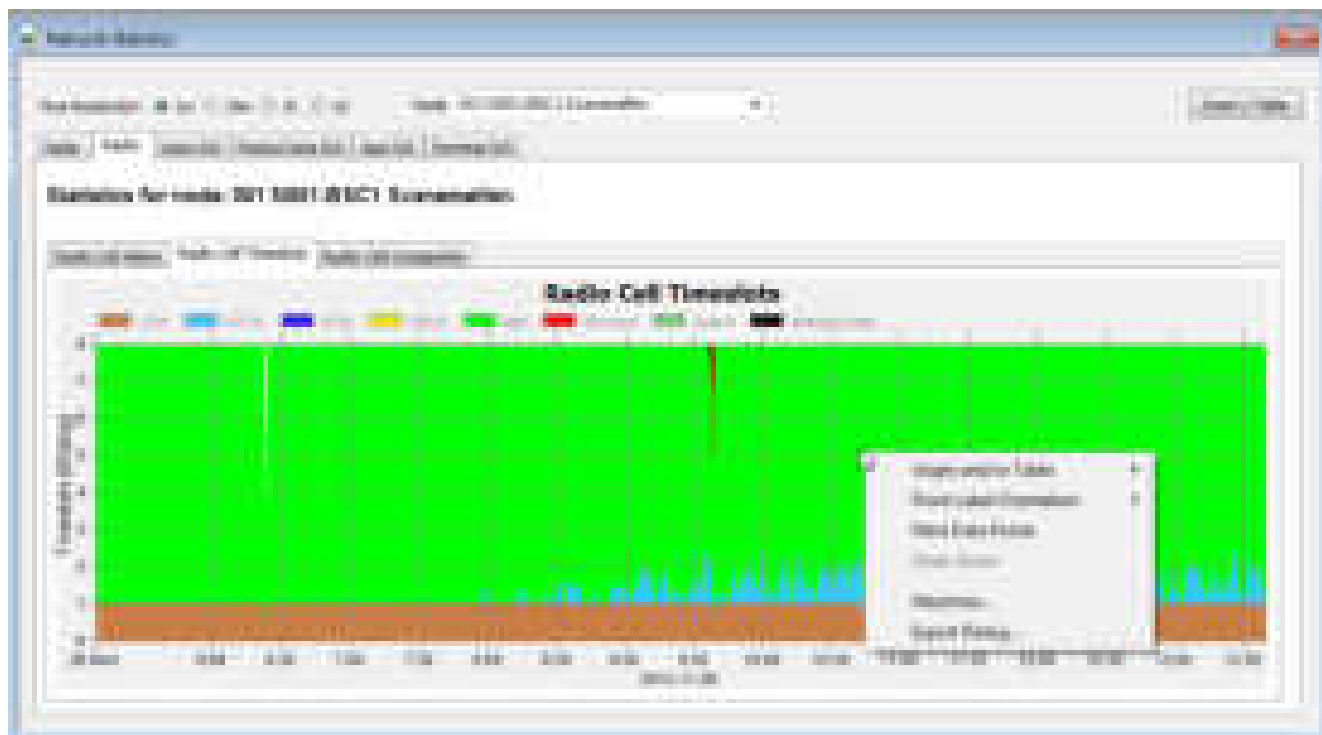


Figure 3-82: Configuration Dialog example



Figure 3-83: Export Dialog example

### 3.7.3.1 Node

Shows the Node Alarm as percentage of time

Indications are

- OK
- Warning (L1)
- Alarm (L2)
- Blocked (L3)
- Shutdown
- Missing



**Figure 3-84: Node**

### 3.7.3.2 Radio

The Radio tab has 3 sub-tabs

All tabs has a selection of resolution to 1 minute, 10 minutes, 1 hour or 1 day

All tabs has the selection of table or graphic view

### 3.7.4 Radio Cell Alarm

Shows alarms as percentage of time



**Figure 3-85: Radio, Alarm**

#### 3.7.4.1 Radio Cell Timeslot

Shows timeslots as function of Erlang



**Figure 3-86: Radio, Timeslot**

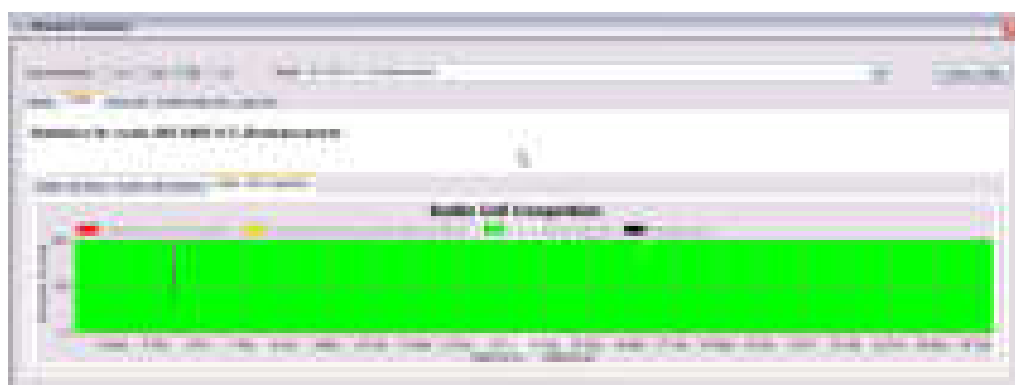
Congestion shows the traffic load in percentage, and Timeslot showing the average timeslot distribution for a specific node. The user has to enter resolution time and specify a Node.

The timeslot types displayed are:

Timeslot table	
Timeslot type	Description
CCH	Control Channel. (MCCH and SCCH)
Group Call TS (GTCH)	Timeslots used for group calls.
Individual Call TS (ITCH)	Timeslots used for individual calls.
Packet Data TS (PDCH)	Timeslots used for packet data.
Idle TS	Unused/Idle timeslots ready for traffic.
Blocked TS	Blocked timeslots which cannot be used for traffic.
Spare TS	Spare timeslots used for redundancy if a transceiver drops out.
Missing Data	No connection between node and log server

#### 3.7.4.2 Radio Cell Congestion

Shows timeslot usage as percentage of time



**Figure 3-87: Radio, Congestion**

### 3.7.5 Voice GW

Voice GW tab has 3 sub-tabs

#### 3.7.5.1 Voice GW Alarm

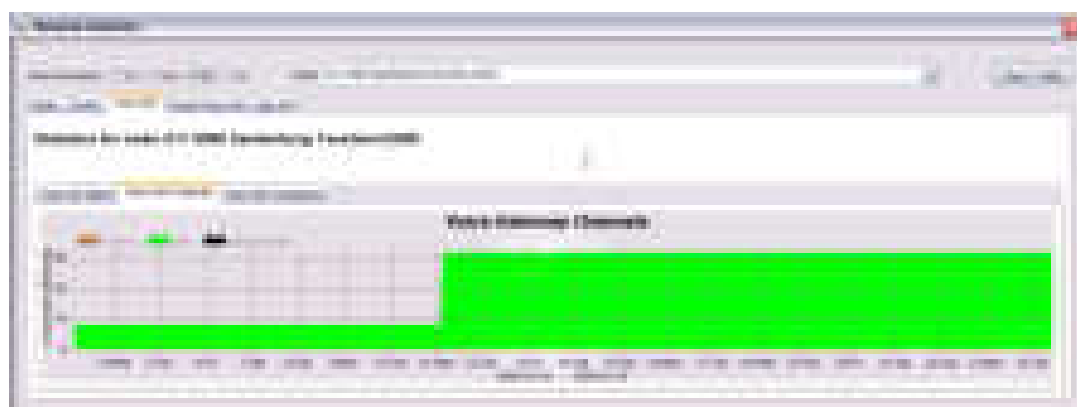
Shows alarms as percentage of time



**Figure 3-88: Voice GW, Alarms**

#### 3.7.5.2 Voice GW Channels

Shows GW channels related to Erlang

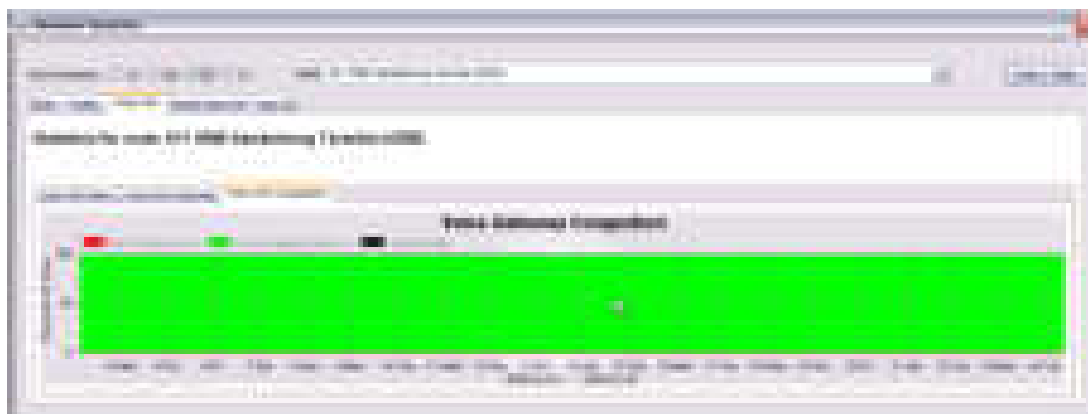


**Figure 3-89: Voice GW, Channels**

#### 3.7.5.3 Voice GW Congestion

Shows GW congestion related to percent of time

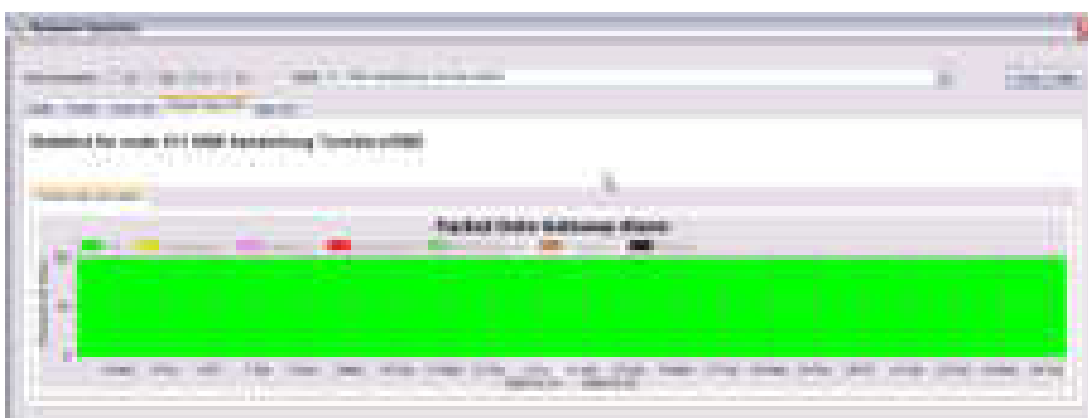




**Figure 3-90: Voice GW, Congestion**

### 3.7.6 Packet Data GW

Shows GW alarms related to percent of time



**Figure 3-91: Packet Data GW, Alarms**

### 3.7.7 Application GW

Application GW has 3 sub-tabs

#### 3.7.7.1 Application GW alarms

Shows GW alarms related to percentage of time

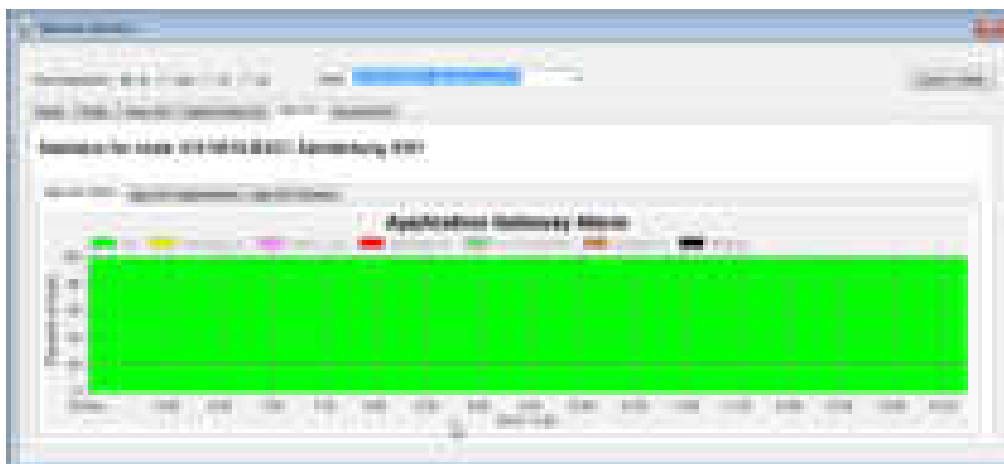


Figure 3-92: Application GW, Alarms

### 3.7.7.2 Application GW registration

Shows numbers of application registered:

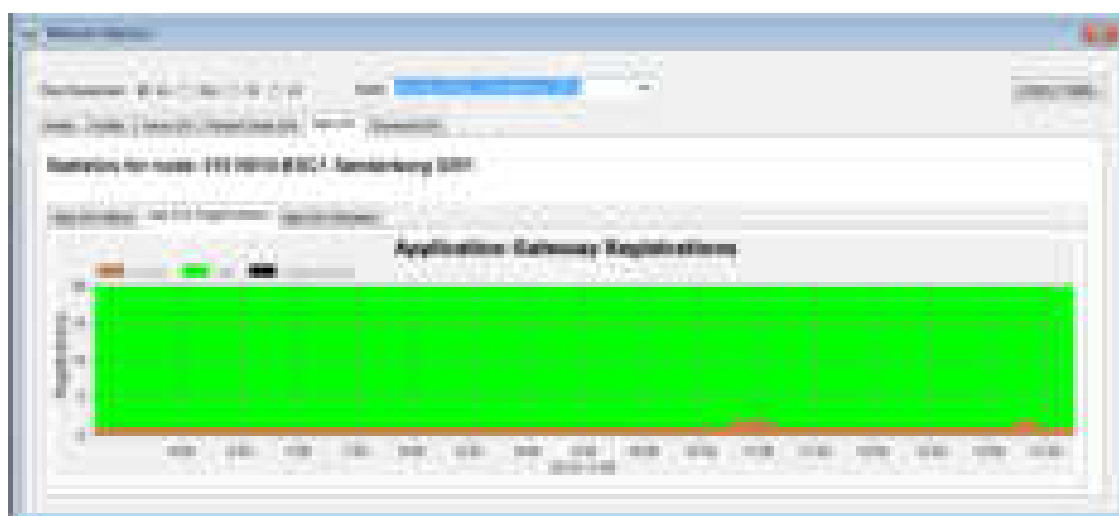


Figure 3-93: Application GW, registrations

### 3.7.7.3 Application GW streams

Shows numbers of application streams:

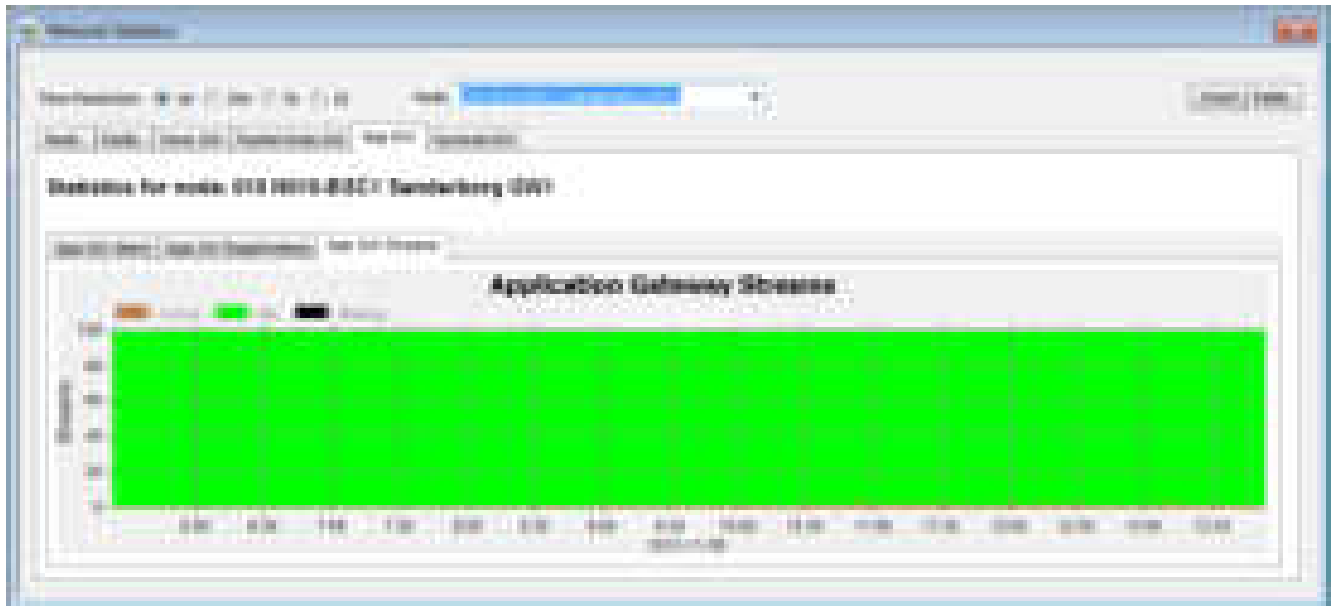


Figure 3-94: Application GW, registrations

### 3.7.8 Terminal GW

Terminal GW has 3 sub-tabs

#### 3.7.8.1 Terminal GW alarms

Shows GW alarms related to percentage of time

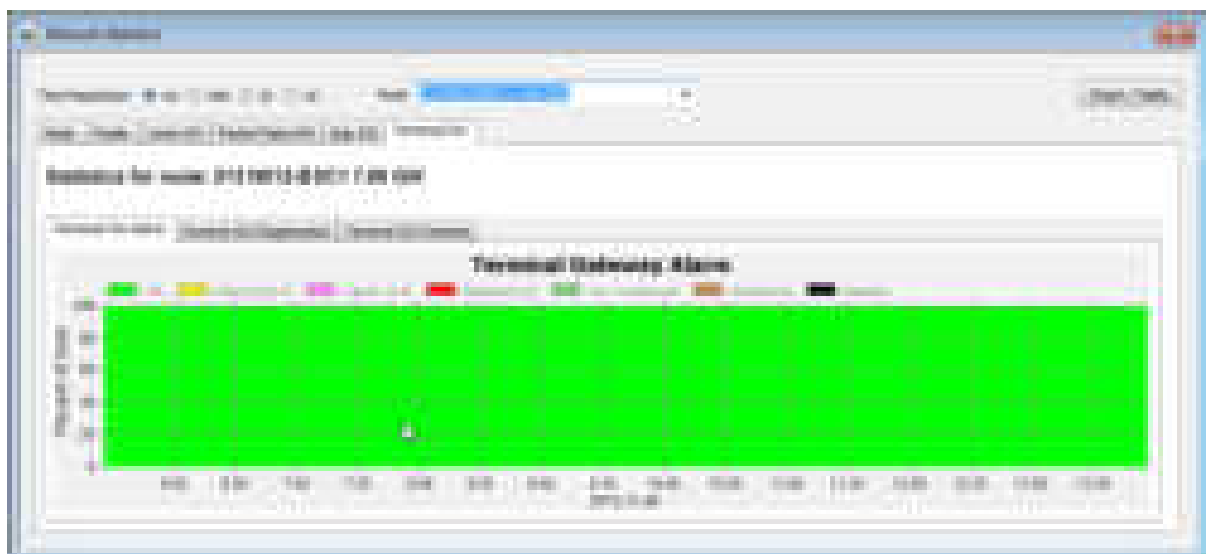


Figure 3-95: Application GW, Alarms

### 3.7.8.2 Terminal GW registrations

Shows the Terminal GW Registrations

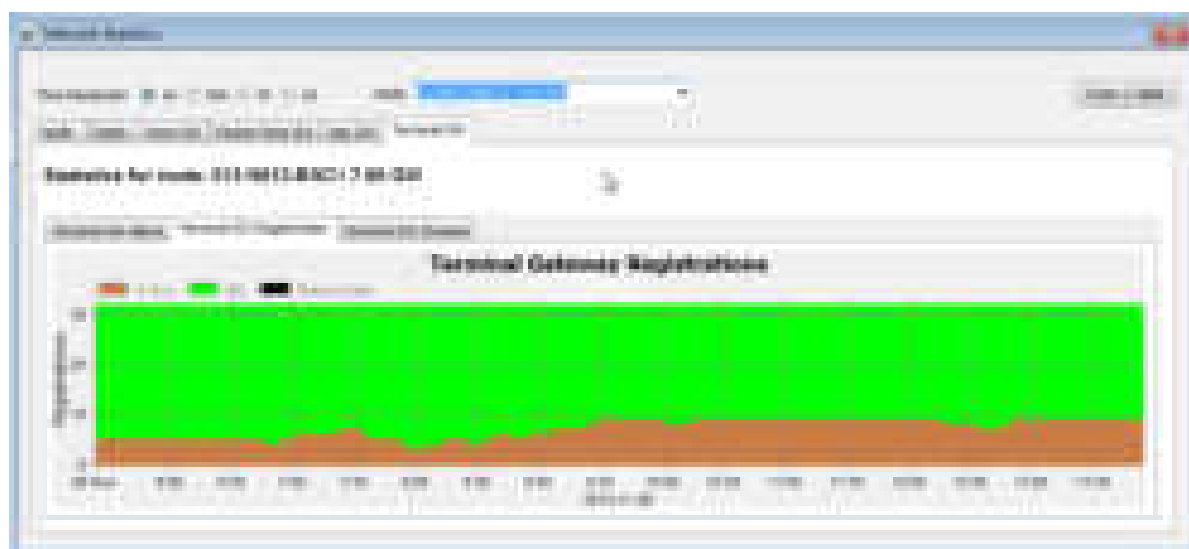


Figure 3-96:Terminal GW, Registrations

### 3.7.8.3 Terminal GW Streams

Shows the Terminal GW Streams

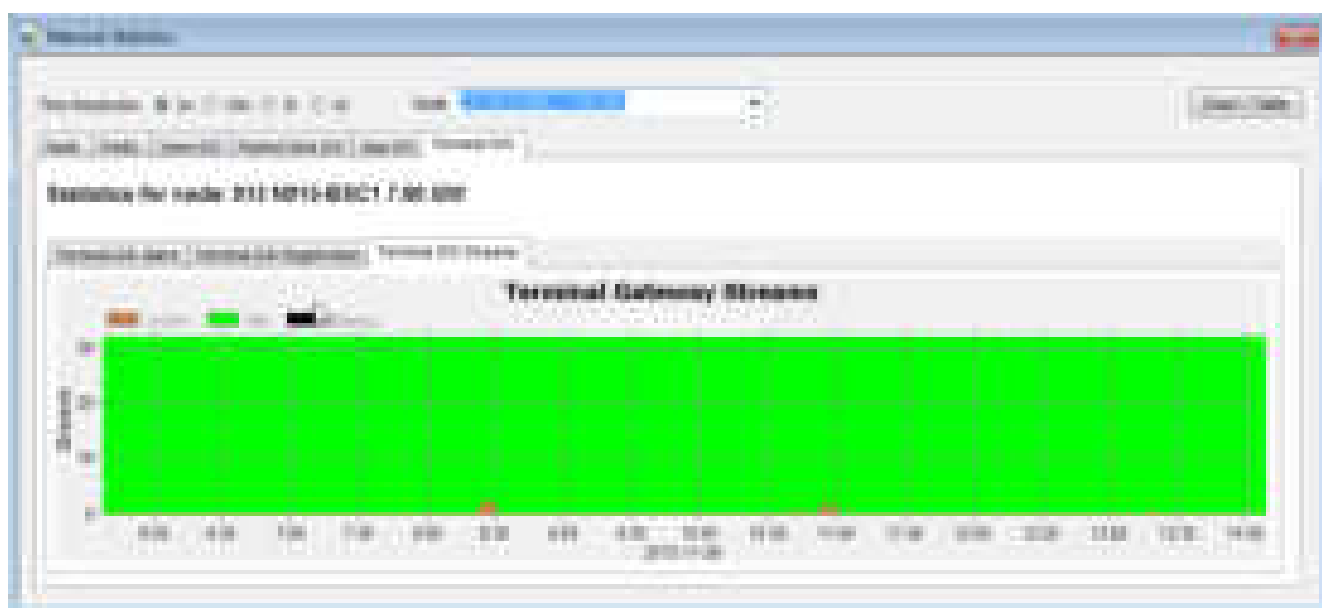

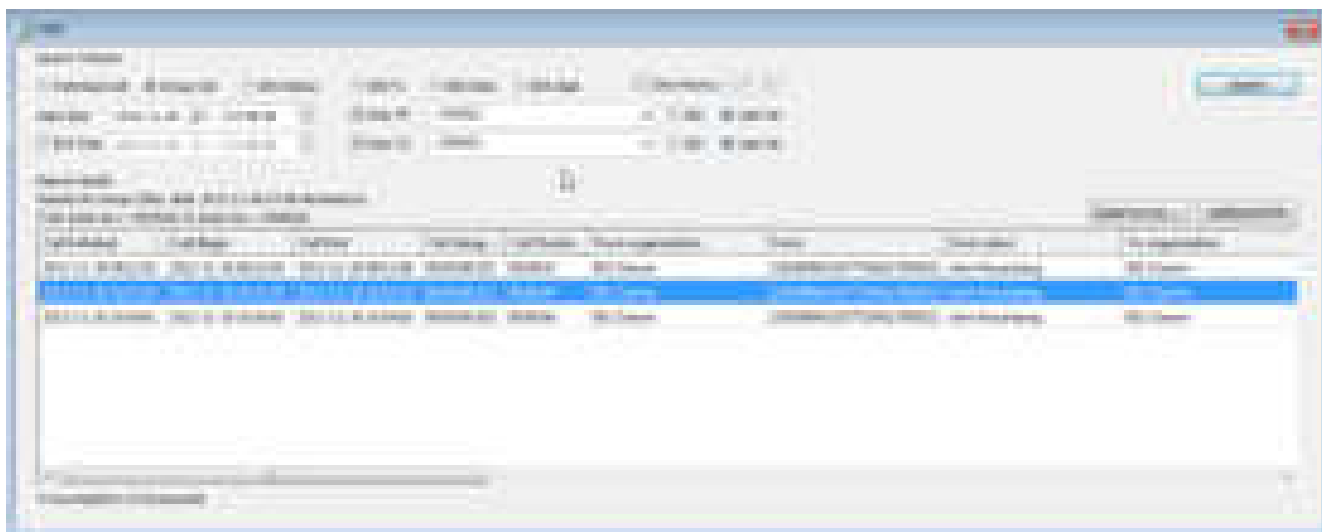


Figure 3-97:Terminal GW, Streams

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### 3.7.9 CDR View

In the CDR View the Call Data Records are presented. The user must enter Search Criterion as the time period and specify whether it is group-, individual- or SDS type- calls to narrow the number of hits. It is also possible to specify a single From and/or To subscriber. When Search Criterion is entered, press Search button to load the Search Results from the SQL Server.




**Figure 3-98: Log Client, Call Data Records**

The Search Result lists all the calls matching the Search Criterion, and it contains the relevant call information like Call Begin, Call End, From, To, From Node, Call Priority etc. One row in the result grid reflects one call.

When the Search Result is loaded it is possible to export the list to clipboard or to a file in CSV format.

To get additional information on a single call, either double click on a single row or select a row and press the Additional Info button.



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### 3.7.10 MS Registration View

The MS Registration view has three tabs, the Latest MS Registration, the MS Registration History tab and the MS RSSI history tab. When a mobile registers it indicates an Update Type to the Node.

These are the update types:

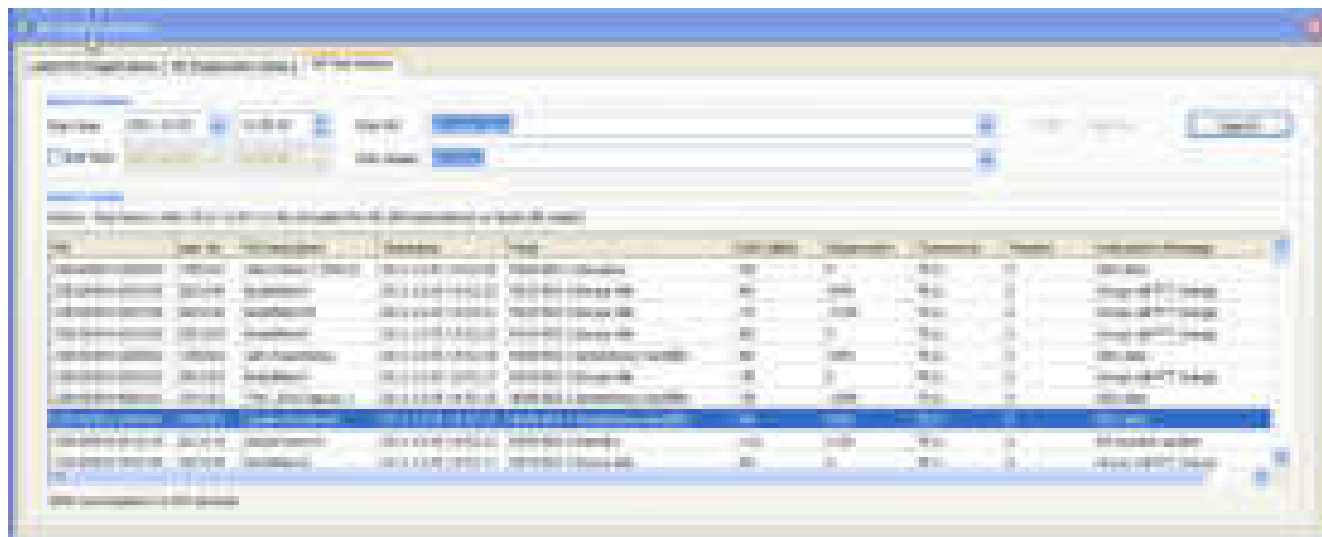
Update Type Table	
Update Type	Description
ITSI Attach (Power on)	The mobile has been turned on.
Roaming	The mobile has moved and is covered by a new Node.
ITSI Detach (Power off)	The mobile has been switched off.
Registered Area timer expired	If there is no communication to a MS in the timeout period defined (See NM connection timeout for setting the timeout) the MS will be set as de-registered
Reserved	BS initiated synchronization check; No restart of the Location Area timer.
Temporary disabled roaming	
Registration	(Migration or Other) attempt from unknown subscriber, rejected
BS detected an inconsistency	<p>"Inconsistency" in registration data means that the data we got from an MS now does not match the last transaction with that MS. That can happen if the MS is under bad coverage and it has only partly registered: It might have sent the U-LOCATION UPDATE DEMAND to the BS and we have received and confirmed it with D-LOCATION UPDATE ACCEPT, but then we might have lost the confirming BL-ACK from the MS. Then the registration data is not fully updated. This is a normal condition if operating in weak coverage with that SSI and will be recovered at the next fully successful registration.</p> <p>Another, much more critical issue is this one: There might be two mobiles with the same SSI configured! One registers e.g. with info "capable of Packet Data", and then the clone MS registers with "not capable of Packet Data", while the first one is still registered. This is an erroneous configuration and shall be avoided in any case.</p> <p>So please verify if it is always shown for the same SSI (or some few), and where that SSI has physically been (coverage wise).</p>





### 3.7.10.3 MS RSSI History

The MS RSSI history view shows the uplink RSSI values in dBm for each time a call is made or a SDS is send.



Call ID	Call Type	Call Status	Call Duration	Call Time	Call Date	Call Location	Call RSSI	Call Signal	Call Quality	Call Priority
1	Call	Success	00:00:01	12:00:00	2013-01-04	12.345678	-110	100	100	1
2	Call	Success	00:00:02	12:00:01	2013-01-04	12.345678	-110	100	100	1
3	Call	Success	00:00:03	12:00:02	2013-01-04	12.345678	-110	100	100	1
4	Call	Success	00:00:04	12:00:03	2013-01-04	12.345678	-110	100	100	1
5	Call	Success	00:00:05	12:00:04	2013-01-04	12.345678	-110	100	100	1
6	Call	Success	00:00:06	12:00:05	2013-01-04	12.345678	-110	100	100	1
7	Call	Success	00:00:07	12:00:06	2013-01-04	12.345678	-110	100	100	1
8	Call	Success	00:00:08	12:00:07	2013-01-04	12.345678	-110	100	100	1
9	Call	Success	00:00:09	12:00:08	2013-01-04	12.345678	-110	100	100	1
10	Call	Success	00:00:10	12:00:09	2013-01-04	12.345678	-110	100	100	1

Figure 3-102: Log Client, MS RSSI History

It is also possible to get the approximately distance to the node and what Transceiver there was used for the call.

NB: From log server version 7.52 MS RSSI history data older than 24 hours will be deleted.

### 3.7.11 Status Views



The status views windows shows the latest received Status messages of the TetraFlex® Node(s). Each TetraFlex® node in the network reports its status on regular interval (default interval is approx.10 seconds). This means that the Status view should always have status messages no older than the interval.

On each status tab the nodes in the TetraFlex® network are listed including the reception timestamp of the TetraFlexLogServer and their latest status.

The Status tab gives an overview of the nodes and their status. Each Status generally has these states:

Status Table	
Status type	Description
OK	Everything in perfect order.
Warning [L1]	Level 1 warning, informational only.
Alarm [L2]	Level 2 Alarm, reduced functionality of component.
Blocked [L3]	Level 3 Blocking Alarm, dropout of component.
Start-up	The component is starting up.
Not Alive	The component is not responding.
[BLANK] or "Not Configured"	The component is not configured on this node.

The list can be refreshed manually by pressing **Refresh**.

#### 3.7.11.1 Status tab

The Status tab shown below gives an overview of the status of the different components. The view is essential the same as shown in the Network Management, so refer to the Network Management Manual for detailed description of the different functions.

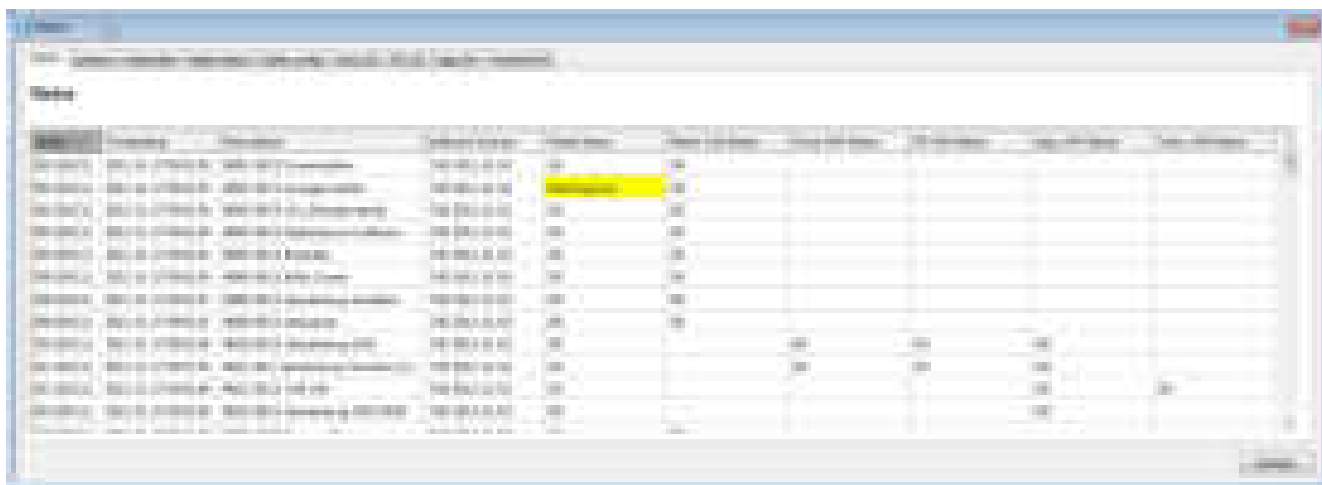
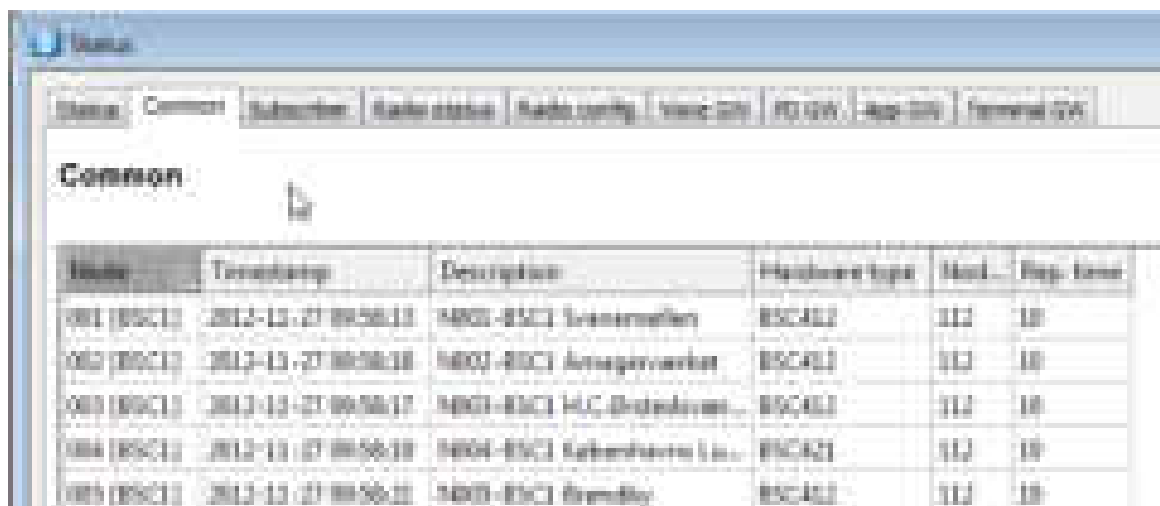


Figure 3-103: Log Client, Status view


### 3.7.11.2 Common



Node	Timestamp	Description	Hardware type	Mod...	Rep. time
001 (BSC1)	2012-12-27 09:58:18	NB01-BSC1 Transmitter	BSC402	112	10
002 (BSC1)	2012-12-27 09:58:18	NB02-BSC1 Antennawork	BSC402	112	10
003 (BSC1)	2012-12-27 09:58:17	NB03-BSC1 H.C. Bredskoven	BSC402	112	10
004 (BSC1)	2012-12-27 09:58:18	NB04-BSC1 København L...	BSC402	112	10
005 (BSC1)	2012-12-27 09:58:18	NB05-BSC1 Bredby	BSC402	112	10

On the Common tab it is possible to see the Hardware type, numbers of Nodes in total and the repetition time interval, which the node uses for sending its status message.

### 3.7.11.3 Subscriber

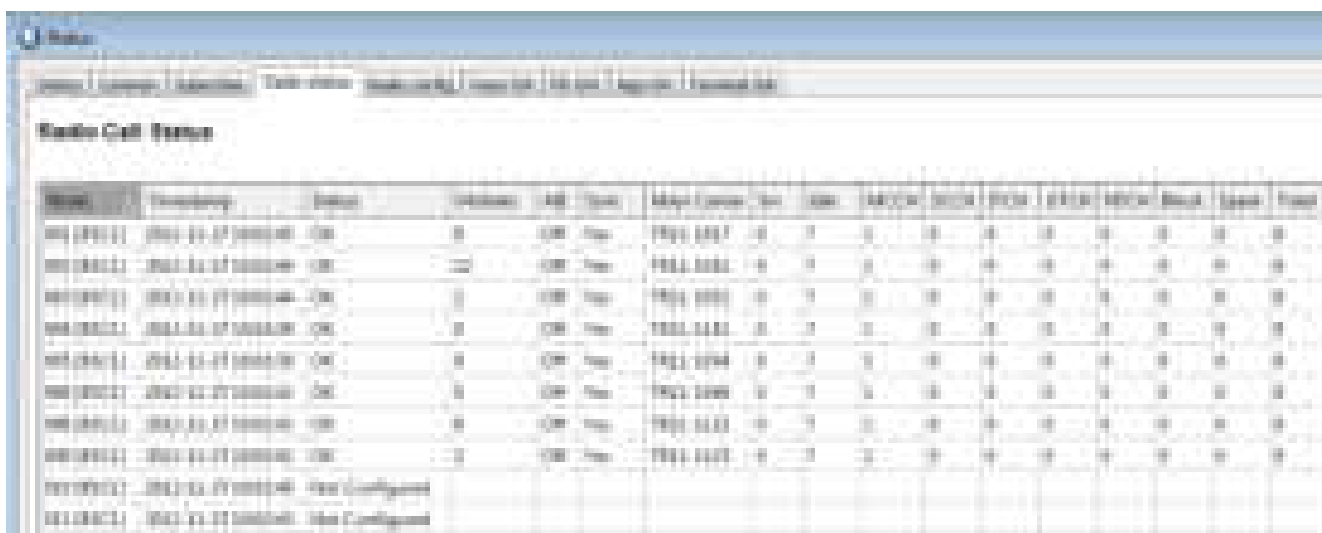


Node	Timestamp	Node	Net ID	Org	Prod	Sub ID	Code	Org ID	Reg ID	Prod ID	Prod ID	Prod ID	Prod ID	Node ID
001 (BSC1)	2012-12-27 09:58:18	Node	00000000	01	00	000	001	01	00000000	00000000	00000000	00000000	00000000	00000000
002 (BSC1)	2012-12-27 09:58:18	Node	00000000	01	00	000	002	01	00000000	00000000	00000000	00000000	00000000	00000000
003 (BSC1)	2012-12-27 09:58:18	Node	00000000	01	00	000	003	01	00000000	00000000	00000000	00000000	00000000	00000000
004 (BSC1)	2012-12-27 09:58:18	Node	00000000	01	00	000	004	01	00000000	00000000	00000000	00000000	00000000	00000000
005 (BSC1)	2012-12-27 09:58:18	Node	00000000	01	00	000	005	01	00000000	00000000	00000000	00000000	00000000	00000000
006 (BSC1)	2012-12-27 09:58:18	Node	00000000	01	00	000	006	01	00000000	00000000	00000000	00000000	00000000	00000000
007 (BSC1)	2012-12-27 09:58:18	Node	00000000	01	00	000	007	01	00000000	00000000	00000000	00000000	00000000	00000000
008 (BSC1)	2012-12-27 09:58:18	Node	00000000	01	00	000	008	01	00000000	00000000	00000000	00000000	00000000	00000000

**Figure 3-104: Log Client, Status Subscriber Register**

On the Subscriber Register tab it is possible to see which node is Master, and the subscriber counts and checksums which should be the same for all Nodes.

### 3.7.11.4 Radio Status

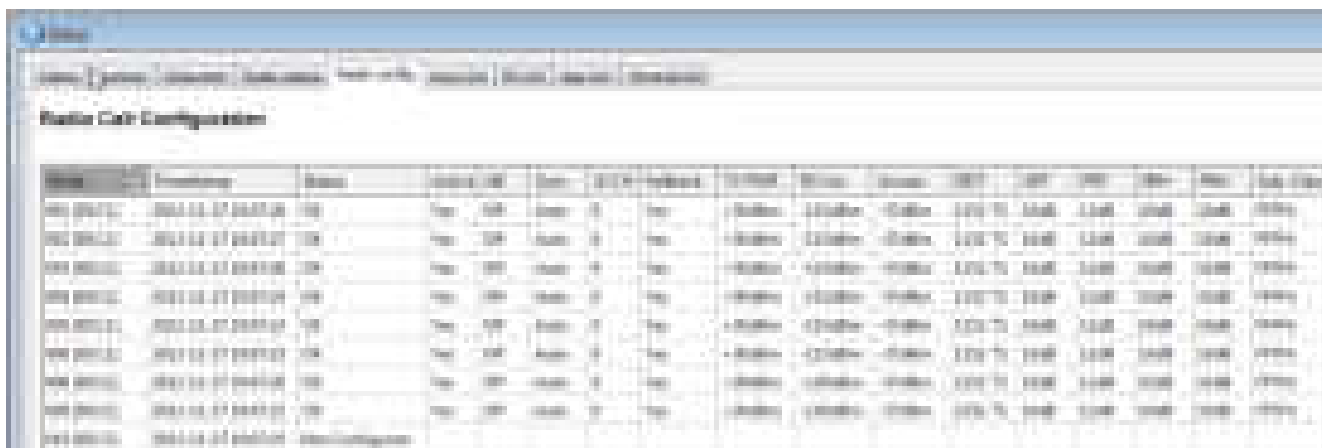


Radio	Frequency	Status	Channels	AIE	Time	Main Carrier	Sec	Chan	ARCCW	SRCCW	PRCCW	GRCCW	MRCCW	BCCH	SCCH	PCCH
00100001	894.0125	OK	8	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100002	894.0125	OK	22	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100003	894.0125	OK	8	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100004	894.0125	OK	8	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100005	894.0125	OK	8	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100006	894.0125	OK	8	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100007	894.0125	OK	8	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100008	894.0125	OK	8	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100009	894.0125	OK	8	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100010	894.0125	OK	8	OK	Yes	894.0125	0	1	0	0	0	0	0	0	0	0
00100011	894.0125	Not Configured														
00100012	894.0125	Not Configured														

Figure 3-105: Log Client, Radio Status

On the Radio Status tab it is possible in real time to see the number of registered Mobile, Air encryption (AIE) status, Neighbor cell synchronization, main carrier and tetra channel and the activity of the time slots.

### 3.7.11.5 Radio Config



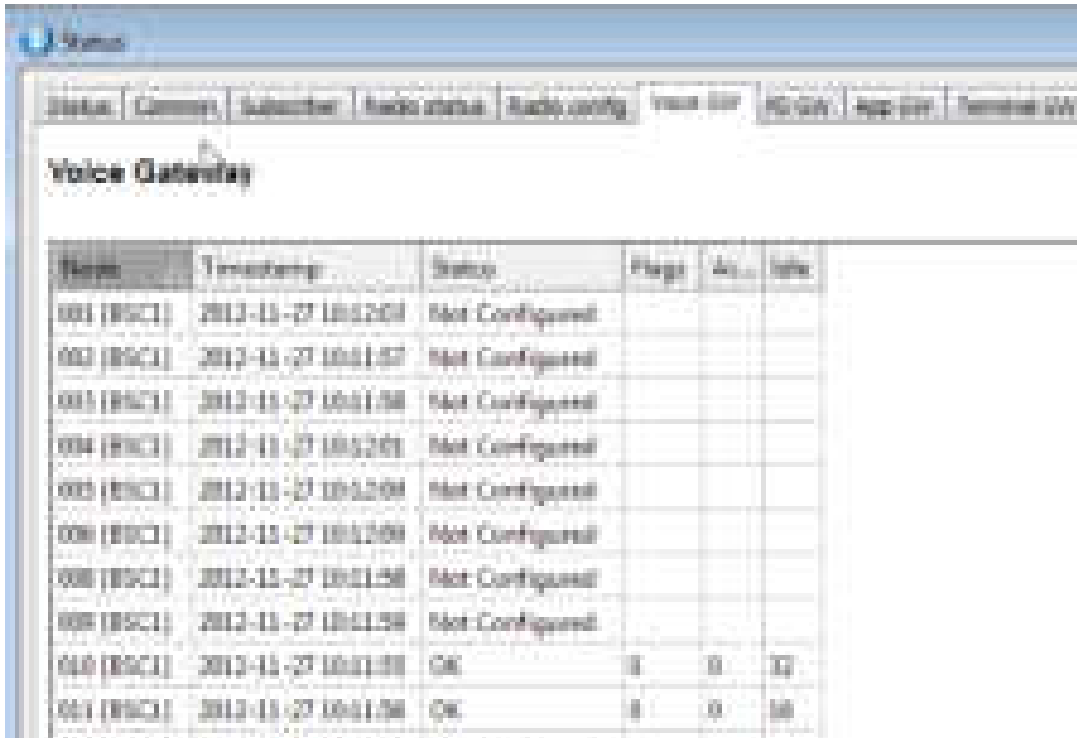
Radio	Frequency	Status	Channels	AIE	Time	SRCCW	PRCCW	GRCCW	MRCCW	BCCH	SCCH	PCCH	MRCCW	BCCH	SCCH	PCCH
00100001	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100002	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100003	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100004	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100005	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100006	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100007	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100008	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100009	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100010	894.0125	OK	Yes	OK	Yes	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
00100011	894.0125	Not Configured														

Figure 3-106: Log Client, Radio Config

On the Radio Config tab it is possible see how all the cell parameters are set.

### 3.7.11.6 Voice GW

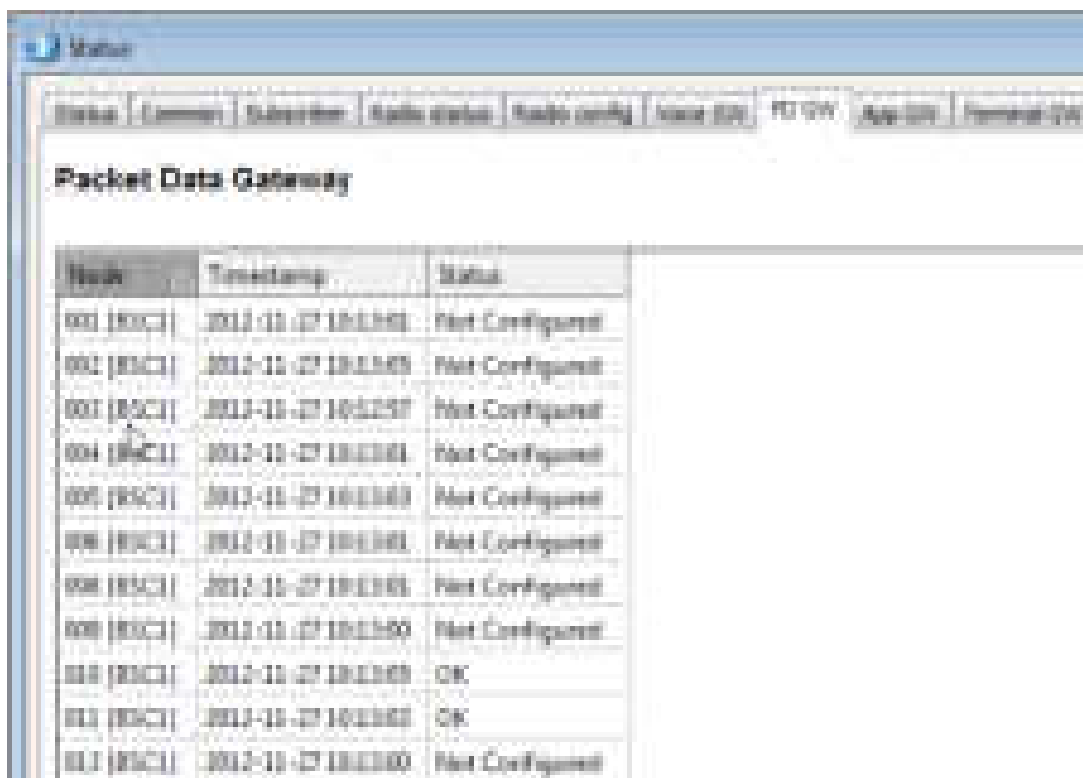
On the Voice GW tab the status for the Voice Gateway can be seen, including number of active and idle calls.



Name	Timestamp	Status	Flags	Act.	Idle
001 (BSC1)	2012-11-27 10:12:04	Not Configured			
002 (BSC1)	2012-11-27 10:11:57	Not Configured			
003 (BSC1)	2012-11-27 10:11:58	Not Configured			
004 (BSC1)	2012-11-27 10:12:01	Not Configured			
005 (BSC1)	2012-11-27 10:12:04	Not Configured			
006 (BSC1)	2012-11-27 10:12:09	Not Configured			
008 (BSC1)	2012-11-27 10:11:58	Not Configured			
009 (BSC1)	2012-11-27 10:11:58	Not Configured			
010 (BSC1)	2012-11-27 10:11:58	OK	8	0	12
011 (BSC1)	2012-11-27 10:11:58	OK	8	0	10

Figure 3-107: Log Client, Voice GW

### 3.7.11.7 Packet Data-GW



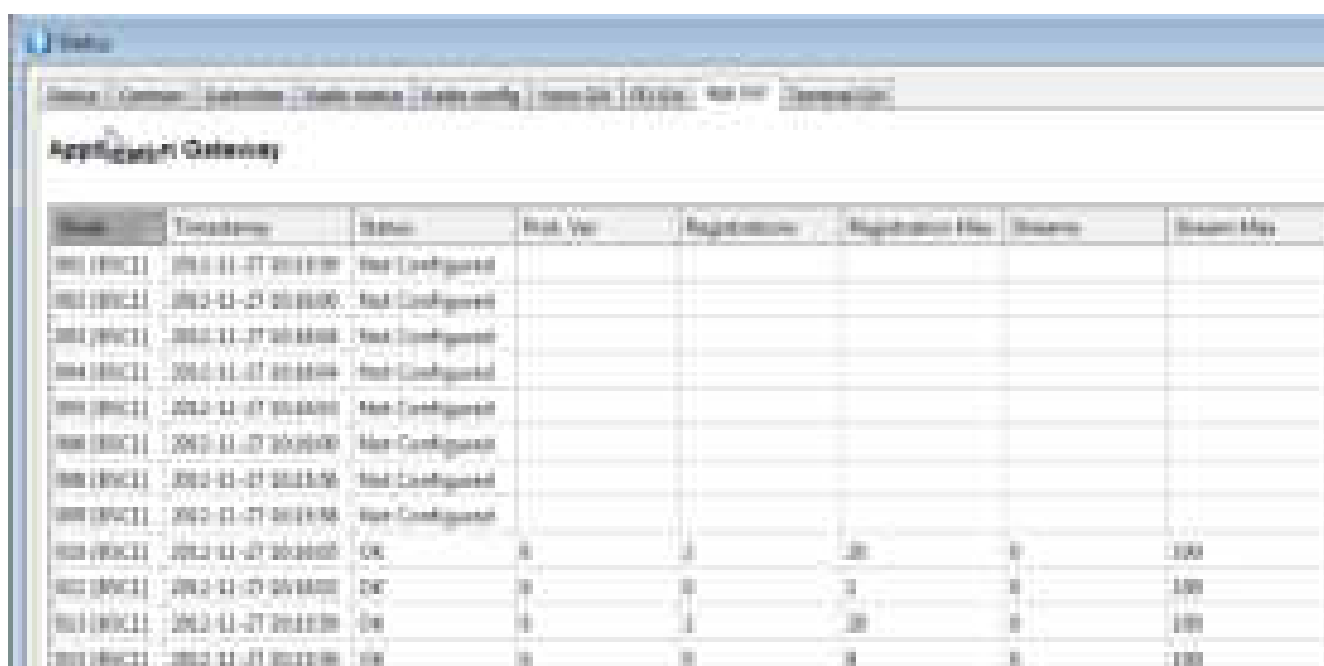
The screenshot shows the 'Status' window for 'Packet Data Gateway'. It contains a table with columns: Index, Timestamp, and Status. The table lists 12 entries (001 to 012) for BSC1. Most are 'Not Configured', while entries 011 and 012 are 'OK'.

Index	Timestamp	Status
001 [BSC1]	2012-11-27 18:13:40	Not Configured
002 [BSC1]	2012-11-27 18:13:45	Not Configured
003 [BSC1]	2012-11-27 18:13:57	Not Configured
004 [BSC1]	2012-11-27 18:13:41	Not Configured
005 [BSC1]	2012-11-27 18:13:43	Not Configured
006 [BSC1]	2012-11-27 18:13:41	Not Configured
008 [BSC1]	2012-11-27 18:13:45	Not Configured
009 [BSC1]	2012-11-27 18:13:40	Not Configured
010 [BSC1]	2012-11-27 18:13:40	OK
011 [BSC1]	2012-11-27 18:13:42	OK
012 [BSC1]	2012-11-27 18:13:40	Not Configured

Figure 3-108: Log Client, Status Packet Data GW

The Packet Gateway view shows only the gateway status.

### 3.7.11.8 Application -GW




The screenshot shows the 'Status' window for 'Application Gateway'. It contains a table with columns: Index, Timestamp, Status, Host Ver, Registration, Registration No, Source, and Source IP. The table lists 12 entries (001 to 012) for BSC1. Entries 001-009 are 'Not Configured'. Entries 010-012 are 'OK' with various registration and source information.

Index	Timestamp	Status	Host Ver	Registration	Registration No	Source	Source IP
001 [BSC1]	2012-11-27 18:13:40	Not Configured					
002 [BSC1]	2012-11-27 18:13:40	Not Configured					
003 [BSC1]	2012-11-27 18:13:40	Not Configured					
004 [BSC1]	2012-11-27 18:13:40	Not Configured					
005 [BSC1]	2012-11-27 18:13:40	Not Configured					
006 [BSC1]	2012-11-27 18:13:40	Not Configured					
007 [BSC1]	2012-11-27 18:13:40	Not Configured					
008 [BSC1]	2012-11-27 18:13:40	Not Configured					
009 [BSC1]	2012-11-27 18:13:40	Not Configured					
010 [BSC1]	2012-11-27 18:13:40	OK	0	1	10	0	100
011 [BSC1]	2012-11-27 18:13:40	OK	0	0	1	0	100
012 [BSC1]	2012-11-27 18:13:40	OK	0	1	10	0	100
013 [BSC1]	2012-11-27 18:13:40	OK	0	0	1	0	100

Figure 3-109: Log Client. Status Application GW



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### 3.7.12 Settings View

The Settings view has six sections: Database, nodes, subscriber, sound, logserver licenses and log server config.

#### 3.7.12.1 Database

Database settings used by the TetraFlex® Log Client is shown.

It is possible to replace SQL Server by specifying the IP address and login credentials.

By pressing the **Connect to Database!** Button the client establishes the connection to the SQL Server and database specified. This can be done on the fly.

The **Reload Database Settings**- and **Save Database Settings** respectively load and save the database settings to a local file Log Client.ini located in the same folder as the Log Client executable.

In the maintenance section it is possible to setup backup and cleanup intervals (please see the section 3.7.13 Log Server Maintenance)

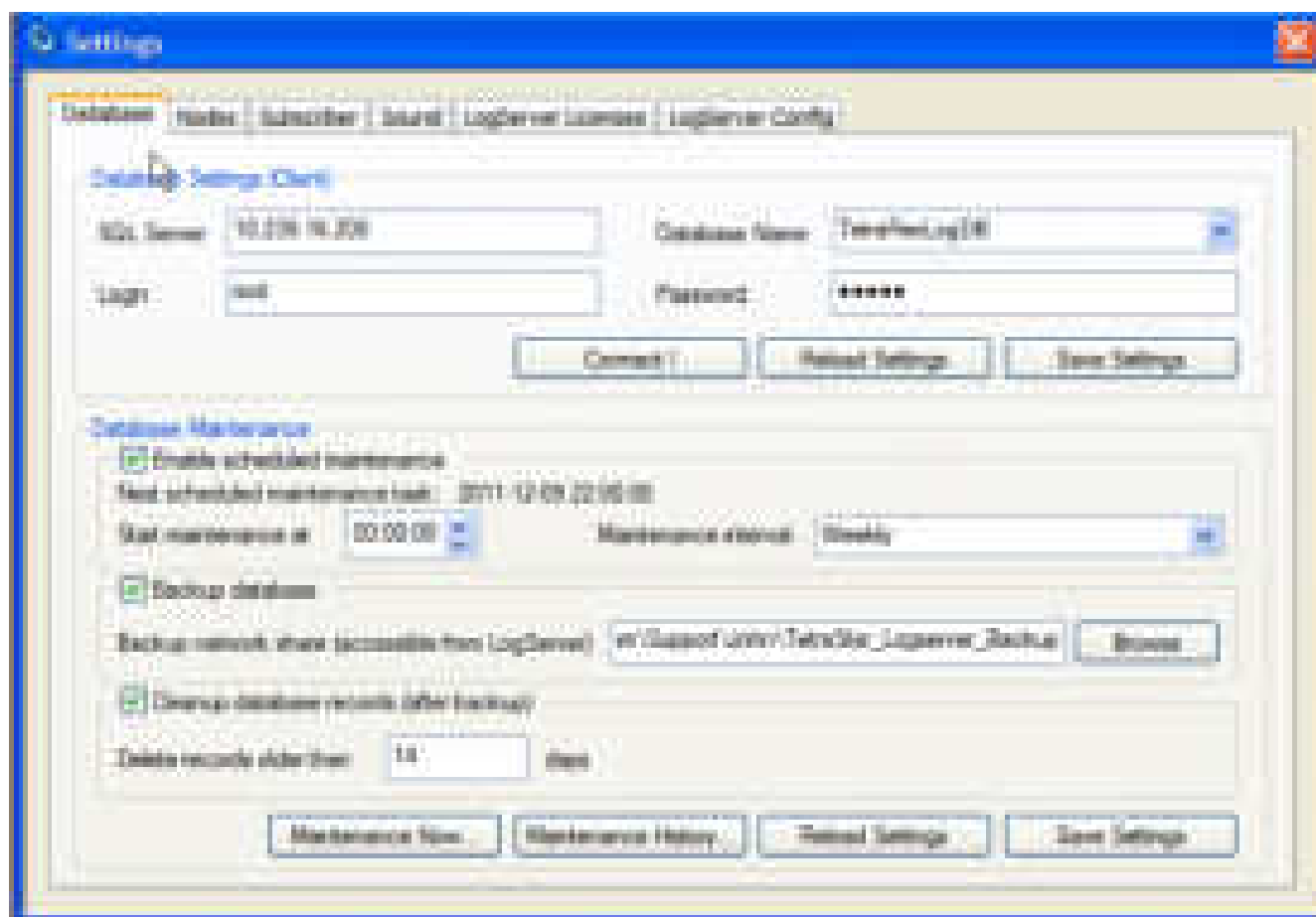



Figure 3-111: Log Client, Settings database



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### 3.7.13 Log Server Maintenance

The database should be backed up on a daily basis; the backup should be saved to an external media, such as tape, external disk, network server or similar.

The Log server can be setup to perform a scheduled maintenance, which can run on specified interval. It is also possible to perform "Maintenance now".

The Maintenance parameters are setup via the LogClient, but the LogClient itself has nothing to do with the execution of the maintenance this is totally done by the log server based on the settings made by the client.

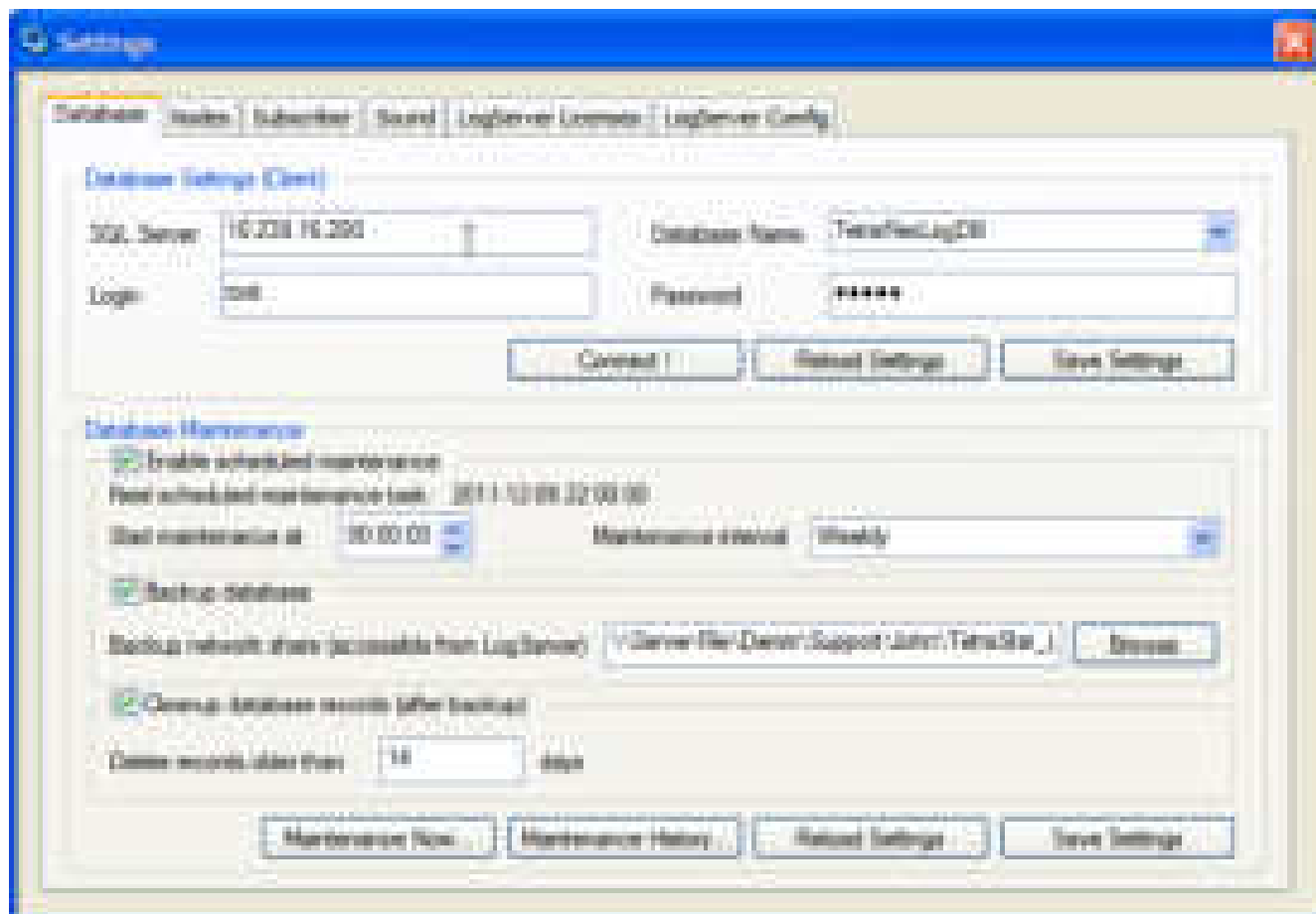
The maintenance is performed by the LogServer, which executes 2 steps: An optional backup of the database files to a network share, and an optional cleanup of old data. Each of these steps can be disabled independently of each other.

It is recommended to enable the scheduled maintenance with backup and automatic cleanup enabled. There are several of good reasons for this:

- Keep the database from running out of disk space.
- backup the database to an external disk to ensure data in case of disk crash.
- Keep high performance when querying data from the database.

#### 3.7.13.1 Scheduled Maintenance

The scheduled maintenance parameters are set up via the LogClient. Open the settings view and select the database tab.




**Figure 3-112 Log Client Setting view –Database tab**

1. In the Database maintenance group box, you can enable/disable “scheduled maintenance”, “database backup” and “Cleanup database records”.
2. To set up scheduled maintenance set a check mark in “Enable scheduled maintenance”.
3. Now set the start time to a time where the TetraFlex traffic load possibly is low, i.e. midnight.
4. Finally set how often this operation should be performed in “Maintenance interval”. The Maintenance task can be executed each day, every week, every 2nd week, or every 4th week, depending on the selected “Maintenance interval”.

To enable backup of database put a check mark in the “Backup database” checkbox. Now you must supply a fully qualified network path to the backup share you are using. This must be on the form \\<BackupServer-IP>\<Share> seen from the LogServer; local drives and mapped drives are not allowed because they are not available when the LogServer is running with no one logged in. Login credentials must have write permissions in the supplied destination share.

E.g.:Figure 3-79 the Backup network share is set to:  
[\\Server-File-Damm\Support\John\TetraStar\\_Logserver\\_Backup](\\Server-File-Damm\Support\John\TetraStar_Logserver_Backup). This is a network destination where the log server has access.

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To enable the scheduled database maintenance settings you have to click the “Save settings” button. When you do this, you will be requested to enter the login credentials for the Backup Destination Login.



Figure 3-113 Backup destination login credentials

When the scheduled maintenance is saved and enabled, you can see when the next scheduled maintenance task is executed in the Next scheduled maintenance task field:



Figure 3-114 next scheduled maintenance task

To enable or disable cleanup of old database records set or remove the check mark in “Cleanup database records (after backup)”, and specify the cleanup threshold in the “Delete record older than” edit box. The scheduled maintenance executes the database backup as the first step (if selected), when this succeeds it continues to clean up the old database records from database.

### 3.7.13.2 Maintenance Now

The LogClient offers the possibility to check/test your database maintenance settings by initiating the database maintenance immediately. Be aware that the “Maintenance now” is executed with the saved “Backup database” and “Cleanup database records” settings. These settings are shown in the confirm dialog:



Figure 3-115 Confirm manual maintenance

When accepting the settings by clicking OK, the maintenance is initiated by the LogClient, and will be executed by the LogServer within the next minute. It is possible to follow the maintenance progress by accepting this, see fig.3.82.



Figure 3-116 Follow maintenance progress

The Maintenance progress is shown in the “Additional info maintenance” dialog, see Fig. 3.83. The rows and fields in this dialog are filled as the progress information becomes available.

### 3.7.13.3 Maintenance History

Once the maintenance has finished, the result of the maintenance can be found in the Maintenance history. Open the “Maintenance History” dialog to see the list of executed maintenance jobs. Each maintenance job has a row containing info about: start- and end time, the result (OK or Error), the type of maintenance executed, backup destination and cleanup of old records. See Maintenance history:

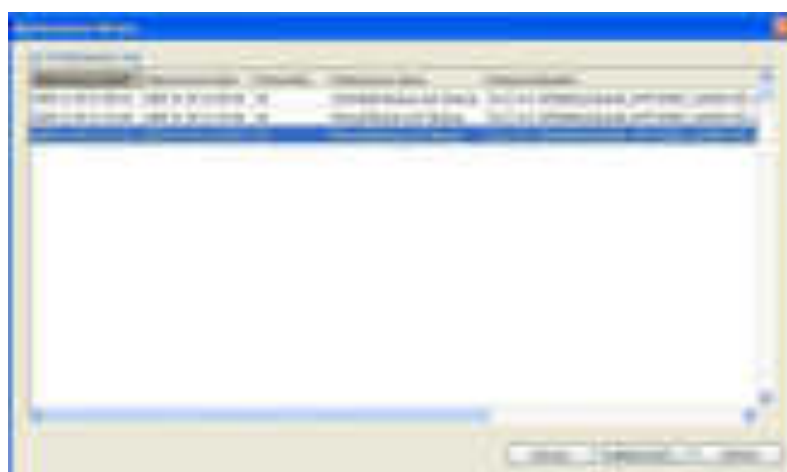


Figure 3-117 Maintenance history

To remove an old Maintenance job choose the row, then press the remove button. The maintenance registration and the corresponding backup files will be removed and deleted. To get additional info about a specific maintenance job, select a job and press the button “Additional info”, see fig. 3.84

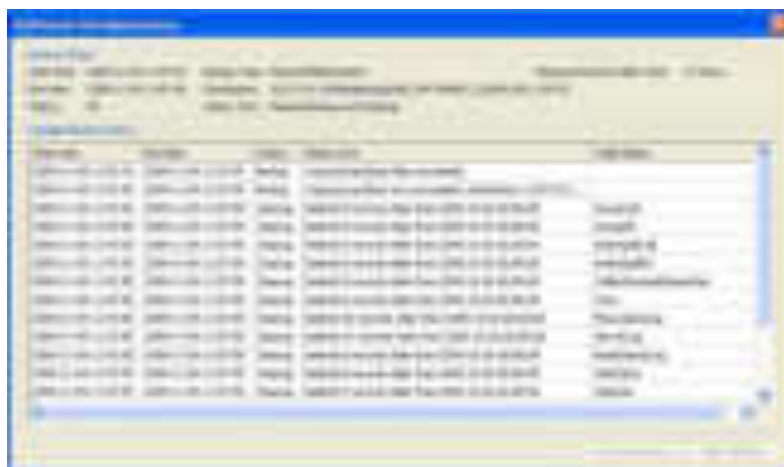


Figure 3-118 Additional info maintenance

In the Additional info maintenance dialog each action performed in the maintenance job is listed.

#### 3.7.13.4 Manual backup of the database

The MySql Server is set up to use the MyISAM storage engine. MyISAM manages non-transactional tables which provides high-speed storage and retrieval of data. The database can be backed up simply by copying the database files. Don't forget to backup (copy) the logClient executable which is located at:  
\\<logServer>\Tetraflex\LogClient\Files\LogClient.exe.

The TetraFlexLogDb database is stored either under the default MySql data path:

C:\Program Files\MySQL\MySQL Server 5.0\data\tetraflexlogdb

or on systems with more partitions:

E:\Tetra\Applications\LogServer\Database\ tetraflexlogdb

Copy this folder and the LogClient executable to an external storage to make your manual backup.

To find the physical database files location look in the MySql configuration file:  
C:\Program Files\MySQL\MySQL Server 5.0\my.ini find the following line starting with datadir, i.e: datadir="C:/Program Files/MySQL/MySQL Server 5.0/Data/"

#### 3.7.13.5 Restoring a database

The scheduled maintenance backup files are stored under the supplied path entered in Scheduled maintenance; see section 3-302 Scheduled Maintenance for further info. The backup contains the database files as well as the LogClient which is able to read it.

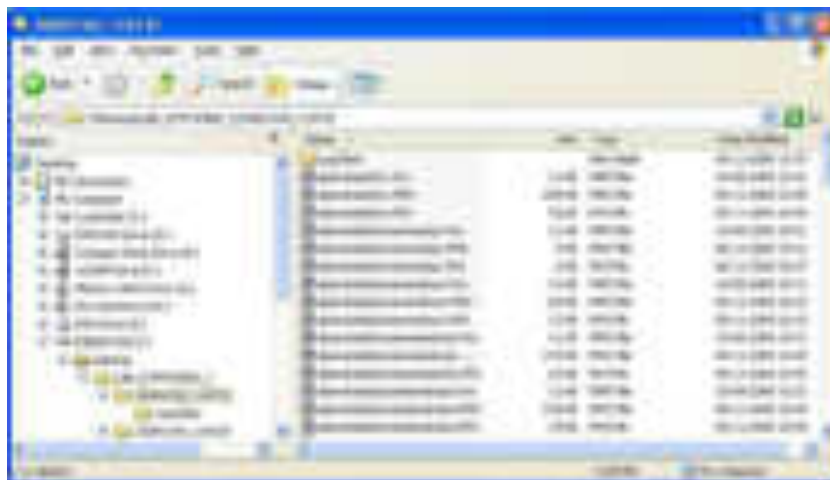


Figure 3-119 Backed up files

Copy the backup directory which is named with the timestamp on the form <YYYY-MM-DD\_hhmmss> to the MySql database directory.

**Important:** When the copy has finished, the MySql Server locks the files and you will no longer be able to rename or delete the database files. The MySql service has to be stopped to delete or rename a database folder.

It should now be possible to connect to the MySql server and select the database with the LogClient, see fig. 3.87. To restore the backup press the connect button. On success you will get a “Connect to database succeeded” dialog, see fig. 3.88.

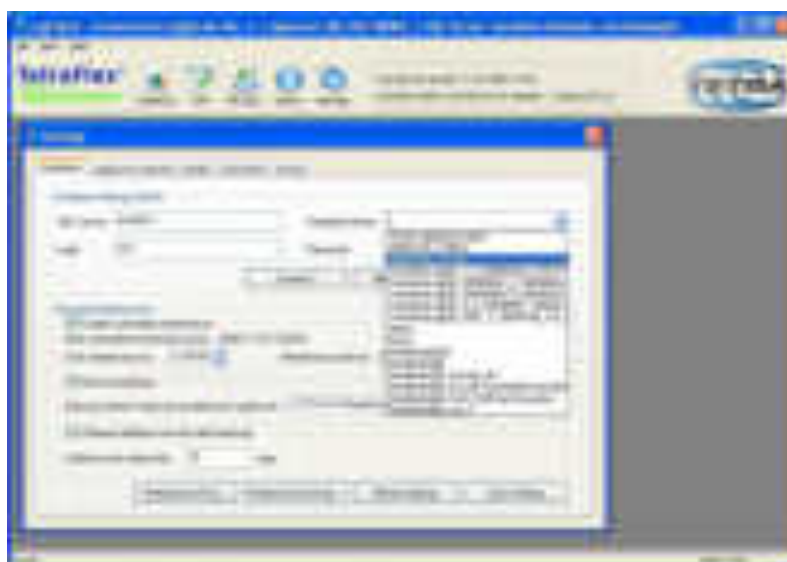


Figure 3-120 Selection the database backup


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Figure 3-121 Backup restored

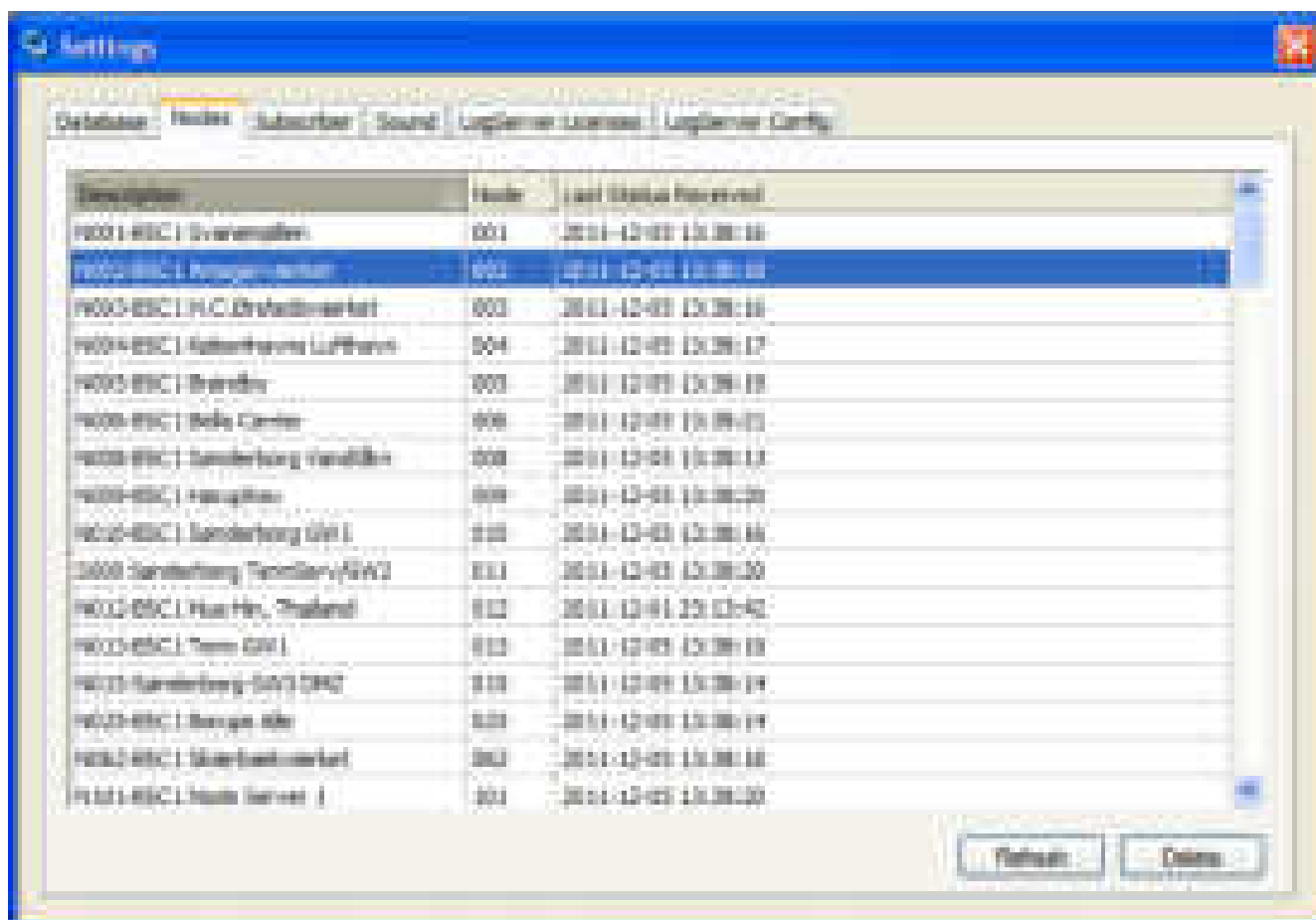
The LogClient is now connected to the restored database and you can only browse through the “old” data till you select the active running database named “TetraFlexLogDb”.

Note: if you have not saved the “database settings (Client)”, then a restart of the LogClient will make the LogClient connect to the previous selected database.

### 3.7.13.6 Nodes

Node descriptions and last status received information

- If a node has managed to send status messages prior to the node being configured with the correct node number etc. the node may be deleted here and will reappear with the correct settings at the next status message (10 sec.)
- A deleted node will be removed from node status and node statistics views and database.

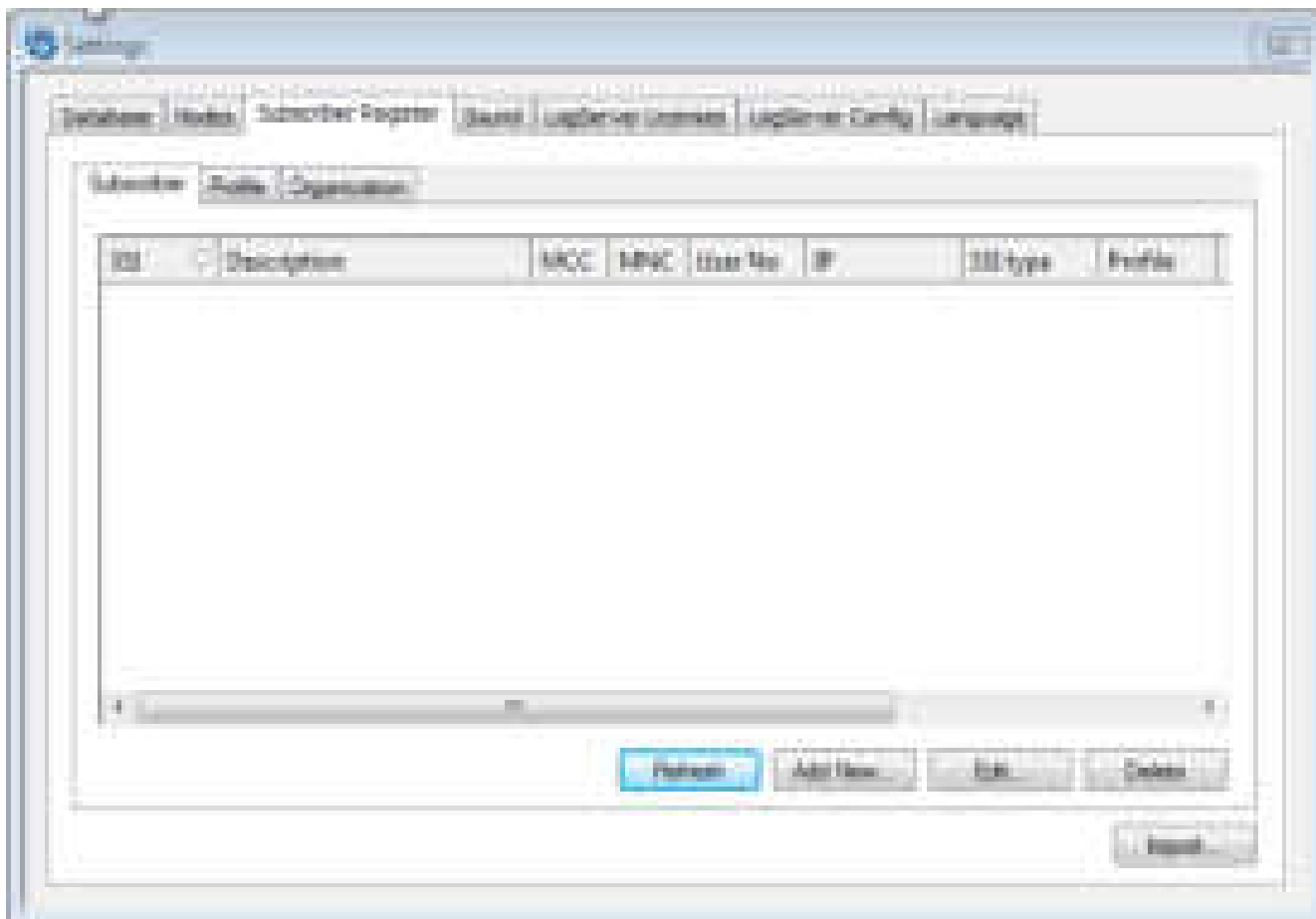


Description	Node	Last Status Received
W001-ESC1 Overvaller	001	2013-12-03 13:28:16
W002-ESC1 Pongelund	002	2013-12-03 13:28:16
W003-ESC1 H.C. Ørstedsmønt	003	2013-12-03 13:28:16
W004-ESC1 Katterhøns Lufthavn	004	2013-12-03 13:28:17
W005-ESC1 Brændby	005	2013-12-03 13:28:18
W006-ESC1 Bølle Center	006	2013-12-03 13:28:19
W008-ESC1 Sønderborg Vandværk	008	2013-12-03 13:28:19
W009-ESC1 Høruphøj	009	2013-12-03 13:28:20
W010-ESC1 Sønderborg Øst I	010	2013-12-03 13:28:16
W011-ESC1 Sønderborg Tøndersvej Øst I	011	2013-12-03 13:28:20
W012-ESC1 Hørup, Thailand	012	2013-12-03 13:28:42
W013-ESC1 Tømme Øst I	013	2013-12-03 13:28:18
W015-ESC1 Sønderborg Øst I Øst I	015	2013-12-03 13:28:19
W016-ESC1 Sønderborg Øst I Øst I	016	2013-12-03 13:28:19
W017-ESC1 Sønderborg Øst I Øst I	017	2013-12-03 13:28:19
W018-ESC1 Sønderborg Øst I Øst I	018	2013-12-03 13:28:19
W019-ESC1 Sønderborg Øst I Øst I	019	2013-12-03 13:28:19
W020-ESC1 Sønderborg Øst I Øst I	020	2013-12-03 13:28:19

Figure 3-122: Log Client, Node information




### 3.7.13.7 Subscriber Register



**Figure 3-123: Log Client, Subscriber List**

By selecting the Subscriber tab the configured subscribers are listed. The log server database has default no information about the subscribers and it is only logging information it gets from the incoming data. If you want to have information like subscriber description user number, and organization description you must add the subscriber information either by using the **Add new** button or by importing the subscribers from a file using the **Import** button.

In this view it is also possible to, **edit**, and **delete** subscriber description and setting.

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Add New Subscriber:



**Description:** Description of the subscriber

**MCC:** Country code

**MNC:** Network Code

**User no:** Subscriber user number


**Profile:** The profile the subscriber belongs to (and because of the profile must belong to a organization this will also give the organization the subscriber belongs to)

**Subscribe kind:** The kind of subscriber (Group, Mobile, Terminal, Application, Personal, Emergency, Dial in)

**IP:** IP address of the subscriber

**Log Voice:** Enable or disable voice logging of the subscriber

**Voice logging**

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**Priority:** **0-15** The Voice Logging Priority only applies to the subscribers where Voice Logging is enabled. If all voice logging channels are occupied (number of voice logging channels is defined by Log Server dongle), then the priority is used to interrupt and stop voice logging for lower priority calls. If no voice logging channel is free when a new call is established, then the lowest priority ongoing voice logged channel is freed for the new higher priority call.

## Log

**Registrations:** Enable or disable the registrations log.

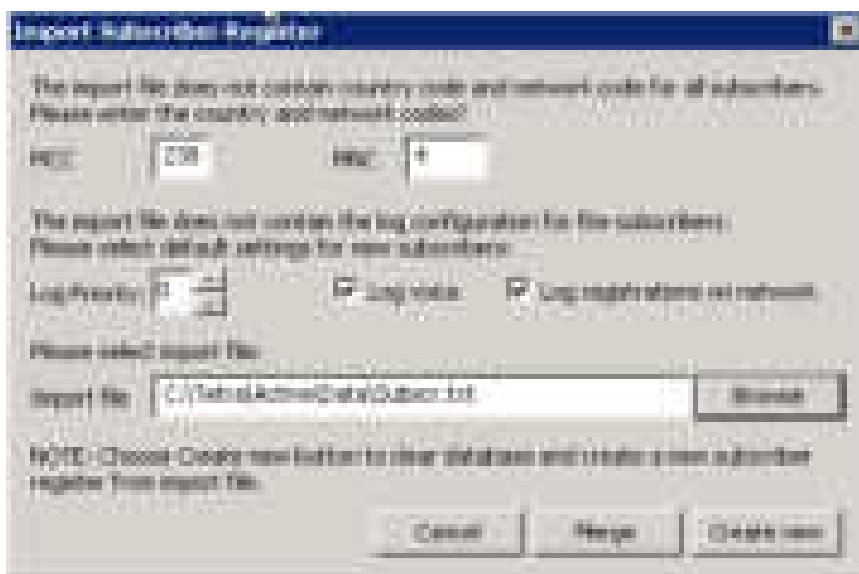
**Note:** Voice Logging, For individual calls the following rule applies: If either the calling or the called party is on the subscriber list\*, the call is voice logged otherwise not.  
For group calls the following rule applies: If the called group TSI appears in the subscriber list\*, then the group call is voice logged otherwise not.

**Note:** The LogServer hardware Dongle settings can override the Voice- and Location Logging settings.


\* Is also logged if the flag “Log all MS by default” is set in the Logserver config (see 3.7.13.10 and LogServer Config and 2.11.3 Log ServerTray setting).

## Subscriber **Import:**

Instead of adding the subscriber information manually they can be imported by using the **Import** button:



The Log Priority, Log Voice and Log registration on network setting will be applied for all imported subscribers.

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The import file can be generated using the OM command S20/SAVE from the master subscriber register node (or the subscriber register on a stand-alone node) and imported by typing the path and import file name (default c:\tetra\active\data\Subscr.txt) and either pushing the **Create new** button (this will delete subscriber that already has been added) or using the **Merge** button (this will add new subscriber to subscriber that already has been added).

### 3.7.13.8 Sound

This setting are for the voice recording playback

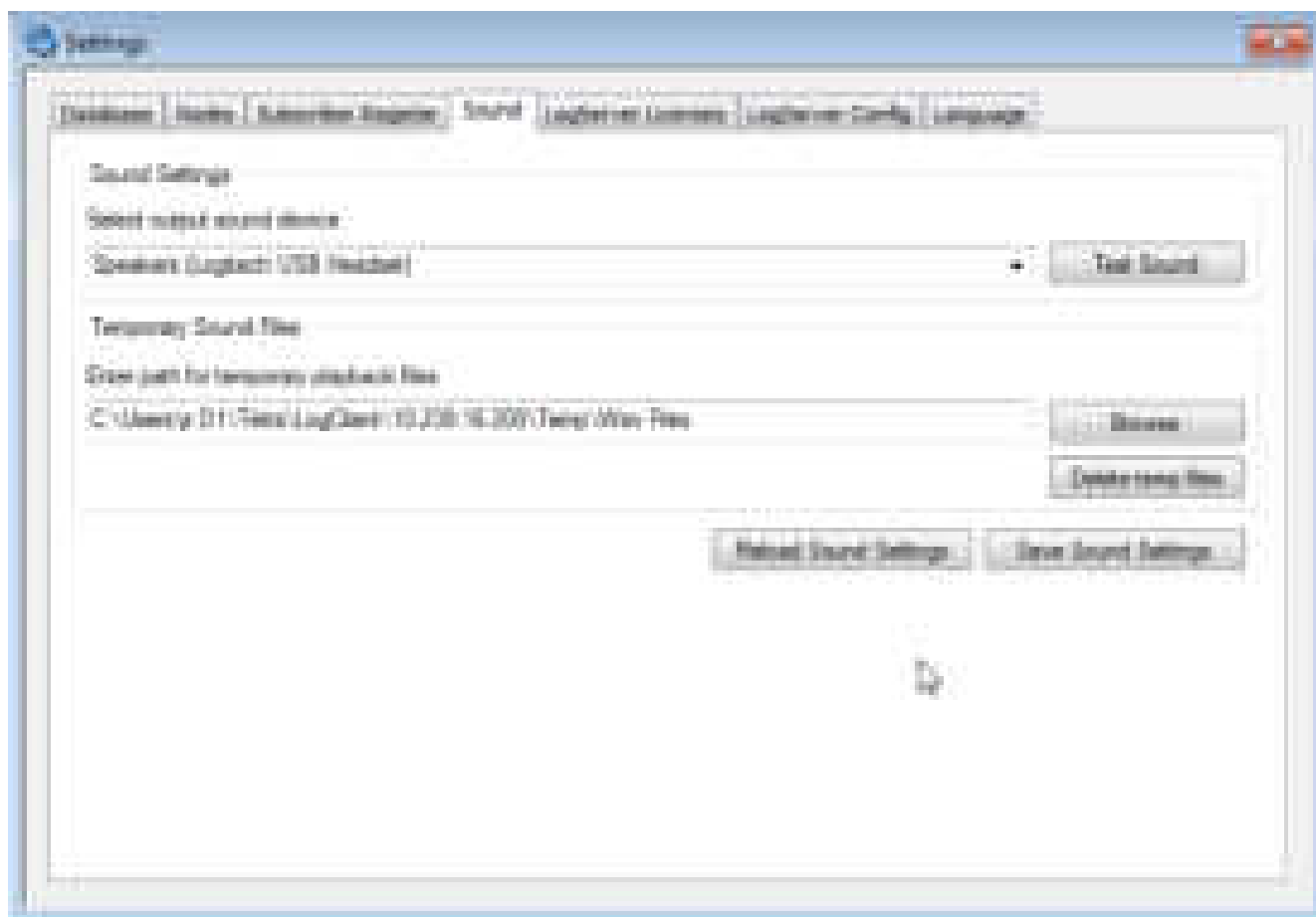




Figure 3-124: Log Client, Sound settings

- Sound Settings - Setup and test of output sound device
- Temporary Sound Files:
  - Setup, save/reload and deletion of the path to the temporary sound files saved whenever a CDR is played

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- Standard setting %USERPROFILE%\Tetra\LogClient\<LogServer name>\Wav Files

The settings can be saved by using the **Save Sound Settings** button and restored by using the **Reload Sound Settings** button

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### 3.7.13.9 LogServer Licens

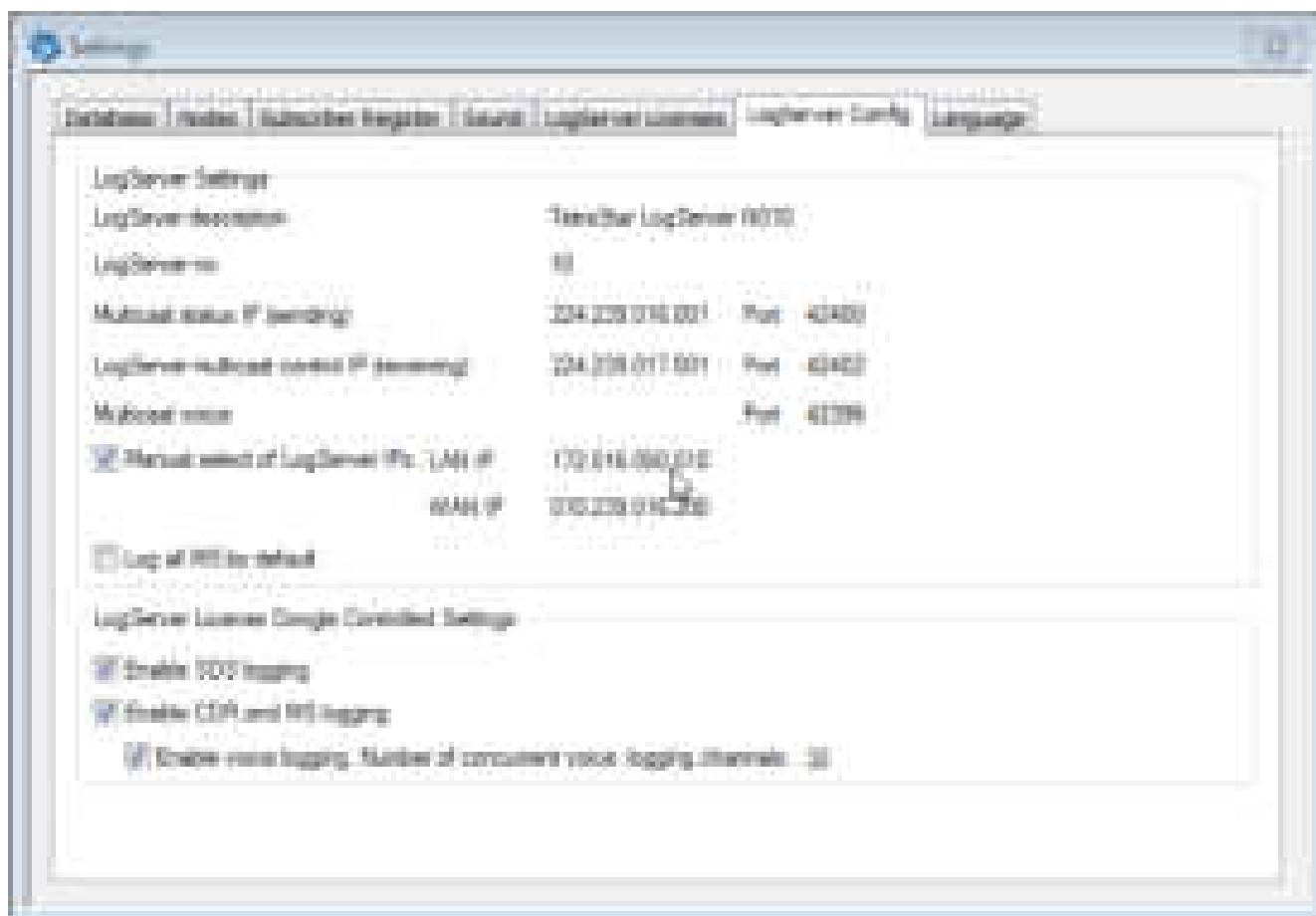
License dongle information shows the license dongle settings for the Log Server



**Figure 3-125: LogServer Licenses**


### 3.7.13.10 LogServer Config

This shows how the log server is configured. It is not possible to make changes to the settings from here. Please see the chapter 2.10.3 for setting the parameters.



**Figure 3-126: LogServer config**

Log Server Settings may be overruled by the dongle configuration. Logging selection may be set equal or less than the settings in the license dongle. As an example license dongle settings gives privilege to do SDS Content Logging (=Allowed) but if the flag “Enable SDS Logging” is not set, the SDS content is not logged, i.e. log server settings overrules the dongle settings.

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## 3.8 GROUP BRIDGE

### 3.8.1 Group Bridge Description

The DAMM TetraFlex® Group Bridge is a Software solution that makes it possible to perform group calls between a DAMM TetraFlex® SwMI, another tetra SwMI, or a analog system. It is also possible to send and receive SDS group messages between TetraFlex® and other Tetra systems.

The following diagram shows an overview of the DAMM TetraFlex® Group Bridge solution:

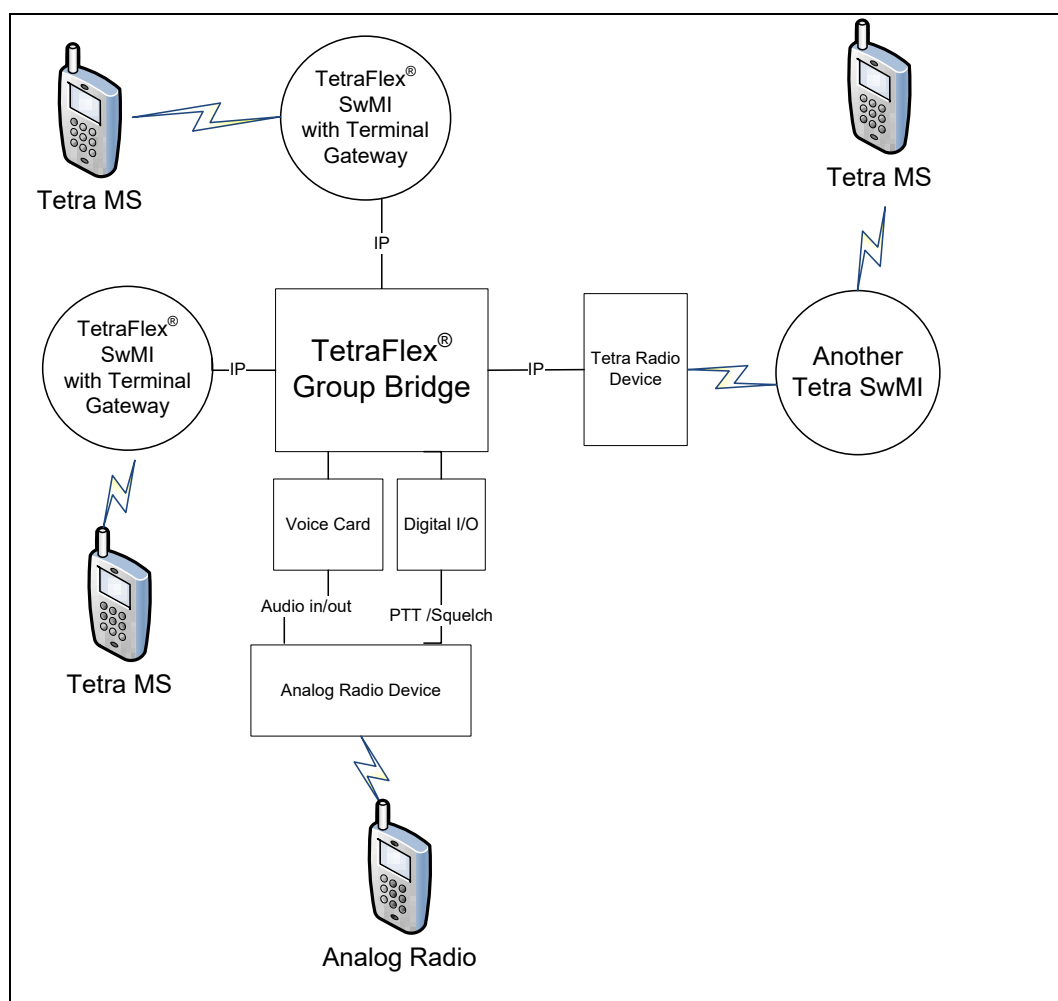



Figure 3-127: Group Bridge connections



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When group calls are initiated on an MS, either connected to the TetraFlex® SwMI, to another tetra SwMI or a analog system, the calls will be routed via the Group Bridge. The talk groups which are to be joined must be configured in the Group Bridge application.

The Group Bridge is connected to the TetraFlex® SwMI through the standard TetraFlex® Terminal Gateway, via an IP connection and to another tetra network through a tetra radio device or to an analog system through an analog radio device.

The TetraFlex® Group Bridge uses the Terminal Gateway for listening to group calls on a TetraFlex SwMI and according to the routing table settings, routing the calls to the other network or to routing group calls from the other network to the TetraFlex® SwMI.

**TetraFlex® Group Bridge Application** is a software application built for the Microsoft Windows operating system. The application runs as a service and has a separate GUI application for setting up and monitoring the Group Bridge service. The maximum number of allowed connections and bridges are controlled by a license dongle connected to a USB port on the computer that is running the Group Bridge. The Group Bridge uses the Group SSI (GSSI) to determine if it should route a call to and from TetraFlex® SwMI or not.

**Tetra Radio Device.** The Tetra Radio Interface is a device connected to the TetraFlex® Group Bridge via an IP connection. On the other side it is a tetra MS, able to register on a tetra swMI (TetraFlex or another system) and receive and transmit group calls.

**Voice Card** - This can be a built in sound card in a PC or an external sound device connected via a USB port. The voice card is used to convert the tetra digital voice to analog voice.


**Digital I/O** - Is used to activate the input ("PTT") on the analog radio device and to detect an incoming call from the analog radio device (ex. squelch signal).

**Analog Radio Device.** Any analog radio with external audio in and out and digital on/off signal for activating a call and to activated the input for indicating an incoming call. A Headset with microphone and "PTT" switch to activate the digital input.

### Group Bridge Routing Table

The TetraFlex® Group Bridge application has a routing table that can be setup from the Group Bridge GUI to match how the group calls should be routed between the different Tetra SwMI or analog systems connected (see figure 3-128: Group Bridge GUI).



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When the Group Bridge Service is installed the GUI shows Status: Running:




And the file GroupBridgeService .exe (or GroupBridgeService64.exe) is generated in the directory where the Group Bridge is installed.

The Group Bridge service can be uninstalled again by using the **Uninstall service**. It is also possible to stop the service without uninstall the service by selecting **Stop service**. The service can then again be started by selecting **Start service**. The Group Bridge GUI can be closed without stopping the running service either by selecting Exit or just closing the application

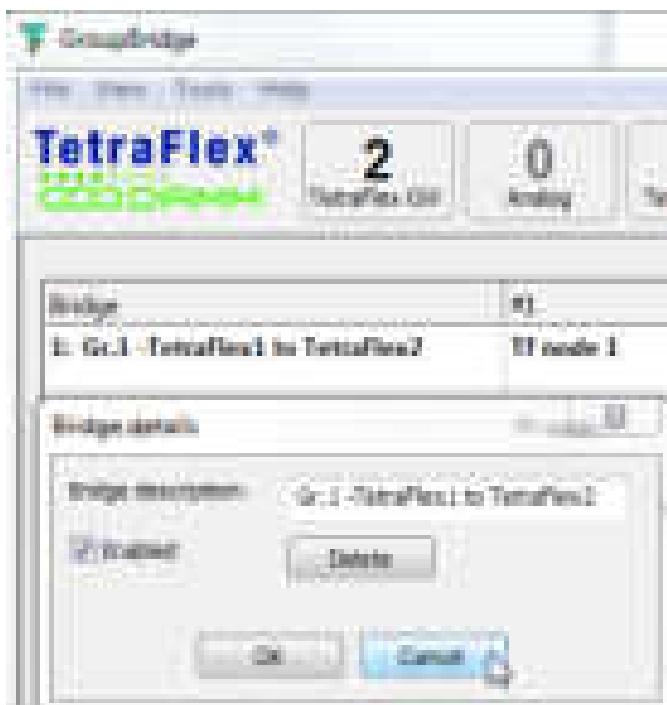
### 3.8.3 Group Bridge Setup

When the Group Bridge is installed the different connections can be setup. There are many different ways the Group Bridge can be configured, please see the examples on the next pages to find the configuration which suit your requirement best.

For all the different combination there is one setting in common that must be made and this is the Terminal Gateway connection between the Group Bridge and a node.

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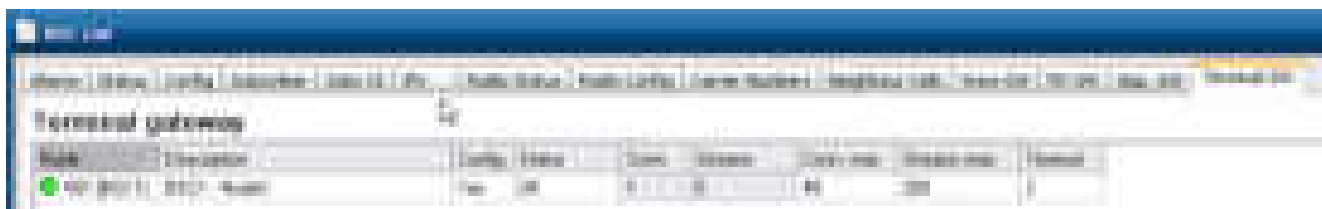
First make a label in the Bridge column that describes the bridge you are going to make.



The dialog is open by right click in the Bridge column in this example we are going to make a bridge between two TeraFlex system and bridging Talk Group 1. The Enabled check box can be used to enable and disable this bridge. When disabled the hole row is grayed.

The next step is to setup Terminal Gateway connection to both TetraFlex system 1 on node 1 and TetraFlex system 2 on node 2 in the column marked #1 and #2. Before the Group Bridge can connect to this nodes the Terminal Gateway must be enabled on both TetraFlex systems.

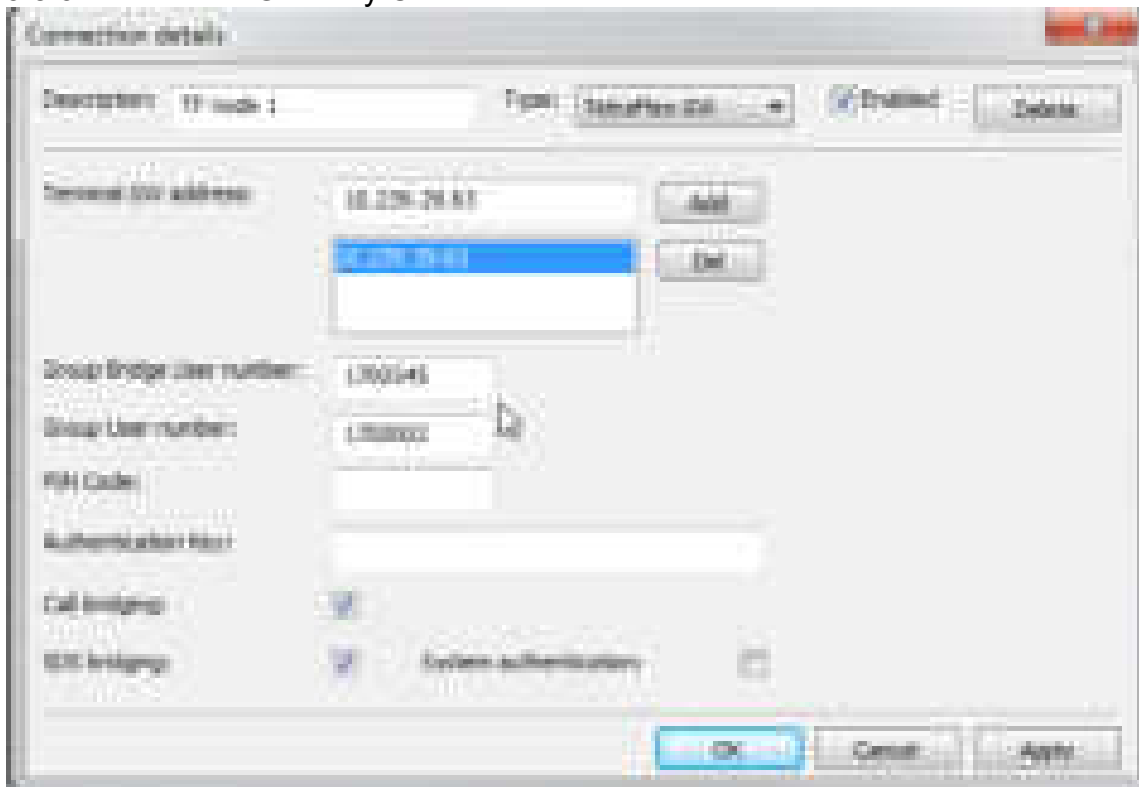
This is done from Network Management by setting the Terminal GW Config to yes (there must be a dongle license for Terminal Gateway on the nodes).



For information about Terminal Gateway connection see chapter “Network Manager”

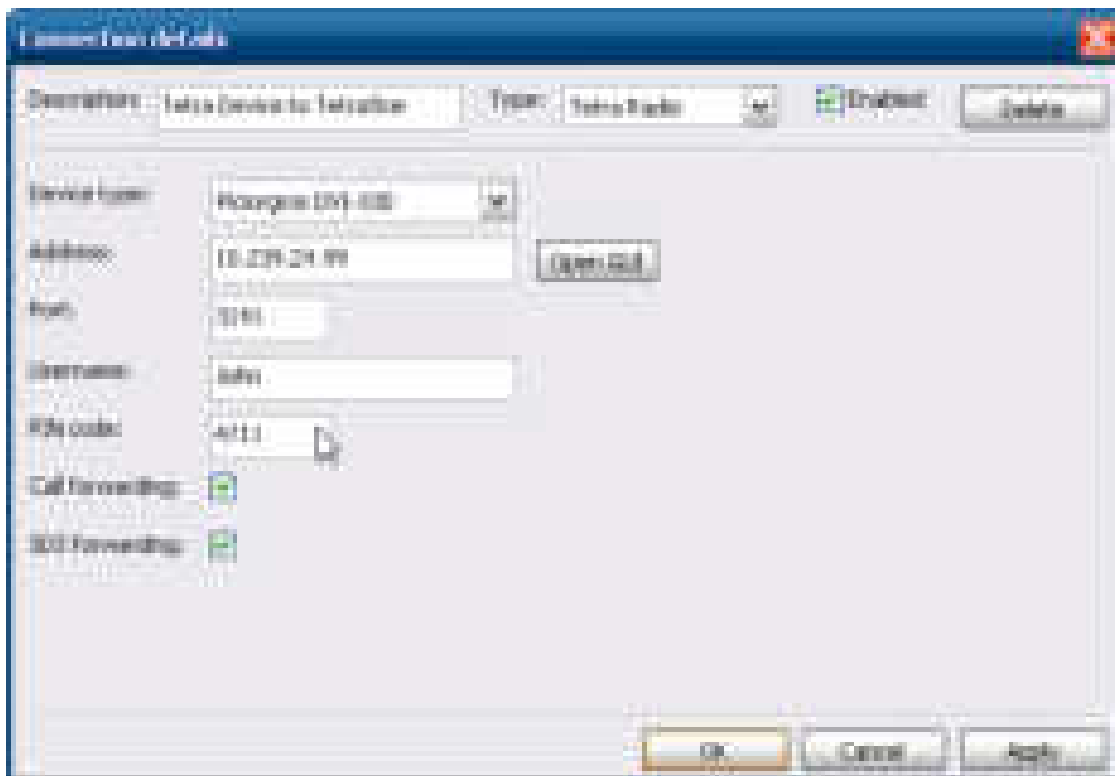
The next step is to set the parameters for connecting to the Terminal Gateways from the Group Bridge.

### 3.8.3.1 Terminal Gateway Connection details:




- **Description:** This is label you see in the Group Bridge main windows to identify the connection.
- **Type:** Select TetraFlex GW for connecting to the Terminal Gateway
- **Enabled:** If set to Enabled the connection is enabled, else disabled and the field is grayed in the Group Bridge main window.
- **Delete:** Delete this gateway setting
- **Terminal GW address:** This is the WAN IP address of the Terminal
- **Group Bridge user number:** This is the user number that must be defined in the subscriber register for each Terminal Gateway connection. SSI number can not be used, and the user number must be unique.
- **Group User Number:** The group User number for the Group call that this connection can be used for. The Group user number must be defined in the Subscriber register. The Group SSI cannot be used.
- **Pin Code:** Optional parameter, if used it must match the pin code set in the subscriber register for this terminal user number
- **Authentication Key:** Optional parameter, if used it must match the authentication key set in the subscriber register for this terminal user number
- **Call Bridging:** When Enabled group call can be send (default on)
- **SDS Bridging:** When Enabled group SDS can be send (default on)
- **System authentication:** Used for mutual authentication using the authentication key.

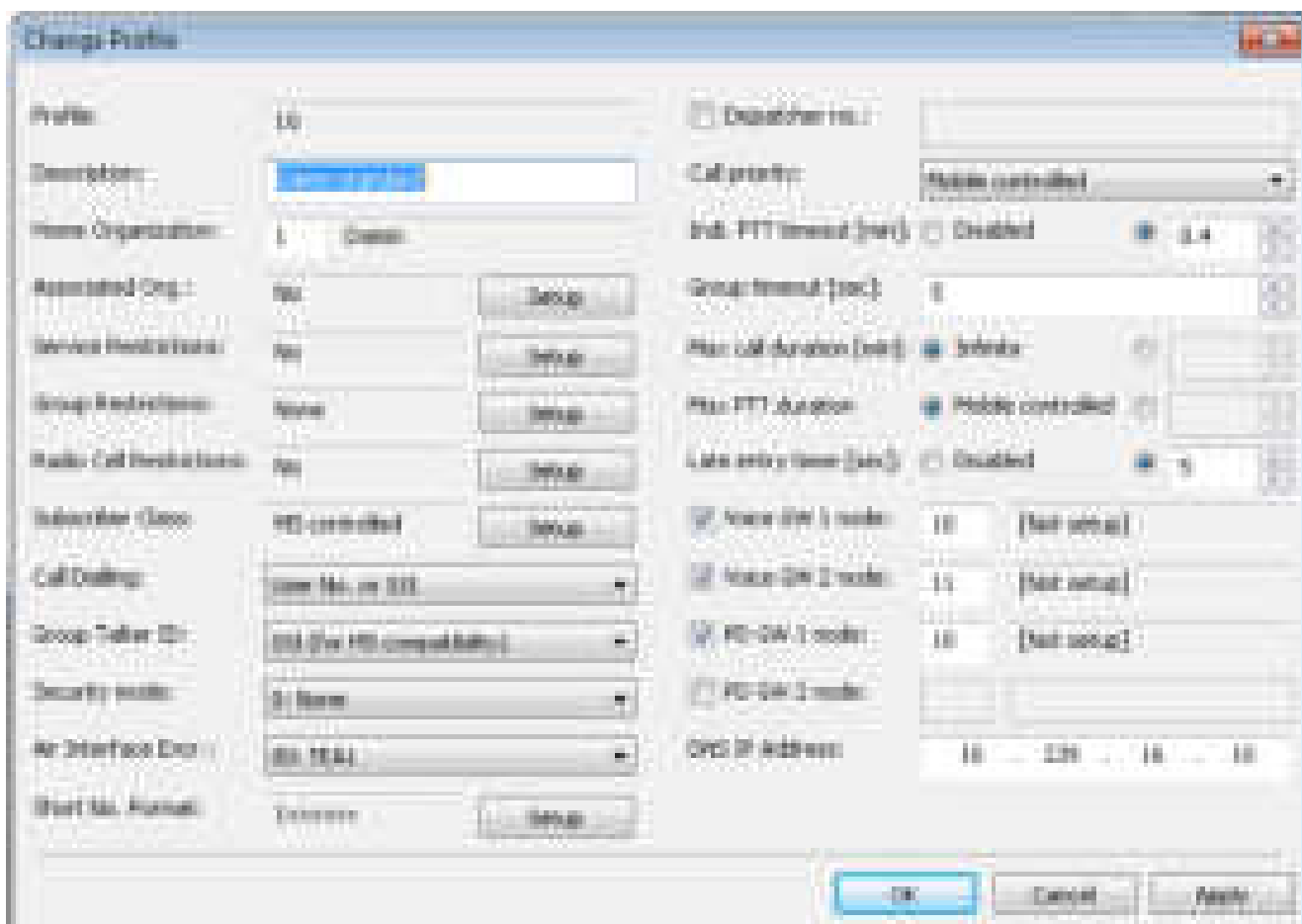
### 3.8.3.2 Tetra Radio Device connection details:



- **Description:** A label for this connection that is shown in the main window
- **Type:** Select Tetra Radio for a connection to another Tetra system
- **Enabled:** If set to Enabled the connection is enabled, else disabled and the field is grayed in the Group Bridge main window.
- **Device Type:** Piciorgros DVI-100 (current version has support for DVI-100)
- **Address:** The IP address for the Tetra Radio Device. Default factory setting from Piciorgros DVI-100 is 192.168.0.199. If necessary this has to be changed in DVI-100 to match the network used. The **Open GUI** button will open the default browser and use the IP address and try to open the GUI for the Piciorgros DVI-100. Please see chapter "Settings Piciorgros DVI-100" parameters for more information.
- **Port:** Must be setup in DVI-100, default 3141
- **Username:** Must be setup in DVI-100
- **PIN Code:** Must be setup in DVI-100
- **Call forwarding:** When Enabled group call can be send (default on)
- **SDS forwarding:** When Enabled group SDS can be send (default on)

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Group talker ID must be set to “SSI (for MS compatibility)” on the profile used by DVI-100 to use Status SDS:



### 3.8.3.3 Settings Piciorgros DVI-100 parameters

This chapter only describes the necessary parameters for using The Group Bridge with DVI-100. For detailed information about setting up the DVI-100 please see “DVI -100 user guide”. When connection to the Piciorgros DVI-100 either from Open GUI button or by starting a browser and type the IP address of the DVI-100 you get a login dialog:




First time you set up the unit you have to use the factory default User name and Password – “user”.

After you are logged in the network parameters can be set that match your network:



Put a label with the IP address on the DVI-100 when changing it from default so that you can remember the new setting. When changing the IP address you will loose connection and have to reconnect with the new IP address. Remember also to change the IP address in the Group Bridge to match.



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The next setting is the DVI-100 mode and the port number. Set this to “Server” and port “3141”. The port address can be changed if needed, but then the port setting in Group Bridge must also be changed to match.



**DVI-100 configuration panel**  
Funk Electronic Pictogram GmbH

Left sidebar menu: Home, DVI, Terminal configuration, Fleet configuration, Server configuration, Status information, Links, About, Backup, Exit Test.

Main configuration area (DVI-100 mode):

- DVI-100 mode: ☒ Client ☐ Server
- Port:
- Default Call:
- Voice call priority:
- More settings internal:
- Monitoring IP address:
- Monitoring IP Port:

Buttons: [Back] [Apply]

Next the user name and pin code for the DVI-100 must be set and this must match the setting in the Group Bridge:




**DVI-100 configuration panel**  
Funk Electronic Pictogram GmbH

Left sidebar menu: Home, DVI, Terminal configuration, Fleet configuration, Server configuration, Status information, Links, About, Backup, Exit Test.

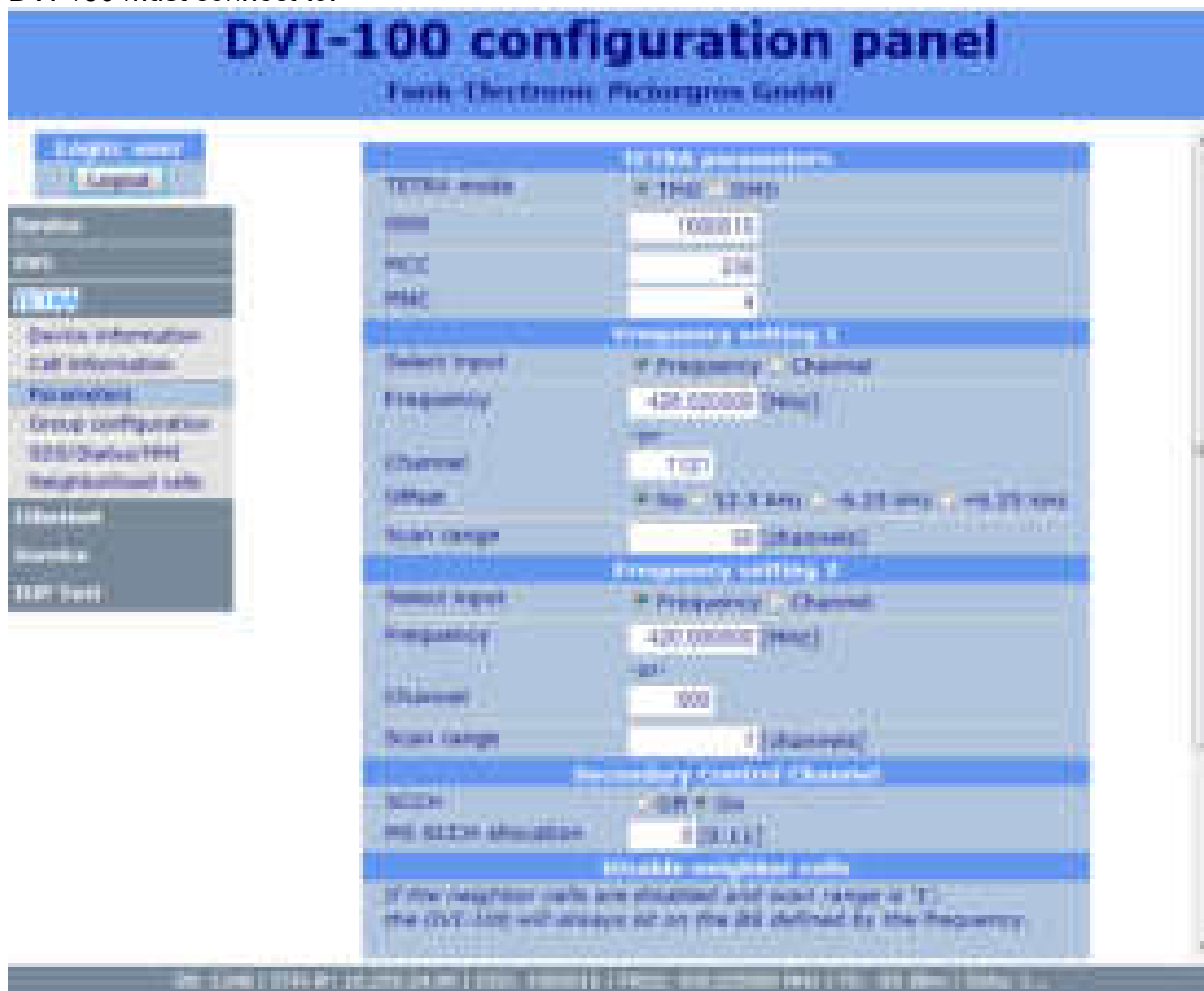
Main configuration area (DVI-100 mode):

- Username:
- Pin:
- Supervision: ☒ Yes ☐ No
- Infrastructure: ☒ Yes ☐ No
- Username:
- Pin:
- Supervision: ☒ Yes ☐ No
- Infrastructure: ☒ Yes ☐ No
- Username:
- Pin:
- Supervision: ☒ Yes ☐ No

Buttons: [Back] [Apply]

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Then the tetra parameters must be set to match the setting in the tetra network which the DVI-100 must connect to:



**DVI-100 configuration panel**  
Forsk Electronic Pictogram GmbH

**TETRA mode** ☒ TMO ☐ TSM

**ISSI**   
**MCC**   
**MNC**

**Frequency setting 1**

**Select input** ☒ Frequency ☐ Channel

**Frequency**   
**Channel**   
**Offset**     
**Scan range**

**Frequency setting 2**

**Select input** ☒ Frequency ☐ Channel

**Frequency**   
**Channel**   
**Scan range**

**Secondary control channel**

**SCCH** ☒ ON ☐ OFF


**MS SCCH allocation**

**Mobile registered cells**

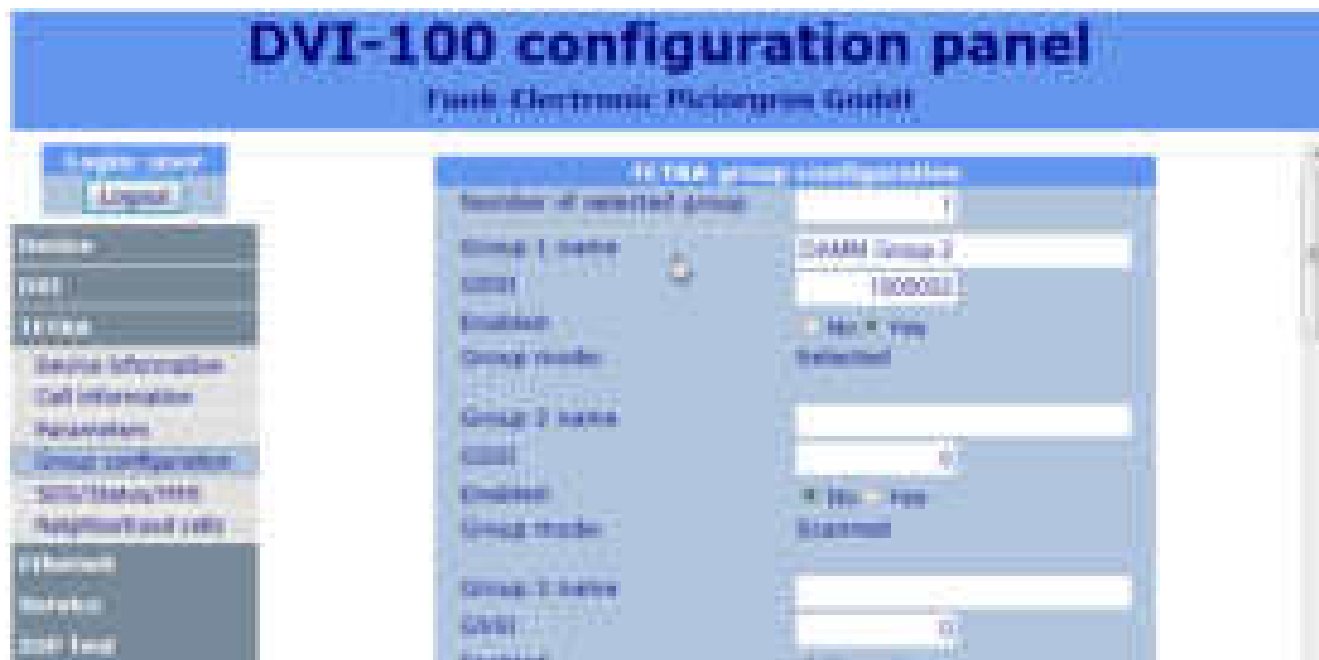
If the neighbor cells are changed and scan range is 1,  
the DVI-100 will always set on the cell defined by the frequency.

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The tetra mode must be TMO and TSI parameters (ISSI:MCC:MNC) must match the tetra network to which it should connect. Then the frequency and channel number, offset and scan range must be set for frequency setting 1.

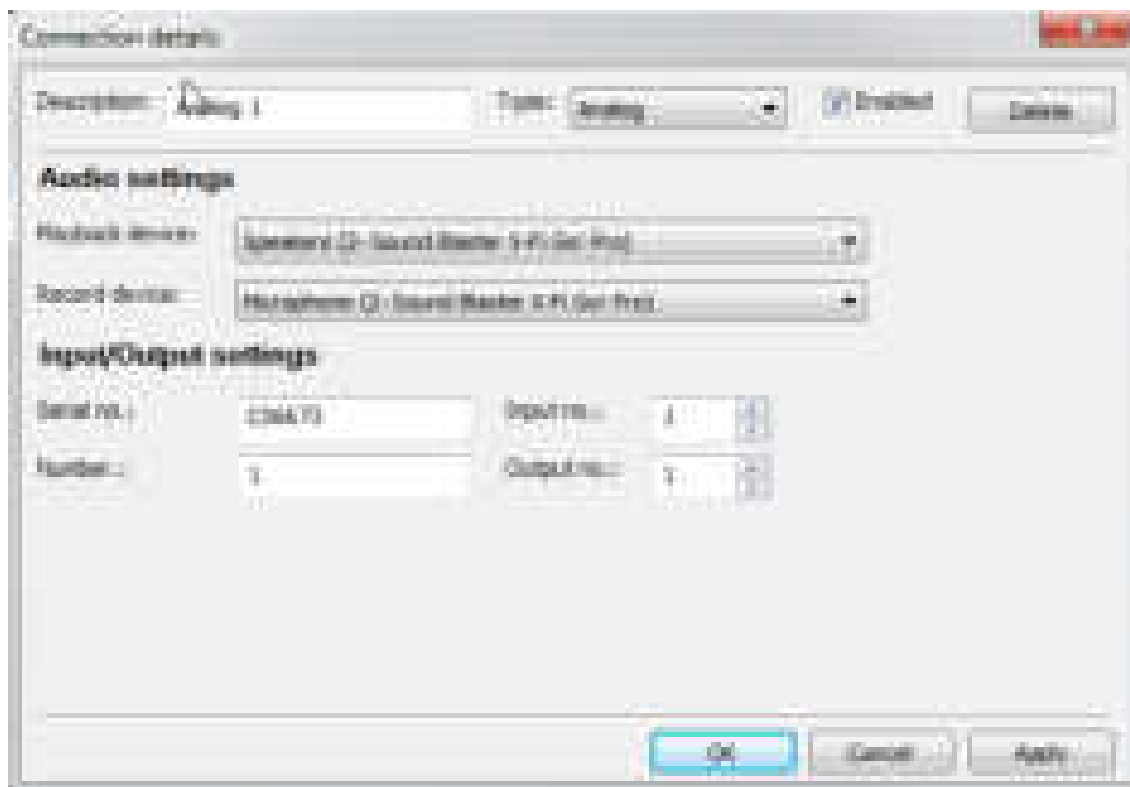
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The last thing necessary to set is Group SSI:



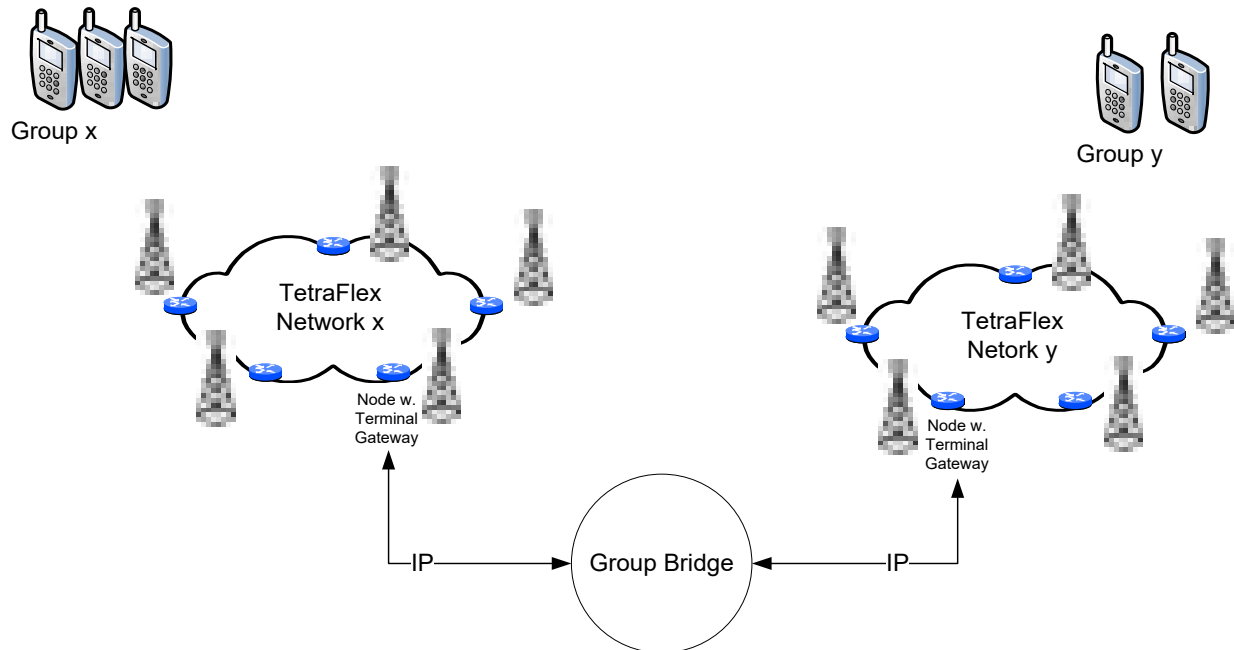
It is possible to use one group together with the Group Bridge.  
The group SSI must be used (GSSI) and group user number cannot be used.

### 3.8.3.4 Analog Radio Device Connection Details

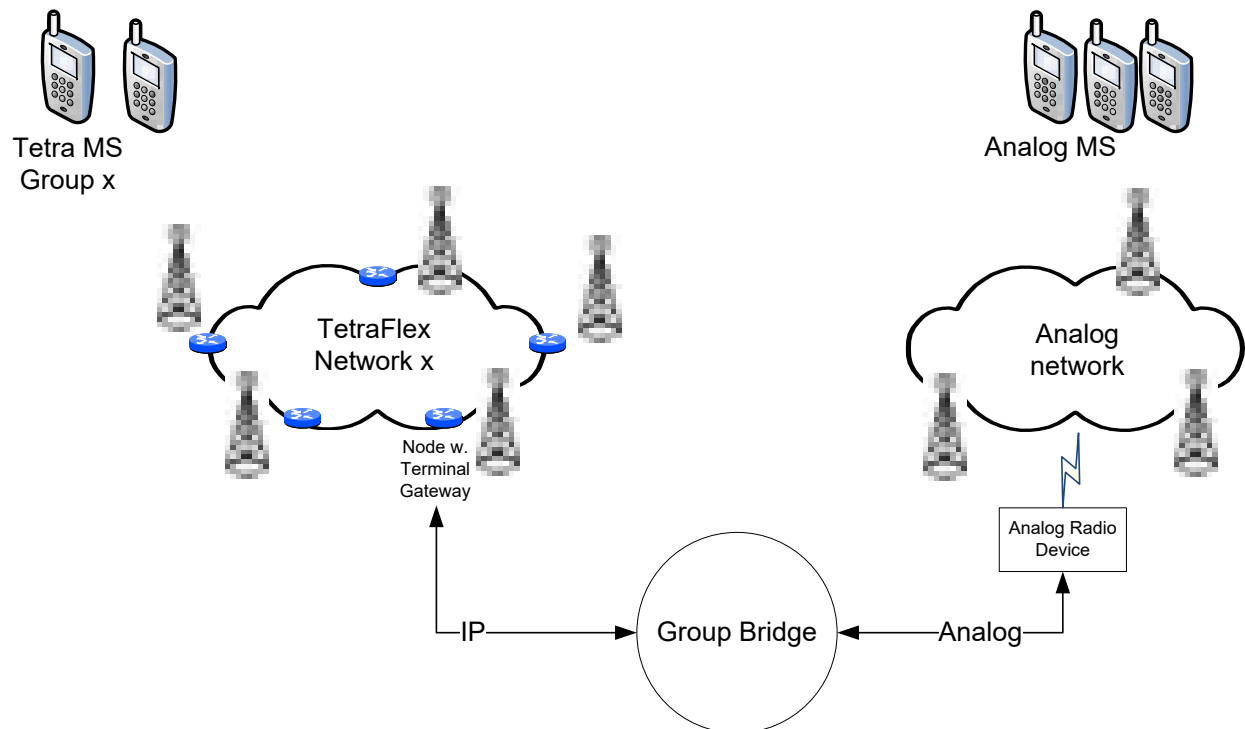


- **Description:** A label for the connection which is shown in the main window
- **Type:** Select Analog for connecting analog devices
- **Enabled:** If set to Enabled the connection is enabled, else disabled and the field is grayed in the Group Bridge main window.
- **Playback device:** From the drop down list any of the installed Windows playback devices can be selected. This is the analog audio output for this connection
- **Record device:** From the drop down list any of the installed Windows recording devices can be selected. This is the analog audio input for this connection
- **Serial no:** This is the serial number for the OnTrak USB I/O interface. (ADU200 or ADU208). The serial number is labeled on top of the OnTrak USB interface.
- **Number:** This is a number which the analog input indicates in the main window when there is an active call on this connection. The number can be in the range from 1 to 9999999
- **Input no:** The digital input number of the OnTrak USB interface. Used for monitoring the incoming signal from the analog device (ex. squelsh output signal from an analog radio)
- **Output no:** The digital output number of the OnTrak USB interface. Used for sending an signal to the analog device to signaling an outgoing call (ex. PTT output signal to an analog radio)

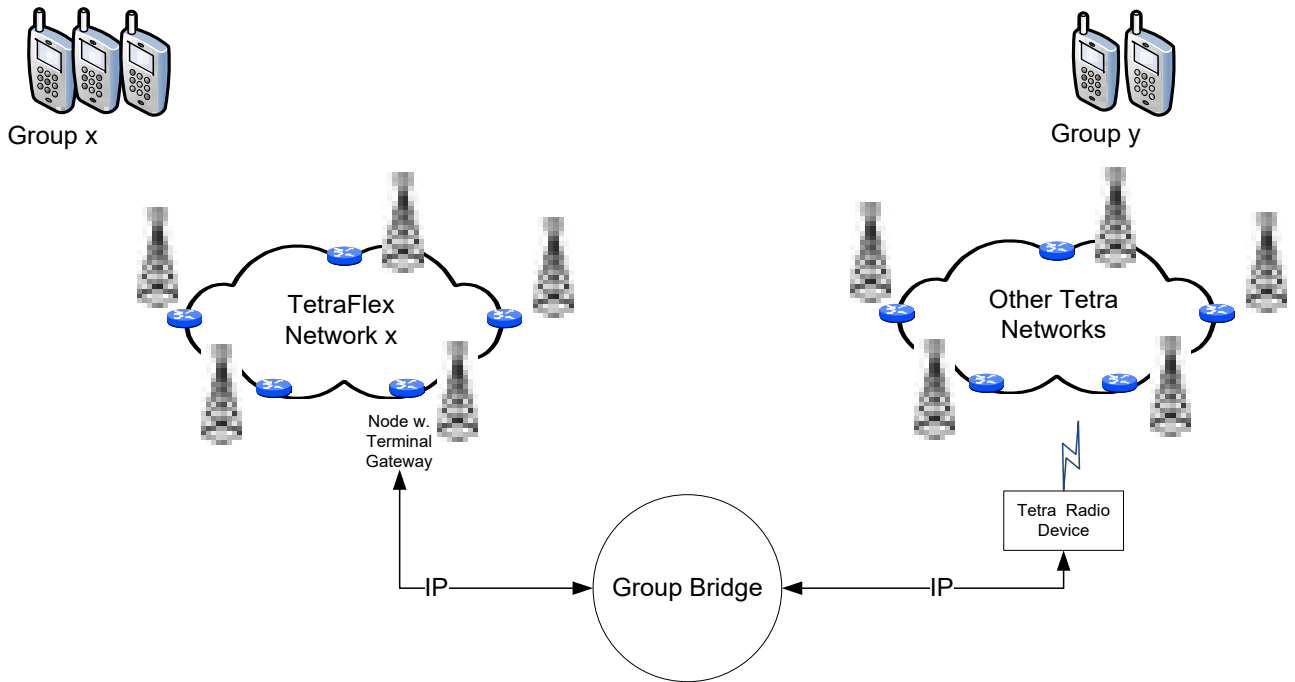
Example 1 - Group call between two different TetraFlex® networks:



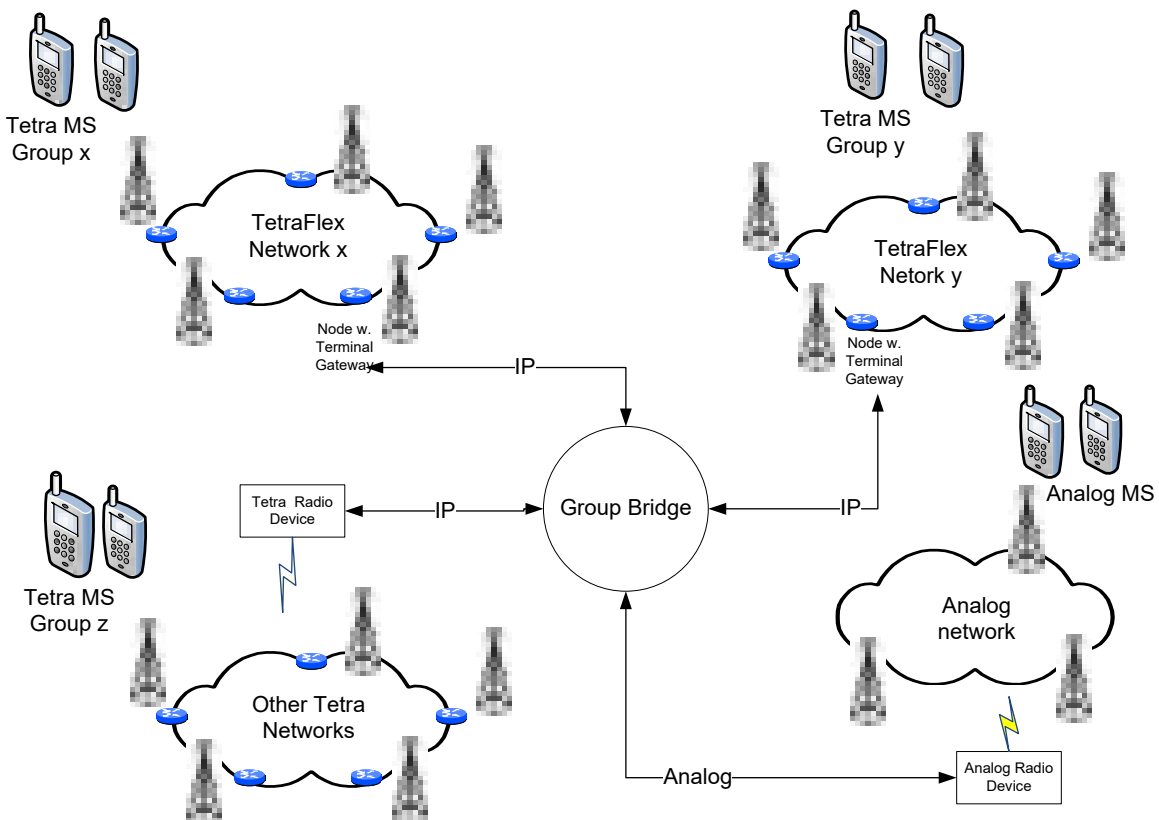
Example 2 - Group call between a TetraFlex® network and an analog radio system:



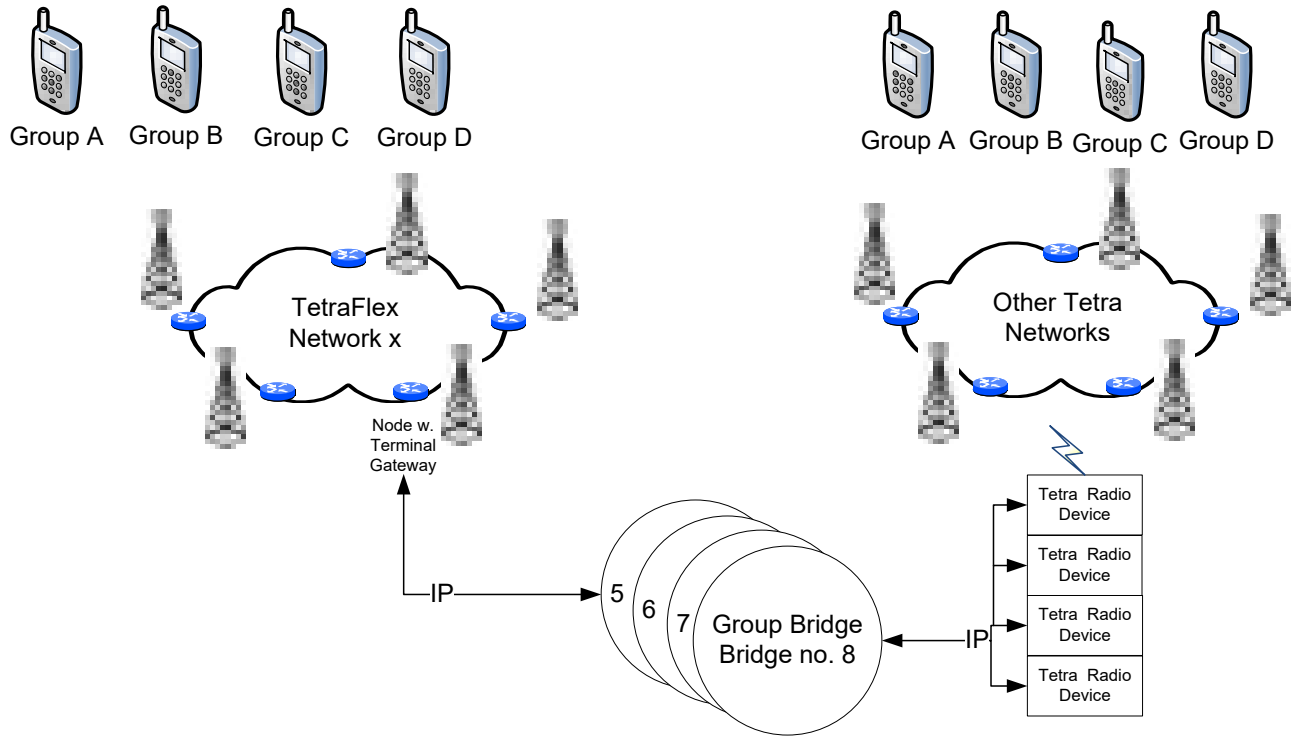
### Example 3 - TetraFlex® to other Tetra networks:




### Example 4 - Combination of connecting different Tetra and Analog networks:



### Example 5 – Group Bridge with more Groups:



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## Group Bridge Requirement

TetraFlex® Group Bridge	Requirement
Hardware and Software platform for running the TetraFlex® Group bridge application	A PC running Windows XP or Windows 7. Min. requirement: 1Gbyte RAM, disk storage 4 Gbyte, 2 usb port, 1 Ethernet 10M/100Mbyte Ethernet card
Tetra Radio Device	Piciorgros - DVI-100* ( <a href="http://www.piciorgros.com">www.piciorgros.com</a> )
Voice Card	Any device that complies with the specifications: Direct Sound compatible, 8 KHz linear, 16 bit mono, Analog I/O connection
Digital I/O	Ontrak ADU200* ( <a href="http://www.ontrak.net">www.ontrak.net</a> )
Analog Radio Device	Any radio with audio, PTT and Squels I/O
TetraFlex® Group Bridge Application	Group Bridge Client Dongle
TetraFlex® Terminal Gateway	TetraFlex® node with a dongle with Terminal Gateway. Max. 200 connection pr. node

\*) tested equipment from external supplier.

## Specification


TetraFlex® Group Bridge data	Value
Numbers of Bridges	max. 32*
Numbers of connections pr. Bridge	max. 5*
TetraFlex® Group Bridges pr. Node	max. 200**
Tetra Radio Devices	One pr. Other Tetra SwMI Group max. 32
Analog Radio Devices ***	One pr. Analog network max. 32

\*) Depending of the settings in TetraFlex® Group Bridge Client dongle

\*\*) Depending of the number of TetraFlex® Terminal Gateway setting in the node dongle.

\*\*\*) Analog flag must be set in TetraFlex® Group Bridge Client dongle




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# PART-4: Technical References

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	TetraFlex® - Antenna System for BS41x		

## 4.1 ANTENNA SYSTEM FOR BS41x

### 4.1.1 Introduction

This application note describes the recommended antenna configuration for the BS41x Tetra Base station.

The BS41x Tetra BS includes either the TMA412 Tower Mounted Amplifier or the TMD412 Tower Mounted Amplifier and Duplexer. The use of the RX amplifier section in the TMA/TMD is mandatory. It shall preferably be mounted in the top of the mast as close as possible to the RX antennas or alternatively ground mounted at the BS rack.

The TMD412 in addition contains a Duplex Filter, which optionally can combine the TX and one RX to run on same antenna.

**Whenever possible it is however recommended to run with two separate RX antennas and one TX antenna.**

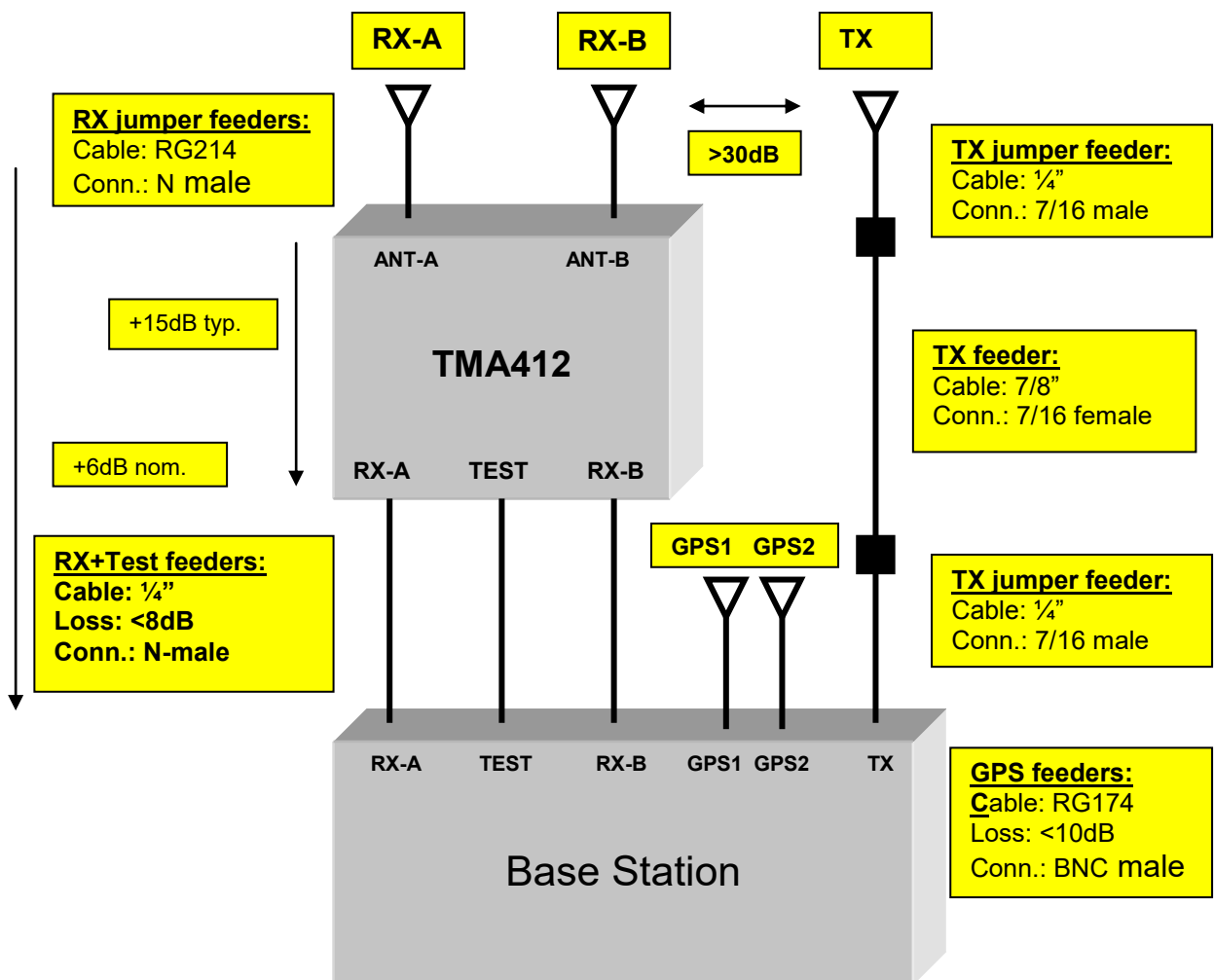
**When using the TMD412 Tower Mounted Amplifier/Duplexer it is recommended not to use the duplex filter option for more than 1 carrier, as the usage of the duplex filter may increase disturbances in the receiver i.e. reduced sensitivity.**

**When using the duplex filter option, care shall be taken not to use TX frequencies generating 5th order IM products on the used RX frequencies**

The antenna system shall in addition contain one GPS antennas for each installed BSC.

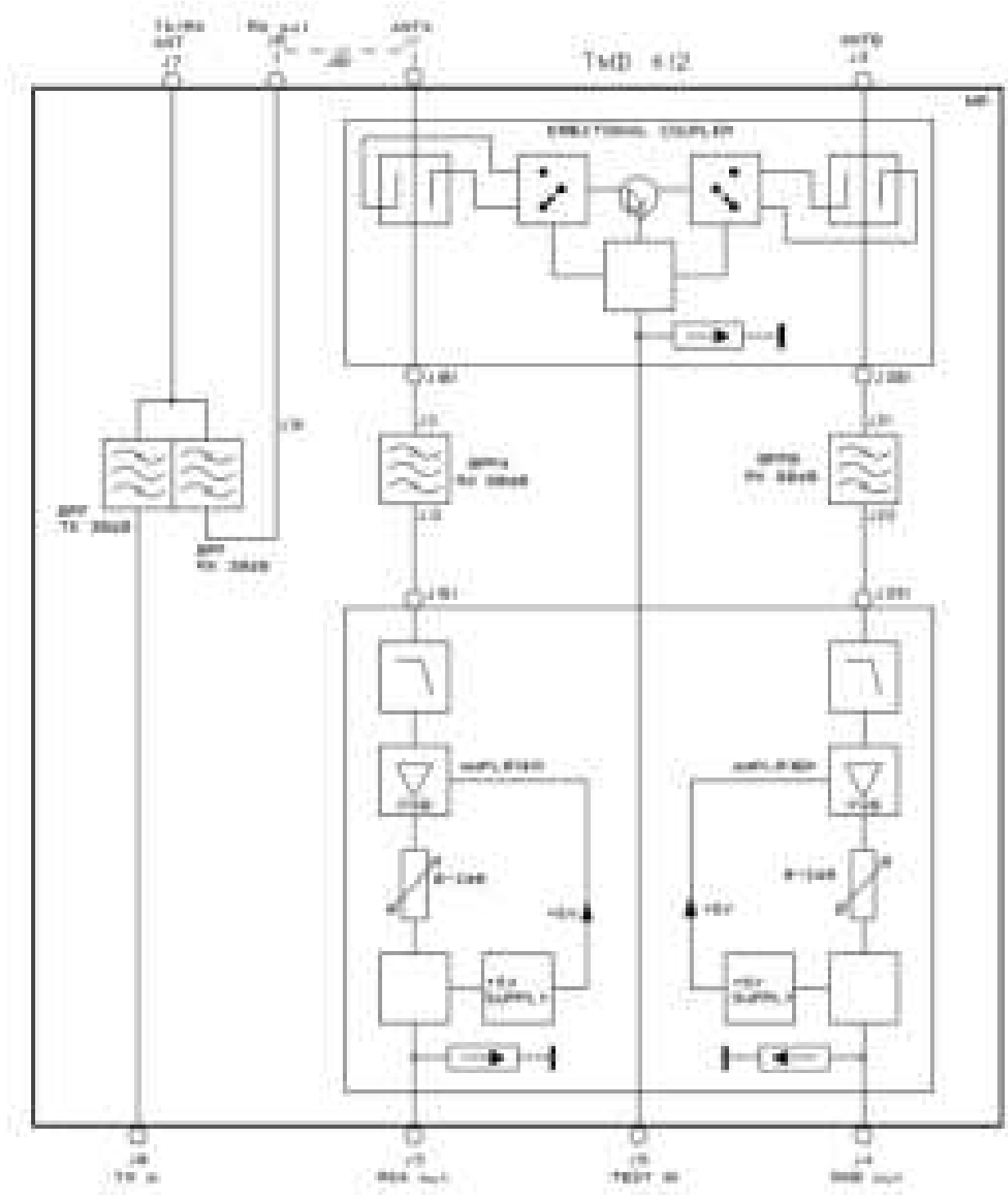
#### 4.1.2 Typical antenna configuration

The drawing below shows a typical antenna arrangement for a base station. If the duplexer is used it combines the RX-A and TX feeder to a single antenna. The feeder system from the BS to the top of the mast is the same for both cases.




##### 4.1.2.1 TMA412/TMD412

A block diagram of the TMD412 is shown below. The TMA412 is identical except for the omitted Duplexer.



#### 4.1.2.2 RX antenna

The BS uses two receiver antennas for its dual RX diversity implementation. The TMA is provided with a dual tower-mounted amplifier with input filters, amplifiers and test circuits for measurements. The BS includes all the required circuitry to supply the two amplifiers with DC power and to control the test circuit through the feeders.

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The two RX antennas should be mounted as widely spaced as possible to optimize the gain of the diversity reception. In addition they should be mounted to have a coupling with the TX antenna of >30dB to ensure proper operation. The TX separation is normally achieved without much effort.

Three identical low-cost feeders are required for the RX antenna system. As the main RX filters are located in the TMA, cables with good screening are needed to avoid radiation into the cables. Cables should either be double shielded or with solid screen. For most applications 1/4 inch corrugated cables is the optimum choice. Cables of type RG58/U and RG213/U should not be used.

The TMA has a nominal gain of 15 dB and the system is designed to have a nominal total gain from TMA input to BS RX connector input of +6dB. With some margins this allows a maximum feeder loss of 8dB. Attenuators are provided in the BS to adjust the total gain. Note that use of lower-loss cables will not improve system performance, just increase the cost.

The following table indicates the maximum allowed length of different possible cable types:

Cable with 8dB loss	450MHz	850MHz
RG223/U	28m	19m
RG214/U	50m	35m
1/4 inch (RFS CF14-50)	85m	60m
3/8 inch (RFS LC38F-50)	105m	75m
1/2 inch (RFS LCF12-50)	170m	120m
5/8 inch (RFS LCF58-50)	220m	155m

If very thick cables are used, jumper feeders in both ends may be needed. Cables and connectors between antenna and TMA412/TMD412 shall be resistance to water ingress and migration.

#### 4.1.2.3 TX antenna

The BS uses a TX antenna for all the installed TETRA carrier units, which may optionally also be used for receiving. All components used in the TX antenna system need to be high quality components with low inter-modulation to avoid distortion product to jam the receiver inputs. The requirements include the TX antenna itself and also the feeders and connectors.

The TX antenna feeder should be provided with connectors of type 7/16. Other connector types should be avoided, including connectors of type N. For 2-carrier only base stations without Duplexer N-type connectors can be used at antenna and BS.

The feeder cables shall have as low as possible insertion loss and have a solid screen. Cables with woven shields of thin wires should never be used.

The TX cable loss can be compensated, by increasing the TX output power to balance the system requirements. For a low-power Base Station this can be an acceptable solution but

for a high-power BS this can give an unacceptable increase in the mains power consumption or may not be possible at all.

As guideline, the TX antenna feeder loss for a high-power BS should not exceed 2dB. This can be achieved when not exceeding the following cable lengths:

Cable 2dB loss	450MHz	850MHz
1/4 inch (RFS CF14-50)	21m	15m
3/8 inch (RFS LC38F-50)	27m	19m
1/2 inch (RFS LCF12-50)	42m	30m
5/8 inch (RFS LCF58-50)	55m	39m
1 1/4 inch (RFS LCF114-50)	93m	65m
1 5/8 inch (RFS LCF158-50)	128m	88m

For normal installations 5/8 inch cables or thicker is recommended. When thick cables are used it is normal needed to have jumper cables in both ends to avoid stress to the connectors on the antenna and BS.

Cables and connectors between antenna and TMD412/BS41x shall be resistance to water ingress and migration.

#### 4.1.3 GPS antenna

Each Base Station Controller includes a GPS receiver, which requires an antenna. The GPS antenna connector delivers +5V for an antenna with built-in amplifier. The GPS antenna should preferably be mounted on top of the building with good all round vision the whole horizon. It should NOT be mounted in top of a high mast and should be kept at the greatest possible distance from any transmit antenna.

The GPS signal is received on 1575.42 MHz with a bandwidth of a little more than 2 MHz. Special care with separation from the TX antenna is important especially, if any transmitter is located in the range 393.5-394.2 MHz (4<sup>th</sup> harmonic). The current used GPS receiver module in the BSC411 is a Motorola M12 and in BSC412 it is an iTrax.

Several manufactures have appropriate antennas, which match the receiver. An example is shown below.



The GPS antenna shall include an amplifier with a gain of about 25dB. As a guideline the cable loss should not exceed 14 dB, which gives the following maximum cable lengths:

Cable type	14dB
RG223/U	23m
RG214/U	46m
¼ inch (RFS CF14-50)	70m

Cables and connectors between antenna and BS41x shall be resistance to water ingress and migration.

#### 4.1.4 TX inter-modulation considerations


One of the most critical aspects about antenna systems for a multi-carrier base station is to control the inter-modulation generated between the different transmitters in the BS.

Inter-modulation happens in many different places on different levels. One major place is the TX output amplifier itself. When a signal from another TX reaches a TX output amplifier, all typical transmitters will generate 3<sup>rd</sup> order IM products with a level typically 15dB below the interfering signal. The BS41x Base Station is provided with double circulators in the TX output to make sure, that IM3 products close in frequency will be at least 70dB below the carrier.

At greater differences in frequency the inter-modulation products are further reduced by the selectivity of the TX cavity combiner and the TX output filter. In the RX frequency band of the BS spurious and 5<sup>th</sup>-order IM products measured at the TX antenna connector are verified to be less than –106dBm. With the expected RX-TX antenna separation of 30 dB, any generated product in the receiver input will be less than –136dBm, well below the RX sensitivity level. This verification has been done with up to 16 simultaneous transmitters of 50W each.

For carrier output of 20W (+43dBm) the –106dBm gives a rejection of –149dB. To reach this level, extreme care is needed to avoid inter-modulation at any point.

Some connector manufacturers have recently started to specify 2-tone 3<sup>rd</sup>-order IM for their high quality connectors. These specifications typically is about –150dB. IM with more than 2

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carriers are not specified. It is recommended only to use DIN 7/16mm connectors in the TX antenna feeder section. N-connectors are an order of magnitude worse and should never be used for more than 2 carriers.

Feeders shall be with solid screen and inner conductors to avoid any possibility for non-linearity due to undefined connections between individual cores in the cable. High quality RG214/U cable has been demonstrated to produce noise when bent mechanically in the lab, simulating a windy condition on a mast.

The larger antenna vendors have in the last years established test set-ups to verify IM properties of their cellular antennas for 900 and 1800MHz. For 400MHz this is almost non-existent. It is recommended that if a tested antenna cannot be purchased, then ask the vendor to confirm that all construction principles are identical to those used in verified antennas in the 900 or 1800 MHz range.

One very critical thing to remember about inter-modulation is, that it is very difficult to predict accurately. For antenna constructions two factors heavily degrade the performance. Over years connectors etc. starts to corrode, degrading IM. Additionally, IM properties can also degrade under windy conditions. Therefore a short verification of a new antenna set-up after installation does not guarantee performance in the longer term.

Inter-modulation can be calculated with the formulas:

$$\begin{aligned}
 3^{\text{rd}}: f &= 2f_1 - f_2 \\
 5^{\text{th}}: f &= 3f_1 - 2f_2 \\
 7^{\text{th}}: f &= 4f_1 - 3f_2
 \end{aligned}$$

RX frequencies should never be selected to be on frequencies, where 3<sup>rd</sup>-order IM is present for high-power Base Stations. However, 3<sup>rd</sup> order IM is only possible with special Base Stations with a TX frequency separation larger than the guard-band between RX and TX bands.

For high power Base Stations running with Duplex Filter, 5<sup>th</sup> order should always be avoided, and 7<sup>th</sup>-order should preferably be avoided as well.

The BS41x is provided with an RSSI indication accurate down the RX noise floor. This can be easily used to check for disturbance from the transmitters.


First, display the RSSI for all carriers with the OM command:

B/21/1


Note the actual RSSI and then key all the transmitters simultaneously with the command:

B/10+



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Check the RSSI again. The difference in RSSI directly indicates the reduction in sensitivity due to disturbance from the Transmitters.

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## 4.2 TX COMBINER FOR BS41x

### 4.2.1 Introduction

The BS41x Tetra Radio Base Stations are provided with a TX combiner system to combine all the installed transmitters to a single antenna.

The combiner system has the following requirements:

- Combine the transmitters to a single feeder with lowest possible insertion loss.
- Give isolation between the TX input ports to avoid the signal from one transmitter to reach the other transmitters and generate inter-modulation. The isolation requirement is normally minimum 55dB in order to reach a suppression of the inter-modulation signals of 70dB relative to the individual carriers.
- Filter the TX antenna output to reduce any unwanted signal in the receiver band of the Base Station to be less than  $-106\text{dBm}$  in order to avoid interference in the receiver with an TX/RX antenna separation of  $\geq 30\text{dB}$ .
- Make wide-band filtering of the TX output signal to avoid interference to other radio equipment installed in the same mast.

Two different methods exist in order to combine several transmitters to a single antenna:

- Cavity Combiner (combining with filters)
- Hybrid Combiner (combining with 3-dB couplers)

The cavity combiner has the advantage that it can combine a high number of transmitters selectively with almost constant insertion loss independent of the number of transmitters used. The disadvantage of the Cavity Combiner is that it requires minimum frequency spacing between each individual transmitter of minimum 175 kHz for the 400MHz band and 250 kHz for the 800MHz band.

The Hybrid Combiner has the advantage that it can combine transmitters with no frequency spacing restrictions and without any adjustment. For a 2-way Hybrid Combiner the insertion loss is almost equal to a Cavity Combiner. However to combine more transmitters the insertion loss increases rapidly. The theoretical insertion loss for a 2-way hybrid is 3dB, for a 4-way hybrid 6dB and for an 8-way hybrid 9dB.

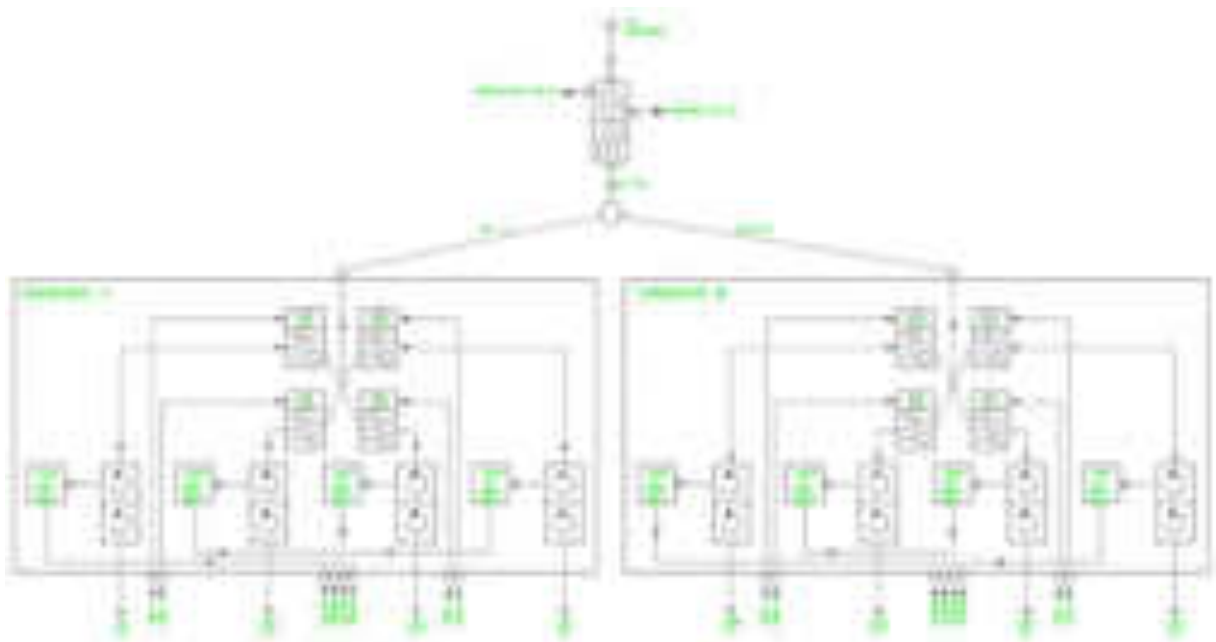
The BS412 2-carrier BS is provided with a hybrid combiner whereas the BS411 and BS414 as standard are provided with cavity combiners. The BS414 can however also be delivered with a 4-way hybrid combiner.

### 4.2.2 Cavity combiner system

The Cavity combiner system consists of the TC411 TX Combiner 4-way module and the TF411 TX Filter. Kits with junction and connection cables connects the units together.




The schematics of the cavity combining system are shown below:



#### 4.2.2.1 Circulator

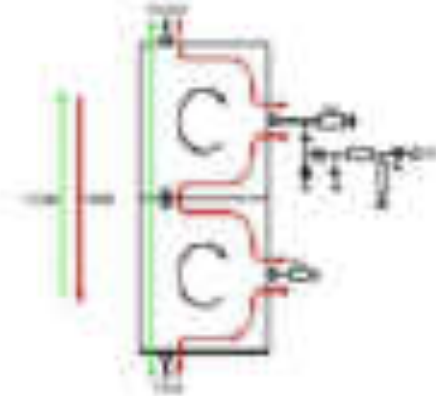
The TX output signals come from the TR41x to the TC411 in cables attached to the Cassettes. In the TC411 it first passes a dual circulator, which gives a reverse isolation of at least 50dB.

A circulator is a very special device with different insertion loss in the two directions. It is a passive but non-linear device, which do not follow Ohm's law.

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A circulator is a 3-port device, which behaves as a turn-around with the rule, that when you enter a port you follow the direction of the arrow around and leave the first-coming outlet again.

The function of a dual circulator is shown on the drawing below:



The TX signal enters the port on the lower circulator and follows the green line. It enters the first circulator, follows the arrow and leaves it again in the first-coming port. The same happens in the second circulator. The TX signal passes the circulator with an insertion loss of around 0.5dB.


Any signal entering the upper port in the reverse direction will follow the red line. This could be the transmitter signal reflected at the cavity filter or at the antenna, or a signal from another transmitter.

Most of the reverse signal will be dissipated in the big high-power resistor connected to the first port. A diode detector connected to the resistor makes it possible to monitor the size of the reverse signal.

Some of the signal will be reflected at the high-power resistor and follow the red line to the low-power resistor on the next circulator, where most of the remaining signal will be dissipated. However a small fraction will be reflected and end up at the TX input port. The total rejection in the reverse direction will normally be higher than 50dB.

The size of the reverse signal can be monitored either by a voltmeter attached directly to the Test Point or via the O&M interface and the TR41x or the TCC411. The test point is used for adjustment of manually tuned combiners. The TR41x will also monitor the level on the TP and generate an alarm if the reverse signal becomes too high.

Note, that when the Base Station runs without antenna or with the cavity filter tuned to a wrong frequency, all the reflected power ends up in the high power resistor, which is designed to dissipate the total transmitted power continuously. The PA of the TR41x will always look into a perfect load as long as the cable is correctly connected between the TR41x and the circulator.

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#### 4.2.2.2 Cavity Filter

From the Circulator the TX signal enters the Cavity filter to combine the TX signals selectively. For the 400MHz range the cavity is a  $\frac{1}{4}$  lambda TEM resonator with an unloaded Q of about 10.000. For the 800MHz range the cavity is a  $\frac{3}{4}$  lambda TEM resonator with an unloaded Q of about 13.000.

The cavity is fully temperature compensated, and is tuned to the center frequency of the transmitter either automatically with a stepper motor or optionally manually by hand.



The TC411 module contains 4 cavity filters, which are internally combined together with a 4-way  $\frac{1}{4}$ -lambda junction, which transforms the short circuit of the cavity at out-of-band frequencies to open circuit at the junction point.


#### 4.2.2.3 Junction cables

The TC411 combiner module can either be connected directly to the TF411 filter or expanded with junction cables to 8 channels (optionally up to 16 channels). The junction cables are  $\frac{1}{2}$ -lambda (or multiply thereof) long in order to keep the high impedance for all out-band frequencies in all junction points.

The junction cables are manufactured with extremely high precision and measured individually for electrical length. Never try to create these cables on your own.

#### 4.2.2.4 Filter connection cable

The combiner output from the junction point is connected to the TF411 TX output filter with a cable with a specific electrical length. The electrical length is important for out-band frequencies due to the serial connection of two filters.

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#### 4.2.2.5 TX output filter

The TF411 high-power TX output filter gives an additional rejection of the TX noise of 25dB in the RX frequency band, which together with the cavity filters gives a total RX band rejection of 60dB minimum.

The output connector of the filter is a DIN 7/16mm connector with good inter-modulation properties.

The filter output also contains two directional couplers with BNC connectors with an accurately adjusted coupling of -40dB and a directivity of minimum 25dB.

#### 4.2.2.6 Power measurement

The outputs of the two directional couplers are connected with BNC cables to the rear of AI411, which contains two precision RMS detectors to convert the actual power into DC current.

The current outputs are forwarded to the BSC412 Base Station Controller, which can display the actual output and reflected power at the TX antenna connector.

The following OM commands can be used to check the output

F15/F (output and freq for each running TR412)

F13 (summarized output after combiner)

The AI411 is provided with two adjustments on the front plate, to allow accurate calibration of the displayed power.

#### 4.2.2.7 TCC411 TX Combiner Controller

The TC411 Cavity Combiner is equipped with the TCC411 TX Combiner Controller, which controls the position of the stepper motors based on channel information received from the TR41x Transceiver.

At power-up the Micro-Controller tunes the cavity to the upper mechanical end stop to know its exact position.

When receiving a channel command from the TR41x the MC calculates the required motor position and automatically tunes the cavity to the required position. The required motor position is calculated from a calibration table inside the MC, created when the TC411 is factory adjusted.

The channel command to the TCC411 is automatically generated in the TR41x when a channel change is done.

If the TR41x is powered off or removed, the TCC411 will automatically after about 30 seconds in brackets return the cavity to the upper end stop to avoid it to interference with other cavities.

The TCC411 is provided with an O&M interface and can be accessed from the BSC411.

The center frequency of the cavity can be fine adjusted with the 13 command in the TCC411. This is normally not needed but could be done if e.g. the BS is placed at a high altitude, where the air pressure is lower, which will increase the cavity frequency.

#### 4.2.3 BS414 4-way Hybrid Combiner system

The BS414 can optionally be fitted with a 4-way Hybrid Combiner module instead of the Cavity Combiner. To compensate for the missing filtering in the cavity the TF411 is replaced with the TF412 60dB TX Filter.

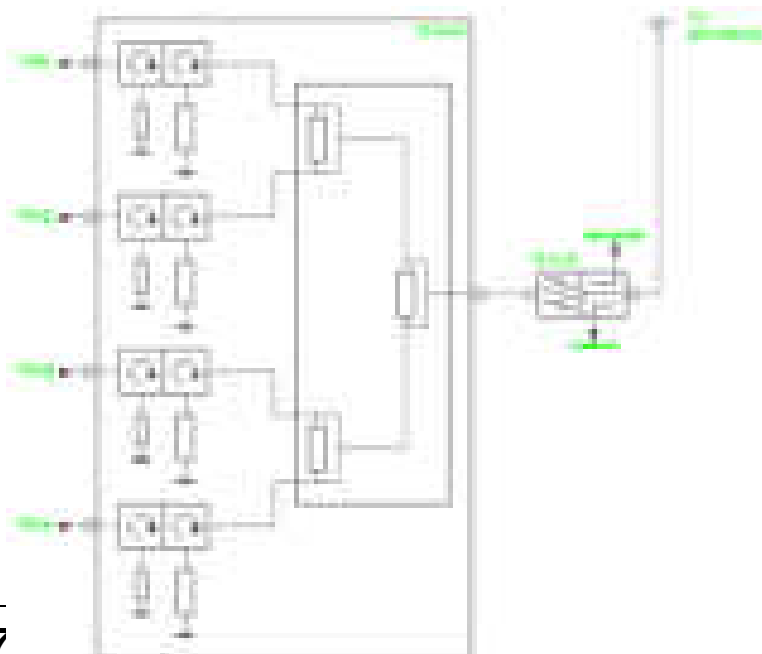
TH414




TF412



The TH414 consists of four dual circulators followed of a 3-dB Wilkinson combining tree giving a theoretical insertion loss of 6dB.



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## 4.3 RX MULTI COUPLER FOR BS41x

### 4.3.1 Introduction

The purpose of the RX multi-coupler system is to distribute signals from the RX antennas to the RX inputs of the TR41x Transceiver.

The Base Station is provided with two completely independent RX signal paths to connect the two RX antennas.

The use of two RX antennas in a diversity scheme gives a considerably improvement in sensitivity of the Base Station. The improvement is described in the Diversity Application Note.

In addition the use of two RX antennas with completely separate signal paths gives redundancy to the BS RX. If a fault occur in one leg of any of the components (antenna, feeder, amplifier etc.), the BS will still be able to operate with the other antenna, only losing the sensitivity of the diversity gain.

The system includes as standard a Tower Mounted Amplifier to eliminate the sensitivity degradation normally caused of the RX feeder loss. The TMA can compensate for up to 8dB feeder loss with no change in RX sensitivity, allowing the use of thin feeders with a considerably saving in feeder expenses. See the Antenna application note for antenna and feeder configurations.

The Base Station is provided with an RF Test Loop feature, which allows a transmitter to generate a test signal for test of the complete RX section, including measurement of RX sensitivity at the TMA input and measurement of RX antenna return loss.

### 4.3.2 RX signal path description


The RX signal normally comes from the RX antenna to the TMA input with a short jumper cable. The TMA is provided with an N-female connector.

Inside the TMA the signal first passes a dual directional coupler used to insert test signals in forward and reverse directions. This feature is described in the RFTL section.

The signal then passes a big low-loss pre-selection filter. The input of the filter is DC grounded to ensure that no DC voltage can be built-up on the antenna feeder. The filter has the following specifications:

Parameter	400MHz	800MHz
Pass-band width	5MHz	14MHz
Guard-band width	5MHz	25MHz
Out-band rejection	60dB min.	60dB min.



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The high 60dB out-band rejection ensures proper duplex operation of the Base Station. With the required RX-TX antenna isolation of 30dB a total rejection of the TX signal of 90dB is obtained before reaching the first amplifier. The filter also ensures good rejection of signals from other transmitters in the same mast.

The filter is followed of an LNA with a GaAs PHEMT transistor with simultaneous very low noise figure and high IM intercept point.

The amplifier output goes to the N-female output connector, where the DC-feed from the BS to supply the amplifier is extracted. An over-voltage arrestor is provided on the connector to protect the amplifier during lightning.

The RX signal is then passed from the TMA to the RX input connector on top of the BS through the RX feeder, and further internally in the BS to the RM input of rear side of the AI411 Antenna Interface Unit.

The AI411 input is also provided with an over-voltage arrestor. After passing the DC insertion circuit, the RX signal passes a directional coupler, which can be used to provide a test input signal through the TNC connector on the AI411 front plate.

Afterwards follows the attenuator used to balance the RX feeder loss, adjustable through the hole in the front plate marked "Gain".

The signal is amplified in a low-noise high dynamic range transistor to compensate for the following splitters. The AI411 is provided with two outputs coming from a 2-way Wilkinson splitter.

The two outputs can either feed up to eight TR41x through external splitters with 13dB insertion loss (used in 4- and 8-carrier BS versions) or feed two TR41x directly (used in the 2-carrier BS version).


A jumper internally in the AI411 changes the output level with 13 dB to compensate for the splitter. The actual setting of this jumper is marked outside the AI411 besides the type plate.

#### 4.3.3 Supply and alarm circuits

Each RX path is provided with independent voltage regulators to feed the TMA and RM amplifiers.

The TMA DC feed is provided with circuitry to detect low-current alarm (no TMA connection) and low-voltage (TMA connection short-circuit).

Similarly the RM amplifier is provided with circuitry to detect low-current and high-current alarms.

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The alarms are connected to the BSC and send to the TR41x's assigned to the particular Radio Cell. If faults exist in one leg only, a warning alarm is generated. If alarms exist in both legs, a blocking alarm is generated.

#### 4.3.4 RF Test Loop path description

The Base Station is provided with an RF Test Loop feature allowing extensive test of the whole Base Station both locally and remotely without any additional equipment.

Each TR41x is provided with an RFTL output (BNC connector) on the front plate. The output can be activated with either a high level output (-40dB relative to the TX output connector), low level output (-50dBr) or turned off (<-80dBr).

The output signals are either combined in RFTL combiner modules and brought to the AI411 RFTL inputs (4- and 8-carrier versions) or brought directly to the AI411 inputs (2-carrier versions).

In the AI411 the two inputs are combined, followed of and attenuator/jumper to compensate for the loss of the external combiner. This setting always follows the similar settings in the RM.

Afterwards follows a variable attenuator adjustable through the AI411 front hole marked IN. This attenuator is used to compensate for output power selection of the TR41x.

The signal now enters a double balanced mixer, where the frequency is converted from the TX band to the RX band. A Crystal oscillator running on the RX/TX duplex frequency offset provides the injection signal.


The mixer is followed of a HPF and a buffer amplifier before it reaches the variable output attenuator, accessible from the front of the AI411 through the hole marked OUT. This attenuator is used to compensate for actual cable loss of the TEST feeder going to the TMA.

A combining circuit at the output connector allows the insertion of an external test signal from the BNC connector on the AI411 front plate marked TEST IN.

At the output connector a DC control signal insertion circuit is provided to the TMA, together with an over-voltage arrestor.

From the TNC output connector on the rear of the AI411 the test signal is connected internally in the BS to the N-female TEST connector on the BS top, from where it goes to the TMA in the top of the mast with a feeder similar to the RX feeders.

The TEST input in the TMA is also provided with an over-voltage arrestor and a DC separation circuit.

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In the TMA the test signal is divided in two, one for the A-path and one for the B-path. The test signal is then inserted in either the forward direction of the two paths to the BS (-50dBr) or optionally in the reverse direction against the antennas (-40dBr).

The direction is controlled of the DC signal in the TEST feeder and reverse direction can be activated of each of the TR41x, when RX antenna return loss measurement is performed.

## 4.4 TR412 TRANSCEIVER DESCRIPTION

### 4.4.1 Introduction

The TR412 Transceiver is a complete Tetra Carrier Unit containing a dual diversity receiver, a highly linear transmitter and all the necessary computer power to handle the lower protocols and control functions. The TR412 is an upgraded plug-in replacement for the TR411.

The TR412 is able to run different modulation and protocol types depending on the actual software running on the DSP and controller. The standard TETRA version also support analogue PM modulation for testing purposes, to allow complete testing of a site with analogue test equipment.

### 4.4.2 Receiver


The receiver contains two completely independent signal paths for dual diversity reception as standard.

Each RX signal comes from the Receiver Multi-coupler system into the TR412 via the TNC connector on the front plate, and is amplified with about 17dB in the RF amplifier, followed of a 3-pole BPF.

The signal now enters 1<sup>st</sup> mixer, where it is converted down to 1<sup>st</sup> IF of 45MHz. 1<sup>st</sup> mixer is a high-level double balanced mixer running with an injection level of +17dBm to obtain a high dynamic range.

The 1<sup>st</sup> mixer is followed of a 4-pole 45MHz crystal filter, an IF amplifier with about 30dB gain and a second 2-pole crystal filter. The crystal filters are of linear phase type to avoid distortion of the digital modulation.

From the output of the second crystal filter the signal enters 2<sup>nd</sup> mixer, where it is converted down to 2<sup>nd</sup> IF of 144kHz. The signal is then amplified and balanced with op-amps before it goes from the RX Front End Board to the Main Board, where it is converted to digital.

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The ADC samples the 2<sup>nd</sup> IF signal of 144kHz directly with a sampling frequency of 576kHz and a resolution of 16bit. The digital signal is going to the DSP on a serial interface.

In the DSP the signal is first down-converted to base-band and is then passing the channel definition filter, which determines the actual bandwidth of the receiver. In TETRA mode the filter is the root-raised cosine filter.

Afterwards frame synchronization, diversity combination and demodulation takes place.

The Local Oscillators for the RX is generated on the RX FS board, locked to a 12.8MHz reference coming from the Main Board.

1<sup>st</sup> LO is a Voltage Controlled Oscillator running either 45MHz below or above the actual receiver frequency. The VCO is phase locked to the 12.8MHz reference with a fractional-N PLL circuit, controlled through a serial interface from the Micro-Controller. The VCO signal is amplified to about +23dBm and brought to the RX Front End via the attached cable. Here it is first filtered in a 3-pole ceramic filter before it is split into two +17dBm injection signals for the two 1<sup>st</sup> mixers.

2<sup>nd</sup> LO is a Voltage Controlled X-tal Oscillator running on 44.856MHz and this is also phase-locked to the 12.8MHz reference. The signal is amplifier to about +13dBm and brought in another cable to the RX Front End, where it is split into two +7dBm injection signals for the two 2<sup>nd</sup> mixers.

#### 4.4.3 Transmitter


The transmitter of the TR412 is build around a Cartesian loop to meet the demanding TETRA linearity requirements. The TX signal is generated directly on the transmit frequency to optimize spurious and wide-band noise performance. The transmitter is able to deliver 60Wpep at the output connector of the TR412, equal to 25W TETRA.

The carrier frequency is generated of a Voltage Controlled Oscillator on the actual TX frequency. The VCO is phase locked to the 12.8MHz reference coming from the Main Board with a fractional-N PLL controlled through a serial interface from the MC. The VCO is running independent of whether the TX is keyed.

The output signal from the VCO is amplified to about +23dBm and split into two signals, a +11dBm signal for the I/Q modulator in the forward leg and a +21dBm signal for the I/Q de-modulator in the feedback leg.

The I/Q modulation signals are generated directly of the DSP and send on a serial interface to the dual 16-bit DAC with associated low pass filters. The I/Q signals acts as reference signals for the Cartesian feed-back loop.

After the comparator comes a variable phase circuitry to adjust for the Cartesian loop phase and the loop filter before the modulation is applied to the I/Q modulator. A linear amplifier increases the output level from the Exciter to +14dBm pep.

 Damm Cellular Systems A/S, Denmark	Doc. No.	Rev. 1.00	Date 2013-1-4
	TetraFlex® - TR412 Transceiver Description		

The Power Amplifier consists of one LDMOS driver and one output transistor, delivering 60W pep output power with good linearity. An attenuator in the input is used to fine adjust the total gain of the Power Amplifier. Both transistors are running in class AB for an optimum compromise between linearity and efficiency and are supplied with +26V DC.

After the PA four directional couplers are provided. A forward and a reverse coupler are used for the Power Meter to allow the display of forward and reflected power. One directional coupler is used to sample the output signal for the RFTL switch, and the last directional coupler is used to take a sample of the output signal for the Cartesian loop feedback.

The feedback signal is brought back to the Exciter in a thin cable. After passing an attenuator to adjust the level it enters the I/Q demodulator, where the signal is converted back to base-band. After the base-band feedback amplifier the signal is compared with the I/Q modulation reference signal from the two DAC.

Running with a DSB signal with 60W pep the forward leg IM3 of about 30dBc. The linearity is improved with the loop gain of about 40dB to reach the Adjacent Channel Power specification for TETRA of 60dB with good margin.

Hardware and software support is provided for open-loop operation with different modulation types to allow easy adjustment and test of the transmitter.

A dual RMS power detector is provided on the main board to permit the read-out of forward and reflected power from the controller as well as for alarm monitoring.

At the TX output the RF Test Loop switch unit is provided with a BNC connector on the front plate. This allows the controller to activate a test output from the TX with an accurately calibrated level of -40dBr and -50dBr relative to the TX output. In off state the maximum level of -80dBr.


#### 4.4.4 Reference oscillators

The TR412 is normally running fully frequency and time synchronized with the BSC. The synchronization is done with the 2.048MHz, the 8kHz and the 1sec. hardware signals and the 1 sec. HDLC message, all coming from the BSC.

The TR412 contains a 12.8MHz VCXO, which is phase locked to the 2.048MHz input signal. This acts as reference for the RX and TX frequencies.

The TR412 also contains a 36.864MHz VCXO, which is phase locked to the 8kHz input signal. This acts as clock reference for the controller, the DSP and for the ADC and DAC and thereby the TETRA symbol-generation.

The TX and RX TETRA framing is normally time synchronized to the 1-second hardware input signal together with the information provided in the HDLC message. This ensures that all TETRA counters are running synchronized on the whole BS. If GPS synchronization is present on the BSC, it will also run synchronized with surrounding Base Stations.

 Damm Cellular Systems A/S, Denmark	Doc. No.	Rev. 1.00	Date 2013-1-4
	TetraFlex® - TR412 Transceiver Description		

#### 4.4.5 DSP

The TR412 is provided with a single high performance DSP handling modulation and de-modulation task directly in software. This gives a high degree of freedom to adapt to any changes necessary. When running in TETRA mode the DSP also handles the LMAC and UMAC protocol parts.

The DSP is connected directly via its serial interface to the PCM highway on the back-plane. Four timeslots are reserved for each TR position. All circuit-mode communication is going this way to the PCM switch in the BSC.

The MC is connected to the DSP through its host port and controls its functionality, including software installation and booting. All packed-type communication also passes the host port of the DSP and goes to the BSC via the MC and the HDLC bus.

#### 4.4.6 Micro Controller


The MC is handling the over-all administration of the TR412.

The MC is provided with 1024kByte segmented FLASH memory, containing all the code for the MC as well as for the DSP. One segment contains the boot program, which is used during start-up and software download from the BSC. A 50-pin connector inside the TR412 allows the insertion of an external boot card, which is needed to update the internal boot section. Two segments of the FLASH memory are used to save the factory and system configuration of the TR412.

One of the MC's internal HDLC controllers is used to communicate with the BSC via the HDLC bus and carries all message type communication with the BSC, including TETRA messages, packed-type voice and data, O&M and house-keeping.

Its UART is connected to the UART bus giving an alternative way of O&M communication.

The MC is provided with a watchdog, which will make a restart of the TR at improper operation of the software.

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	TetraFlex® - RX Diversity for BS41x		

## 4.5 RX DIVERSITY FOR BS41x

The BS41x TETRA Base Stations are provided with a dual RX diversity scheme allowing the connection of two RX antennas simultaneously to improve the RX sensitivity.

The Base Station can run with only one antenna connected. Connecting a second antenna can however give a considerably improvement of the total BS sensitivity, especially under fading conditions. It is therefore highly recommended to make use of the dual diversity receiver feature.

The BS41x runs with a typical TX output power of about 10 W Tetra at the rack connector. Compared with the typical output power of 1W of a handheld mobile station, a difference of about 10dB in the link budget exists between down-link and up-link, if the same RX sensitivity is present.

Considerably effort has been made in the BS41x to improve RX sensitivity to compensate for the low output power of the handheld subscriber units.

The use of an RX Tower Mounted Amplifier removes the influence of the RX feeders, effectively improving the link balance with the loss of the TX feeder, which could be 2 dB for a typical system.

The use of a dual RX antenna diversity system (space diversity) can improve the sensitivity of BS receiver by up to 7 dB and thereby almost compensate for the remaining difference in the link budget.

This application note describes the implemented diversity scheme of the BS41x and gives typical measured sensitivities and diversity improvements under various conditions.


### 4.5.1 Diversity implementation

The dual diversity system is implemented with two completely independent receive sections from the RX antenna via the TMA, feeder and RX multi-coupler into the carrier unit. In the carrier unit two independent RX sections exists with first and second IF and two Analog-to-Digital converters connected directly to the DSP.

The DSP thereby receives two completely independent RX signals. First it tries to recover the timing synchronization independently of the two signals and to make a signal quality evaluation.

If the two signals are not very different in quality, they will be added and the combined signal will be used to improve the sensitivity.



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	TetraFlex® - RX Diversity for BS41x		

If the two signals are very different in quality the best signal will be selected and the other signal will not be used. This is done when the addition of the bad signal to the good one reduces the sensitivity.

The improvement of sensitivity is considerably under fading conditions. If the two received signals are close to being uncorrelated, the probability, that a low input signal level is present on both inputs simultaneously becomes low, effectively removing the fading.

The sensitivity will however also be improved under static conditions, when the two signals are fully correlated. Here close to a 3dB improvement in sensitivity is achieved. This is the same result as if the two antennas were combined directly, however without the problem in obtaining the correct phase of the combination.

The gain of combining under static conditions can also be seen from the result of the combining process. If two equal signals are added, the two input signals are added, effectively giving the double input voltage equal to an increase in input signal of 6dB. The noise is also added. However the two noise signals are fully uncorrelated, and adding the power of the two signals only gives an increase in noise of 3dB. The difference between the 6dB and the 3dB gives the resulting improvement of sensitivity under static conditions of 3dB.

The same improvement of 3 dB is achieved if two signals with fully correlated fading are present. When the two received signals become uncorrelated, the sensitivity improvement will increase.

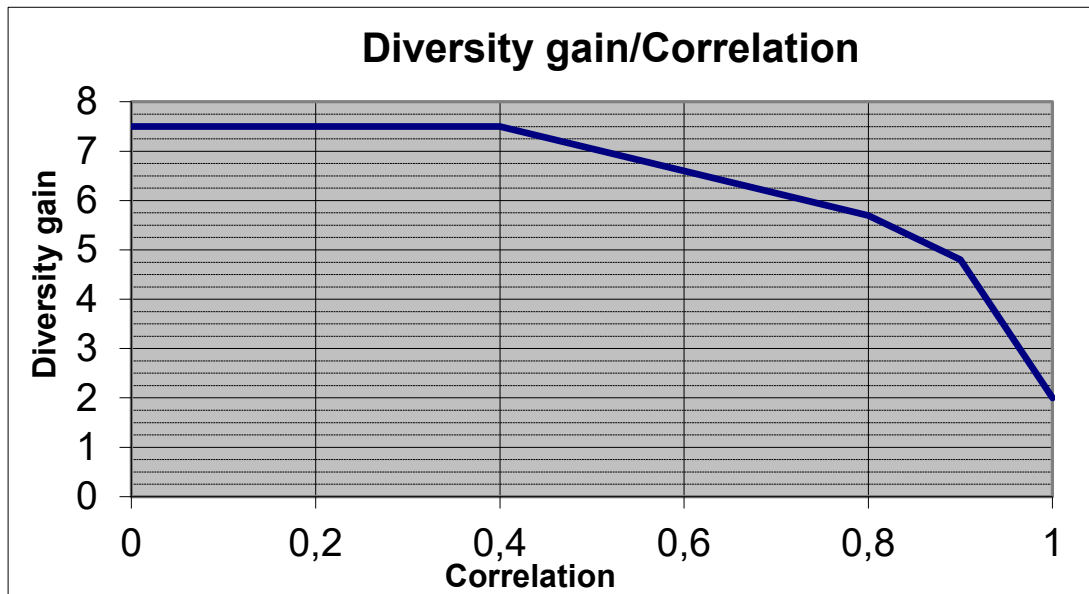
In the following sections graphs are shown with typical measured RX sensitivity improvements under various conditions.

#### 4.5.2 Diversity gain versus correlation factor

This curve shows the diversity gain (RX sensitivity improvement) for an SCH/F channel (signaling channel) with TU50 fading profile and an MER (Message Error Rate) of 4.7%.

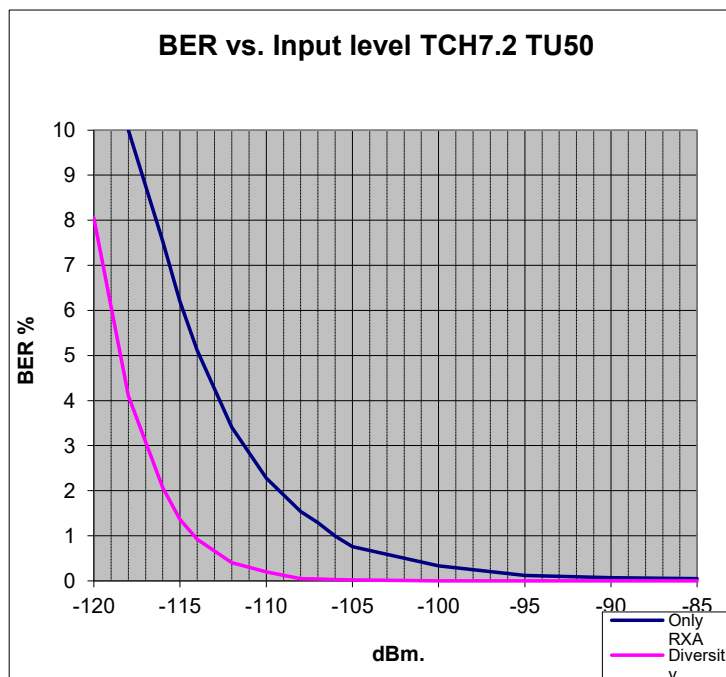
For two fully correlated signals the gain is almost 3dB as described. When the correlation factor approaches zero, the diversity gain is about 7.5 dB.





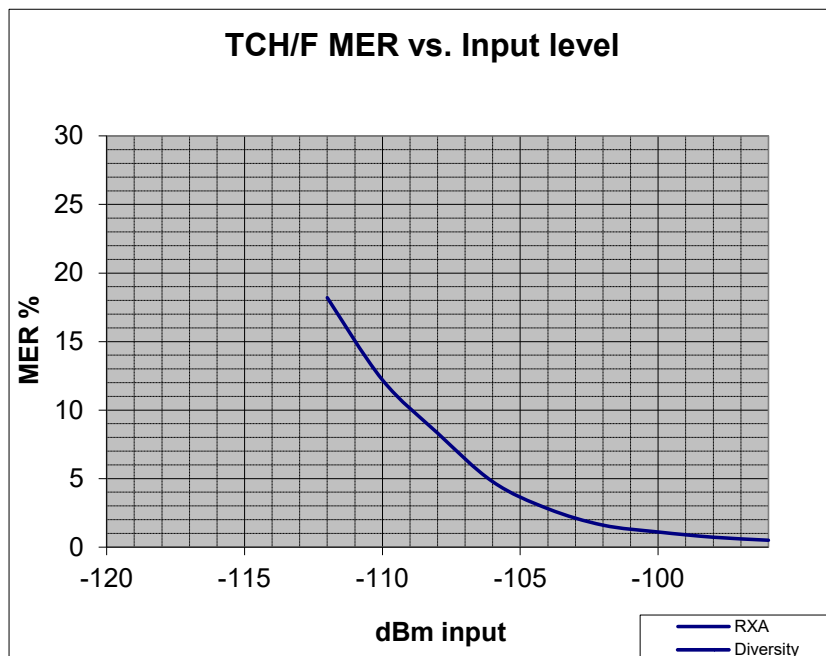
#### 4.5.3 BER versus input signal TCH7.2

These curves show the measured BER (Bit Error Rate) for a standard TCH7.2 traffic channel with the TU50 fading profile. The correlation factor between the two signals is 0.2.



#### 4.5.4 MER versus input signal SCH/F

These curves show the measured MER (Message Error Rate) for a standard SCH/F (Signaling Channel Full) with the TU50 fading profile. The correlation factor between the two signals is 0.2.



## 4.6 POWER SUPPLY FOR BS41x

### 4.6.1 Introduction

The BS41x Base Stations are provided with a flexible Power Supply scheme allowing it to run in a variety of different configurations. It can run from either mains AC directly, run from a DC battery source or a combination hereof with battery charging.

The different BS versions have space for from 2 to 4 PS411 Power Supply units running in parallel with full power share on all sections. Redundant n+1 operation is provided as all Base Stations can run with full specification with one PS411 out of operation.

All the variants can be connected with an external –48V lead-acid battery and has all the needed circuitry to charge the battery

The PS411 Power Supply contains 4 major parts:

- AC Rectifier providing –48V DC
- DC/DC converter providing +26VDC (for the TX PA)
- DC/DC converter providing +14V DC (for all other BS parts)
- Microprocessor (for charging control, monitoring and alarm generation)


The following number of PS411 is needed depending on the number of carriers installed in the Base Station:

Carriers	No redundancy	N+1 redundancy
1 carrier	1 x PS411	2 x PS411
2 carriers	1 x PS411	2 x PS411
3 carriers	2 x PS411	3 x PS411
4 carriers	2 x PS411	3 x PS411
5 carriers	2 x PS411	3 x PS411
6 carriers	3 x PS411	4 x PS411
7 carriers	3 x PS411	4 x PS411
8 carriers	3 x PS411	4 x PS411

### 4.6.2 Rectifier

The Rectifier section converts the mains AC input to –48VDC, which can charge the battery and feed the two DC/DC converters. The connection of the battery is optional.

The Rectifier accepts a wide voltage input range, supporting the 3 different standards used worldwide, namely 100V, 115V and 230V. It also accepts both 47Hz and 63Hz. No jumper or setting changes are needed to switch between the variants. However a change of the size of the fuse mounted from the front of the PS411 is needed when changing from 230V to 100/115V. The values are marked on the front plate.

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	TetraFlex® - Power Supply for BS41x		

The –48V DC output is fed to a common –48V power rail on the back plane of the cassette. A power sharing circuit ensures close to equal load on all inserted PS411.

The actual produced output voltage depends of the configuration. When battery charging is active, the delivered output voltage will vary around 54V, controlled of the micro-controller. The accurate value is determined of the charging voltage setting, consisting of a fixed voltage part and an associated temperature compensation setting.

When charging is not selected or the external temperature sensor is not working, the rectifier will deliver 48.0V fixed.

Two different connections are provided on the back plane:

- –48V Battery connection
- –48V DC external load

The –48V battery connection is provided with a current sensor to measure the actual battery charge/discharge current.

The –48V DC external load connection allows the Base Station to drive external units, e.g. Ethernet switches, E1 modems etc.

#### 4.6.3 +14V and +26V DC/DC converters

The PS411 Power Supply contains two independent DC/DC converters providing +14V and +26V respectively from the –48V DC input.

The outputs are fed to two power rails on the back plane. Independent power-share circuits on each converter ensures about equal load on all inserted PS411.


The input to the two converters comes from the external –48V rail. An internal feed is also provided allowing the converters to run even if the external –48V rail is short-circuiting to ground.

The DC/DC converters are able to run on –48V as provided of the rectifier or an external battery.

The input of the DC/DC converters are provided with an under-voltage detector to turn off the load on the battery when nearly discharged to prevent deeply discharge of the battery, which could affect its lifetime. The turn-on voltage is about 45V DC and the turn-off voltage about 40V DC. The 5V hysteresis is provided to prevent oscillations between on and off.

#### 4.6.4 Micro-controller

The PS411 is provided with a micro-controller to allow close monitoring of the actual operating condition of the Power Supply. In addition the micro-controller also controls the battery charging voltage.

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	TetraFlex® - Power Supply for BS41x		

The PS411 is connected to HDLC-bus in the Base States as well as the serial UART interface. O&M communication is possible on both interfaces.

The PS411 is provided with internal resident settings to hold the charging configurations etc. When used in a BS41x these settings will normally be overwritten of the common configuration received from the active BSC at power-up. The yellow power led on front of the PS411 will flash until the configuration from the BSC is received.

## 4.7 BATTERY TEST SB421

1. Connect to BSC with O&M, send the command **AP** (select power supply)  
Check response from command **10**

```
***** PS421 STATUS *****
Rectifier State: Charge
Mains Voltage..: 227V
Rectifier.....: On
Output Voltage.: 53.6V
Output Current.: 3.02A
Output Power...: 161W
Internal Temp..: +46C
TR1/TR3 Power..: On
TR2/TR4 Power..: On
Battery Current: +0.00A
Battery Temp...: +29C
```

the battery current shall be 0.00A if the battery is fully charged

2. Check the battery capacity by stopping the rectifier with the command **21-**  
Check the response from command **R/10**  
(If the battery is defect, the BSC will be shut down by stopping the rectifier, so the battery can be checked first by the command **22+, 23/48.0 R/10**, if the response shows Output voltage more than 48V and battery current more the -0.20A the rectifier can be switch off safely, without shutting down the BSC )

```
***** PS421 STATUS *****
Rectifier State: Off
Mains Voltage..: 227V
Rectifier.....: Off
Output Voltage.: 49.5V
Output Current.: 0.00A
Output Power...: 000W
Internal Temp..: +46C
TR1/TR3 Power..: On
TR2/TR4 Power..: On
Battery Current: -3.30A
Battery Temp...: +29C
```

The Output voltage of a battery with full capacity will drop to about:

- One TR - Load 1.75A - after one minute 49.5V after one hour 48.0V (drops ~ 1.5V)

see fig. 1

- Two TR's Load 3.30A - after one minute 49.5V after one hour 47.0V (drops ~ 2.5V)

see fig. 1

- Fig.2 Show a battery in bad conditions (probably a defect cell) that has to be replaced.

3.

If the battery voltage drops more, then the battery does not have the full capacity anymore and may need to be replaced.

After the test switch on the rectifier, manual control off, by the commands: **22-** and **21+**

Fig.1 new full charged batteries with one and two TR (10-20W tetra) load:

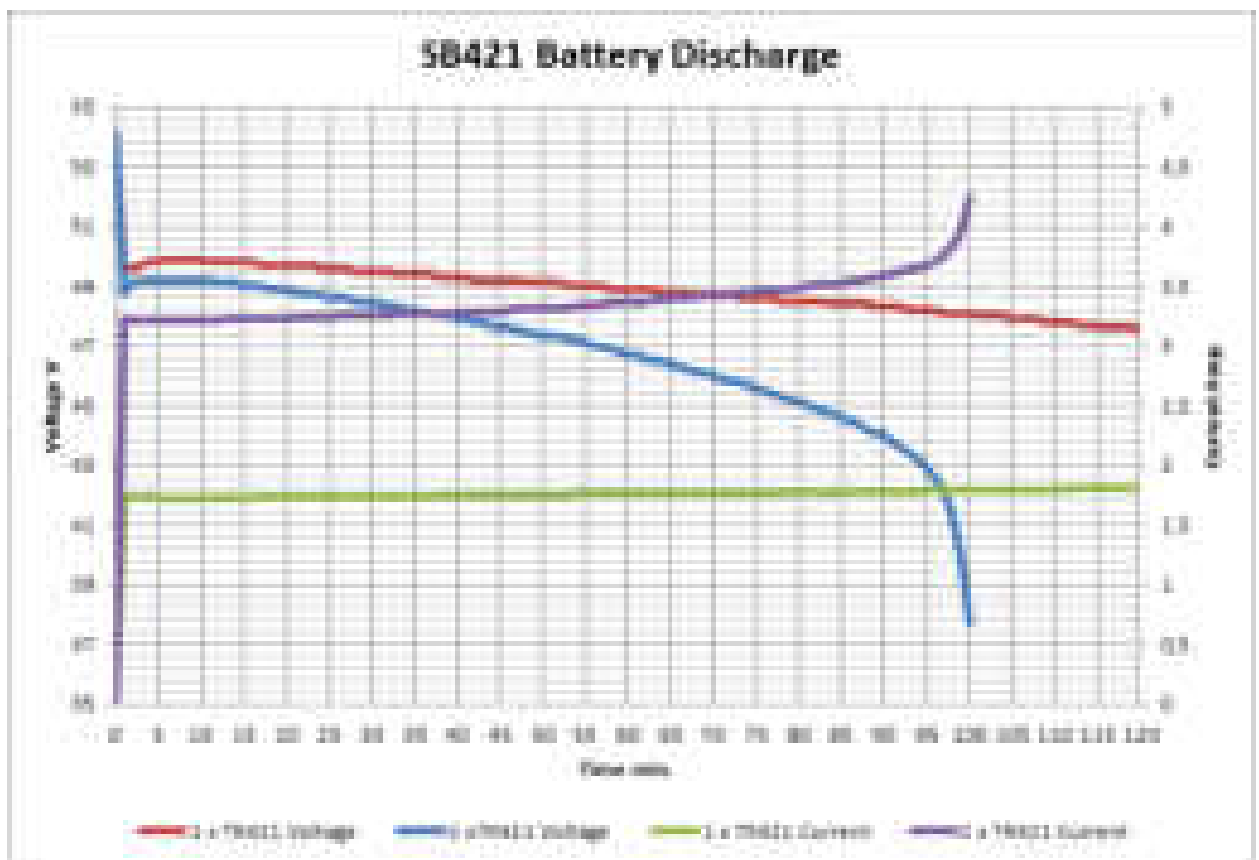
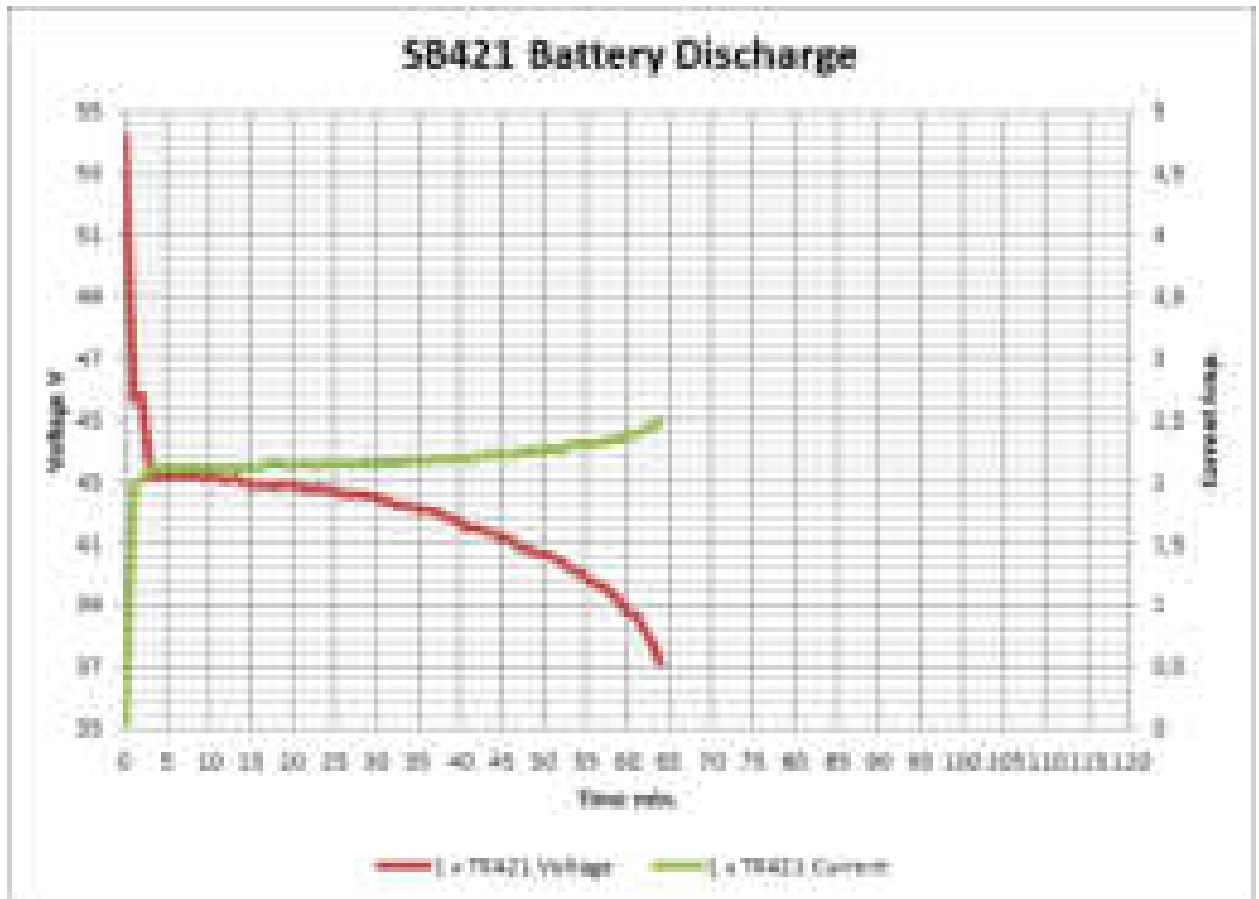




Fig.2 Example of a defect battery:






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	TetraFlex® - Battery test SB421		

 Damm Cellular Systems A/S, Denmark	Doc. No.	Rev. 1.00	Date 2013-1-4
	TetraFlex® - Hardware Unit References		




## Part-5: Hardware Units

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	TetraFlex® - Hardware Unit References		

## 5.1 HARDWARE UNIT REFERENCES

Description	Doc. No.
<b>Indoor:</b>	
BS 414 Base Station 4-Carrier	D100200-REF
BS 411 Base Station 8-Carrier	D100300-REF
BS 411 Base Station 8-Carrier High Power	D100300 HP-REF
BSC412 Base Station Controller	D104211-REF
TR412 Transceiver	D104011-REF
CAB411 BS Cabinet for BS411	D104811-REF
CAS411 TR Cassette for BS411	D104307-REF
CAS414 Cassette for BS414	D104306-REF
CAS417 PS Cassette	D104352-REF
CON411 Connection Box	D104803-REF
External Battery kit for BS41x	D104260-REF
PS411 Power Supply with rectifier	D104251-REF
RMD411 Dual 8-way div.	D104431-REF
RMD414 Dual 4-way div.	D104441-REF
RTC411 RFTL 8-way combiner	D104451-REF
RTC414 RFTL 4-way combiner	D104461-REF
TC411 4-way TX combiner	D104601-REF
TF411 TX filter 25dB	D104701-REF
TH414 4-way hybrid combiner	D104661-REF
TMD412 Tower mounted duplexer	D104531-REF
AI411 Ant. Interface	D104401-REF
<b>Outdoor:</b>	
BS421 Base Station Outdoor	D105001-REF
SB421 Service Box, 1,4GHz	D105101-REF
CS421 2-way Combiner/Splitter	D105911-REF
<b>External log units:</b>	
External log workstation	D105638-REF
External log server	D105639-REF

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	TetraFlex® - Recommended hardware		

## 5.2 RECOMMENDED HARDWARE

The following hardware represents the items used at DAMM

These items are not mandatory, but the list indicates items which are tested, and thus can be recommended for use

All listed items may be purchased from DAMM

If this recommendation is not used, it is mandatory to procure hardware with similar or better characteristic to ensure a problem free operation of the system

DAMM item No.	Description	Page No.
880014	Sealed coaxial cable got BS to BS and BS to Antenna	5-370
105091	Ethernet Cable (Reel of 150m)	5-372
105092	Ethernet Cable (Reel of 500m)	5-372
105093	Power cable BS/BSC421 (Reel of 150m)	5-376
105094	Power cable BS/BSC421 (Reel of 500m)	5-376
798001	Internal Battery SB421 1 piece (4 total in SB421)	5-377
823001	GPS antenna	5-379

### 5.2.1 Sealed Coaxial cable 880014

[illegible]

### ETX 300 (1/2") Connections

ETX Connect® Milled connectors are premium quality. The low plate construction is designed for quick and convenient installation while maintaining superior performance. Termination performance is made as robust as a rivet nut by using a 1/2" milled thread and galling proof zinc.

Steel is used on the external load bearing surface in the ETX connectors with zinc plating. All other surfaces are milled for metal. Insulators are made of polypropylene, polytetrafluorethylene (PTFE), polyethylene and Delrin. All O-rings are made of ethylene propylene rubber (EPDM) to ensure the highest level of liquid resistant integrity.



ETX 300



ETX 300



ETX 300 1/2 inch



ETX 300 1/2 inch



ETX 300 1/2 inch



ETX 300 1/2 inch

#### Recommended Hardware

Steel 304, 316, 316L, Stainless 316, 316L

#### Recommended Hardware (Optional)

ETX 300, ETX 300 1/2 inch, ETX 300 1/2 inch

ETX 300, ETX 300 1/2 inch

Part No.	Material	Length	Weight	Part No.	Material	Length	Weight
ETX 300	304 Stainless	1.00	0.18	ETX 300	304	0.18	0.18
ETX 300	316 Stainless	1.00	0.18	ETX 300	316	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18


#### Recommended Hardware

Recommended Low Voltage Terminals, Terminals, Terminals

Part No.	Material	Length	Weight	Part No.	Material	Length	Weight
ETX 300	304 Stainless	1.00	0.18	ETX 300	304	0.18	0.18
ETX 300	316 Stainless	1.00	0.18	ETX 300	316	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18
ETX 300	316L	1.00	0.18	ETX 300	316L	0.18	0.18

Recommended Hardware (Optional) - Terminals, Terminals, Terminals


## 5.2.2 Ethernet cable 105091 / 105092



**SF/UTP Category 6 LSZH + PE 500m reel**

Nexans ref.: 20020021  
 Clouster ref.: 4751015

- Complies to Cat 6 standards
- Supports Class E applications
- Excellent cross member mechanical properties and performance
- Tested up to 25000V



**Standards**  
 International: IEC 60754-1, IEC 60754-2, IEC 60332-1, IEC 60332-2  
 National: NF EN 60754-1, NF EN 60332-1


**Application**  
 Category 6 cables are the ultimate solution for a future proof network. It is specifically designed to support the existing requirements for tomorrow's protocols, yet is fully backwards compatible with today's needs. It is the recommended cable for all forthcoming installations.

- 10Base-T Ethernet
- 100Base-TX Fast Ethernet
- 1000Base-TX Gigabit Ethernet
- 10GBase-T
- 40GBase-T
- 100GBase-T
- Future class E applications

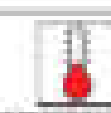
Installed to exceed the requirements of the ISO/IEC 11801-2002 Category 6 requirements.


**Performance**  
 Tested to 250 MHz and with guaranteed performance to 250 MHz, Nexans Category 6 cables provide guaranteed bandwidth and bandwidth over and above the requirements of all international, European and American cable standards, including ISO/IEC 11801-2002, IEC 60754-1, IEC 60754-2, EN 60754-1, EN 60754-2, NF EN 60754-1, NF EN 60754-2.


**Installation**  
 The outer PE sheath of the cable is LSZH-rated and the cable is suitable for fixed outdoor installation. It is not suitable for direct burial. It has to be protected in a duct when it is installed in the ground. The cable can be installed indoors if the outer PE sheath is removed using the zip cord for this need the cable will be protected from flame extension.

  
 Flame resistance  
IEC 60332-1

  
 Flame resistance, single  
IEC 60332-2

  
 Flame resistance, single  
IEC 60332-2

  
 Bend radius  
IEC 60332-1

  
 Bend radius  
IEC 60332-2

**Recommended installation practices**

For more information, please refer to the Nexans website: [www.nexans.com](http://www.nexans.com)  
 For more information, please refer to the Clouster website: [www.clouster.com](http://www.clouster.com)

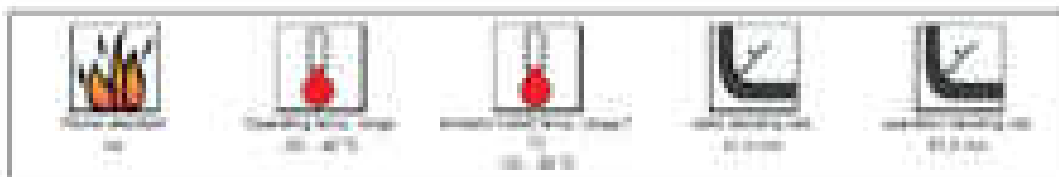


## SF/UTP Category 6 LSZH + PE 500m reel

### Supplier

Seppel Telecom - your partner cables  
SE-2114 01 Göteborg  
Sweden  
Phone: +46 (0)31 84 1000  
info@seppeltelecom.se | www.seppeltelecom.se

4



**Recommended LSZH Cable** Page 2/4

LSZH (Low Smoke Zero Halogen) cables are designed to meet the requirements of the IEC 60332-3 and IEC 60332-1 tests. These cables are suitable for use in fire-prone environments where the release of smoke and toxic gases is a concern. The LSZH cable is recommended for use in fire-prone environments.





## 1P/UTP Category 6 LSZH + PE 500m reel

Nexans ref.: 20120811

### Overview

#### Construction characteristics

Type of cable	UTP
Cable jacket	PE
Color	Blue
Shielding	Not applicable (see Table 1)

#### Dimensional characteristics

Conductor cross-section (mm²)	2.0
Conductor outer insulation	1.1 mm
Overall outer diameter (mm)	10.5 mm
Approximate weight (kg/100m)	80 kg/100m

#### Electrical characteristics

Transfer impedance	20
Return impedance (off line)	100 Ω
Max. DC resistance of the conductor at 20 °C	19.2 Ω/km
Characteristic impedance	100 Ω

#### Performance characteristics

Attenuation (max. 100 MHz)	20.8 dB/100m
Insertion loss (max. 100 MHz)	20.8 dB
Attenuation Coefficient Ratio (100 MHz)	1.8 dB/100m
Return loss (max. 100 MHz)	24.3 dB
Propagation delay (max. 100 MHz)	19 ns
Return loss (100 MHz)	17.3 dB
Delay	19 ns/100m
Velocity of propagation	65.5 %
Coupling attenuation (at 20 MHz)	80 dB
Propagation delay (max. 100 MHz)	19 ns/100m

#### Usage characteristics

Shielding	None
Length (m)	500 m
Category	Class 6
Flame retardant	Yes
Component function	Cable
Operating temperature range	-20 ... 40 °C
Minimum installation temperature range (°C)	-10 ... 30 °C
Minimum static bending radius	81.3 mm
Using operational bending radius	81.3 mm

### Electrical Performance

Frequency (MHz)	Attenuation (dB/100m)	Return loss (dB)	Insertion loss (dB/100m)	Propagation delay (ns/100m)	Velocity of propagation (%)
1	2.8	74.3	70.3	70.3	67.5
4	3.8	63.3	60.3	58.3	55.5
100	20.8	24.3	17.3	19.3	47.5

Measured at 20 °C, 100% relative humidity

Nexans ref.

All drawings, designs, specifications, codes and part numbers of Nexans and its subsidiaries are subject to change without notice. Nexans is not responsible for any errors or omissions in this document.



### 5F/UTP Category 6 LSZH + PE 300m reel

10	7.8	56.2	49.8	54.2	43.8	41.8	25
50	8.5	56.8	49.8	55.8	44.8	41.8	25
100	10.7	57.8	49.8	49.8	46.8	37.8	25.8
400	10.8	47.8	50.8	45.8	38.1	31.1	25.8
1000	19.8	44.8	54.8	40.8	38.0	27.8	30.1
1250	20.2	47.8	58.2	39.8	38.2	28.2	38.8
2000	20.0	38.8	58.8	37.8	34.8	27.8	38.0
3200	20.8	38.2	5.2	36.8	32.8	19.8	37.8
3500	26.8	37.1	5.8	35.2	38.8	17.8	38.8
3800	29.8	38.1	—	38.2	38.1	18.2	38.1

### 5.2.3 Power cable 105093 / 105094



**REKA**  
KABEL

105093 / 105094

**DATASHEET**

**NHH-J**

Halogen: free, flame retardant, non corrosive, low smoke installation cable

100 V

Construction according to DG 3382 HD 31.5.82

IEC 60332-1	IEC 60332-3	Flame retardant
IEC 60754	IEC 60332	Halogen free, low corrosive
IEC 61034	IEC 60335	Low smoke density

**Application**

For fixed installation on surface and/or in conduits, as well as in movable, portable and flexible power systems. Suitable for use in indoor and outdoor applications (subject to the relevant national rules of regulation) and indoors.

Max. operating temperature: 70 °C  
 Max. installation at short circuit: 100 °C for max. 5 s  
 Min. bending radius: 100 mm  
 Min. bending radius: 100 mm  
 Max. pulling force when pulling from the conductors: 4 x 20 N (at the end of the conductors)


**Properties**

Conductor	1 x 1.5 mm <sup>2</sup> twisted stranded copper (EN 60228 class 5)
Insulation	Halogen free polyethylene compound
Color code	Green-yellow, blue, black
Outer jacket	Halogen free polyethylene compound, black

IEC 60332-1	IEC 60332-3	Flame retardant	Halogen free	Low smoke density	Low corrosive	Low smoke
105093	105094	105095	105096	105097	105098	105099


REKA KABEL

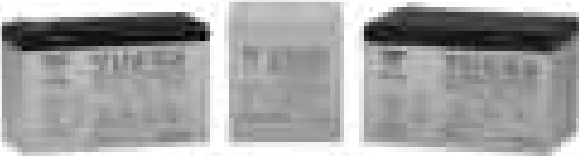
## 5.2.4 SB421 internal battery 7980001




**SEAL-ED RECHARGEABLE LEAD-ACID**

DELTA/PC SERIES








**YUASA  
RE SERIES  
EXTENDED LIFE PRODUCTS**

RE3-1218 12V 3.0AH  
RE7-1218 12V 7.0AH  
RE12-1218 12V 12.0AH

**Capacities-Dimensions-Weights**

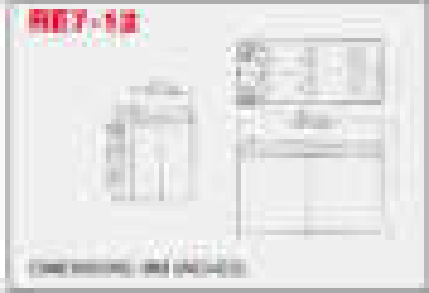
CAPACITIES					DIMENSIONS			
TYPE	15 MIN RATE 1.05VPC	1 HOUR RATE 1.25VPC	5 HOUR RATE 1.75VPC	10 HOUR RATE 1.85VPC	HEIGHT	WIDTH	DEPTH	WEIGHT (kg)
RE3-1218	3.0	3.0	3.0	3.0	105	70	175	0.8
RE7-1218	7.0	7.0	7.0	7.0	105	140	175	1.8
RE12-1218	12.0	12.0	12.0	12.0	105	210	175	3.0

**RE3-12**



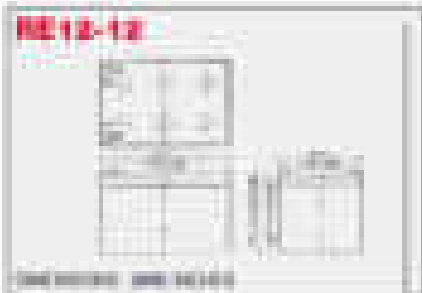
TERMINAL: 518-01-000

**RE7-12**




TERMINAL: 518-01-000

**RE12-12**




TERMINAL: 518-01-000

**Terminal**

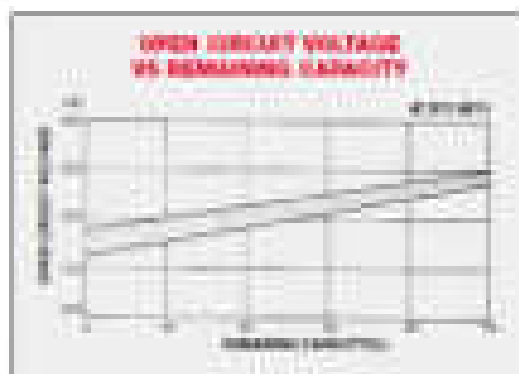
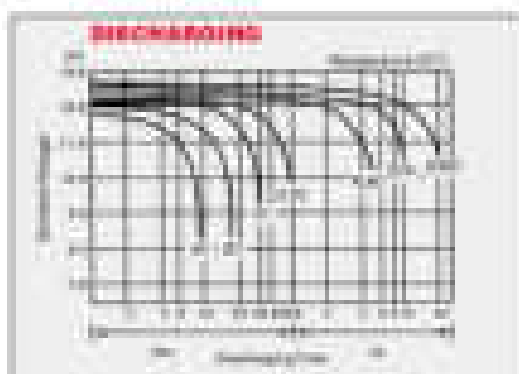
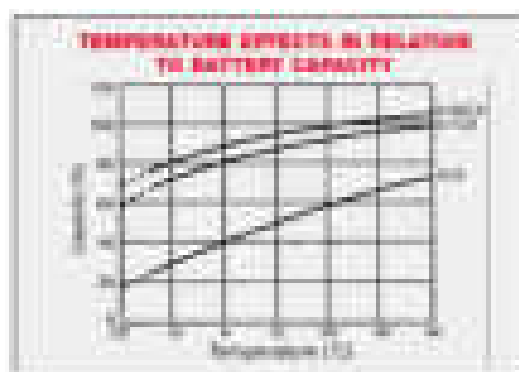
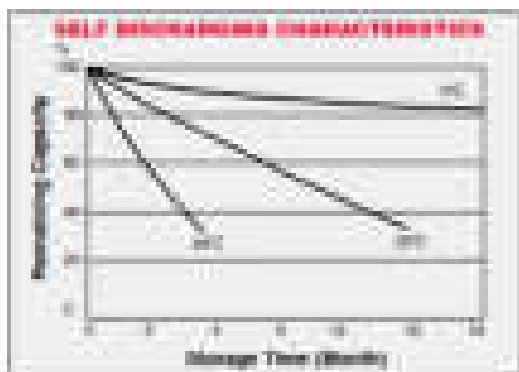


TERMINAL: 518-01-000



RECOMMENDED BY UL FOR ALL APPLICATIONS

Rev. 1.00



Within the building will be used by the system is outside of 27, some of which (modified by) some is due

[illegible]

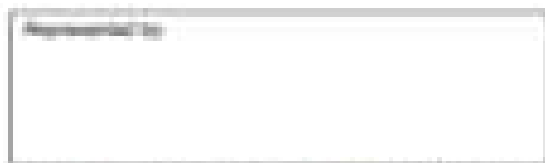
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• **Second: Short circuit**  
• **After: Test changes for a second instance**

\_\_\_\_\_

[illegible]

\_\_\_\_\_



What is your top business goal for 2014? Is it to grow revenue and add new customers? To save and reduce expenses? Reduce your risk? Increase the quality of service? Another business owner's response can be helpful. "My top goal is to grow revenue and add new customers," says Bob, a business owner. "I want to grow my business and add new customers. I want to grow my business and add new customers. I want to grow my business and add new customers."




1000

Customer Support: 1-800-441-1000, ext. 1000  
 Fax: 202-462-2770  
 E-mail: [customersupport@nrc.gov](mailto:customersupport@nrc.gov)  
 Website: [www.nrc.gov](http://www.nrc.gov)

Source: *Author's calculations*.


#### 5.2.5 GPS antenna 8230001

[illegible]

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## 5.2.6 TetraFlex Fuses replacements

Item no.	Description	Installed in	Installed position
794005	Fuse 5x20 6.3A F IR 63A Schurter 0034.1524	TR412 Transceiver BSC412 Base Station Controller	F801 + F802 F1
794006	Fuse 5x20 6,3A F IR 1500A	PS421 Power Supply	F101
794025	Fuse 5x20 3.15A T IR 100A 541-2975	Router cass. (DC booster) SB421 Inter connection board	F101 F133A + F113A
794026	Fuse 5x20 10A T IR 100A	TR412H Transceiver PS421 Power Supply SB421 Inter connection board	F802 F1 F101A
794027	Fuse 5x20 1A T IR 100A	SB421 Inter connection board	F102A + F153A
794028	Fuse 6.3x32 32A T RS Components 247-4021	PS421 Power Supply TCC411 (304600) Combiner	F400 F1
794054	Fuse 4A F MELF	AI411 Ant. Interface	F401 + F302 + F202


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