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1 Introduction

This document gives an overview TETRA radio system for voice and data according the ETSI standard.

1.1 Guaranteed future with TETRA standardisation by ETSI

This Compact system is based on the TETRA standard, the only European harmonized standard for digital radio systems. TETRA was developed, in order to fulfil the requirements of professional radio users, for fast point to point and point to multipoint radio communication for voice and data.

Such users are for instance utility companies, public transporting services, airports and industrial plants. TETRA fulfils the needs of professional radio users and replaces old proprietary solutions, which are not sufficient to fulfil today's requirements.

From the beginning Motorola has been cooperating in definition and standardisation of TETRA. This work is continuing and permits designing also in the future.

The definition and specification of the TETRA standard is a continuous and dynamic process. Based on the available documents stable and reliable infrastructures and terminals were developed, which are in use in many networks.

In addition, the dynamic of the standardisation process of TETRA permits to consider new experiences, realizations, new demands and features at any time. By this procedure there is no point of time, where the standardisation is "finally" completed.

1.2 Digital Trunked Radio with Dimetra IP Compact

Trunking allows a large number of potential users to have sufficient access to a limited number of resources. In a conventional radio system, users are assigned specific base stations to operate on. Some channels may be busy while other channels are idle. The trunking concept allows channels or other resources to be made available to users as they are needed. Instead of channels being dedicated to specific users who may or may not use the channels, trunking allows all the channels to be pooled together. As a traffic channel is needed, system grants an available traffic channel from its pool of traffic channels. Trunking reduces the number of busies and improves the efficiency of the system resources.

The usage of a control channel for the call set up allows advanced access procedures depending on the priority of users and services.

Contrary to analogue operating radio systems the Dimetra IP Compact system enables apart from group calls also full-duplex individual calls, full-duplex telephone calls, an efficient data communication as well as a better voice quality.

1.3 The TETRA Compact Radio System

The TETRA Compact system is a very flexible radio system. The system covers all system components for voice services as well as network and configuration

management. Depending upon customer needs the system can be equipped furthermore with components for:

- Authentication and key management
- Air Interface Encryption
- Connection to existing Conventional Channels

The Dimetra IP Compact system is based on a constant IP technology. This ensures maximum availability, makes possible highest flexibility during build up or extensions of the network, and an easy integration of future technological applications.

Thus, for example within the ranges of telemetry and remote control, existing systems can be built up on the Dimetra IP Compact system, where the Dimetra IP Compact system provides a reliable data communication (included in the offer).

The Dimetra IP Compact system has flexible interfaces for the connection to external systems for the adaptation of fleet management systems or computers supported operating control systems (optional).

Because of the built in GPS receiver in Motorola radios, the Dimetra IP Compact systems enables locating of radio users supported by GPS (optional).

Dimetra IP Compact systems can be deployed as single-cell radio systems for small regions or more-cellular radio systems for medium regions. The Dimetra IP compact system exists of one Mobile Switching Office (MSO) containing one Zone.

With Dimetra IP Compact systems an integration of existing analogue radio systems is possible.

The Dimetra IP Compact system offers in particular:

- Independence from a public network operator (e. g. GSM)
- Data and voice communication within one system (included)
- High system availability (optional redundant components)
- Geographical Redundancy (optional)
- Investment safety by standardisation and longevity of the components
- Group communication, with fast call set up times
- Full duplex individual calls
- Full Duplex telephone calls (included)
- Access to public networks (optional)
- Air Interface Encryption and Authentication (optional)
- Security for emergencies by GPS locating (optional)
- Future proof by TETRA standard

2 Dimetra IP Compact System Overview

Figure 1. depicts an overview of the Dimetra IP Compact radio system. It consists of the following components and software licenses:

- Switch
- Short Data Gateway (included)
- Packet Data Gateway (included)
- Telephony Gateway (included)
- Centralized Voice Logging Recorder (up to 60 channels) (optional)

- Redundant Components (optional)
- Geographical Redundancy (optional)

- Network Management System
- Dispatch Console (one console included)
- Conventional Channel Gateway (optional)
- Redundant Site Link to Control Rooms (optional)
- Remote Control Room Option (optional)

- Base stations

- 4-site License
- DGNA License (optional)
- Zone Historical Report License (included)
- Zone Watch License (included)
- Zone Dynamic Report License (optional)
- 1000 user License
- Affiliation Display License (optional)

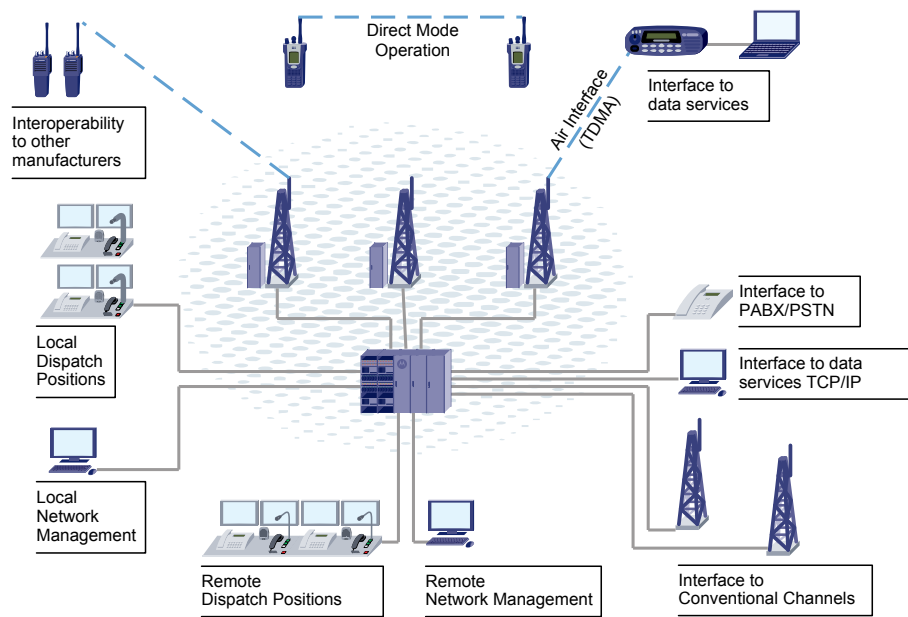
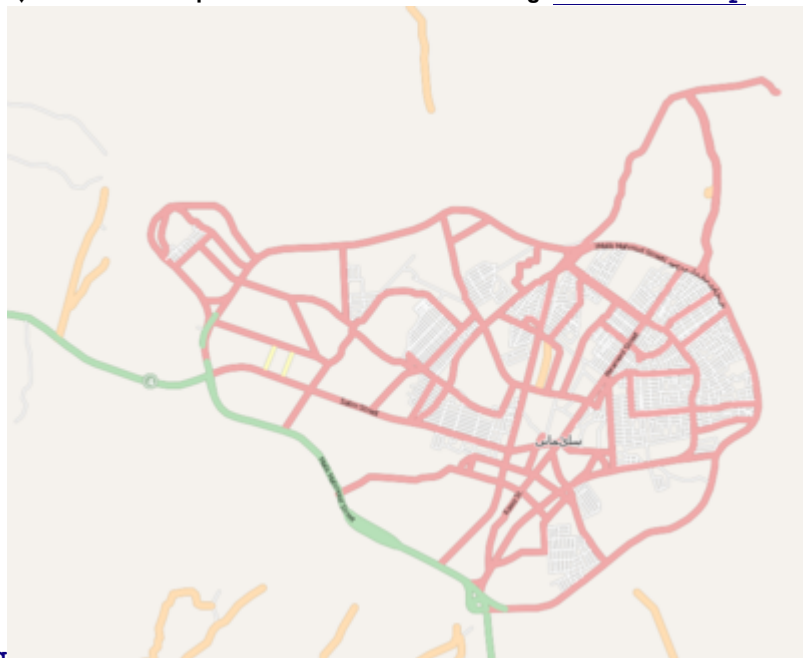


Figure 1: Dimetra IP Compact Radio System

2.1 Location map of Sulaymaniyah

2.2 [nameSulaymaniyahborder](#)

coordinates [35.6145.36](#) ←↕→ [45.4835.53](#) map center [35.57°N 45.42°E](#) [image](#) [Location map](#)



[Sulaymaniyah.png](#)

Switching Infrastructure

The TETRA standard defines all the Central Network Equipment (CNE) as the switch equipment; however, it does not define any of the components or the architecture within the switch. Traditionally, mobile radio networks have employed central switches, but Motorola's Dimetra-IP Compact switch employs an intelligent networking concept with distributed call processing and in the traditional sense there is no "switch".

Traditional switches provided both the intelligence (call processing) and the physical switching fabric. The trend in modern communications systems is to use a more flexible "intelligent network" concept whereby the call processing and switching functions are separated. Dimetra-IP Compact uses this concept with the switching being provided by an IP network and the call processing being provided by various servers and gateways connected to the IP network.

Servers and gateways provide the call processing functions for the base stations. The Dimetra-IP Compact system consists of the following main servers and gateways:

- Consolidated Network Management System/Zone Controller – provides mobility management functions and call processing for voice calls as well as network management functions.
- Combined Core/Gateway Router – performs all IP routing in the system as well as provides the interface point for WAN connections to remote base station sites and remote console sites.
- Cooperative WAN Router – provides connectivity to base stations.
- LAN switch – provides IP interconnectivity between all servers, gateways and routers.

2.3 Short Data Gateway (included)

The Dimetra IP Compact system supports point-to-point and point-to-multipoint Short Data Messaging of up to 140 characters. Short Data Messages can be sent between subscribers (subscriber-to-subscriber), or can be sent between a subscriber and a fixed host.

Short data traffic can be delivered concurrently with voice traffic or packet data traffic.

2.4 Packet Data Gateway (included)

The Packet Data Service (PDS) is a bearer service that allows IP hosts to communicate using the Internet Protocol (IP).

Access to the PDS is via the Peripheral Equipment Interface at the subscribers and via an IP connection to the GGSN in the infrastructure.

The Packet Data Service is supported by the GGSN (Gateway GPRS Support Node)- Router, together with the PDG (Packet Data Gateway). The GGSN is the responsible router within the IP-Network and supports also DHCP (Dynamic Host Configuration Protocol) which simplifies the connection of the Customer Enterprise Networks (CENs) of separate organisations.

The implementation of the Packet Data Service within the Dimetra IP Compact system is very effectively realized:

- If there is a large data volume to transmit it is possible to use multiple Packet Data Slots for this transmission (Multi Slot Packet Data). Furthermore it is possible to increase and decrease the number of Packet Data Slots dynamically.
- If the data volume is not so large, different users can share one Packet Data Channel.
- It is also possible to share channels between voice and data traffic. These shared channels are known as Dynamic Data Channels and are normally dedicated for the Dimetra Packet Data Service, but they can be pre-empted for voice calls

2.5 Telephone Interconnect Gateway (included)

The optional Telephone Interconnect Gateway (MTIG) provides the main functionality needed in order to support automatic telephone interconnect for up to 60 lines into a PSTN or PABX switch. The MTIG will support telephony via QSIG signalling over an E1 connection.

The Echo Canceller associated with the Telephone Interconnect is used to reduce the acoustic echo that can occur on telephone interconnect calls. This echo is due to the vocoder delays, telephone system delays, imbalance in the telephone network and acoustic feedback in the subscriber environment.

Telephone calls are full duplex calls in both directions.

2.6 Centralized Voice Logging Recorder (optional)

Centralized Voice Logging provides an IP based voice logging service for non-encrypted group calls, which logs a total of 30 clear group calls (thereof max. 10 private / telephone interconnect calls). The logged calls can be replayed on the Voice Replay Station. It includes the following elements:

- Archiving Interface Server (AIS) - a stand alone server which acts as the interface between the Dimetra Small System and the logging system, passing both Call Control and Audio Packets to the Voice Logger.
- Voice Logger - the NICE supplied Voice Logger records all traffic forwarded to it by the AIS.
- Voice Replay Station - used to replay the voice recorded by the logger and to configure the logger.
- Admin Application for configuration of logging recorder.

2.7 Redundant Components (Optional)

The Redundant Components Option provides a redundant configuration for the following components:

- Redundant ZC Server
- Redundant Ethernet LAN Switch
- Redundant Combined Core/Gateway Router
-

2.8 Geographical Redundancy (optional)

In the Geographically Redundant Dimetra IP System, the switch equipment is installed at two locations. Each location includes Core and Redundant LAN switches which are connected to their equivalents at the other location by dedicated fibre optic links. The redundant ZC and CGR are installed at the second location, together with optional redundant SDR and Border Router. A second MTIG can be deployed to act in a load sharing configuration with the first MTIG.

Geographic redundancy protects the system against a catastrophic failure at one of the locations such as fire, earthquake or terrorist activity. The following table describes the impacts on the system following total loss of one of the two locations.

Functionality	Impact after Loss of Location A ²	Impact after Loss of Location B
RF Site Links	RF Sites with non redundant links on location A will go into LST, but could be reconfigured to Location B. RF sites with non-redundant links on Location B and MTS sites with redundant site links will re-establish wide trunking.	RF sites with non-redundant links on Location A and MTS sites with redundant site links will continue in wide trunking. RF Sites with non redundant links on location B will go into LST, but could be reconfigured to Location A.
Console Site Links	Remote MCC 7500 sites on location A will be disconnected, but could be reconfigured to Location B. Control Sites on Location B will continue operation.	Remote MCC 7500 sites on location B will be disconnected, but could be reconfigured to Location A. Control Sites on Location B will continue operation.
Network Management	Loss of NM services	No impact.
Telephone Interconnect	Loss of MTIG capacity provided by Location A.	Loss of MTIG capacity provided by Location B
Short Data Service	If SDR was active, then Red SDR in location B will need to be manually activated to continue short data service.	If Red SDR was active, then SDR in location A will need to be manually activated to continue short data service.
CEN Connection	No impact.	No impact.
Packet Data Service	Loss of packet data services	No impact.
Voice Logging	Loss of Voice Logging	No impact.

2.9 Dimetra IP Compact Network Management (included)

The purpose of the network management system is to configure, operate and maintain the system so that it achieves high availability and efficient operation. Motorola's Dimetra IP Compact Open Management System (OMS) offers a suite of software tools for configuring, managing, reporting and troubleshooting Motorola's infrastructure portfolio and other subsystems, in an SNMP (Simple

Network Management Protocol) environment, helping to reduce and control the cost of network operations.

Motorola's Dimetra IP Compact Open Management System (OMS) complies with the industry standard (OSI) FCAPS model for network management functionality:

- Fault
- Configuration
- Accounting
- Performance
- Security management

2.10 Dispatch Console (optional)

Motorola's new MCC 7500 IP Dispatch Console is designed to ease the complex job of a radio dispatcher. Each Dispatch Console provides access to the system's dispatch services and features. Also based on the use of IP technology, the MCC 7500 Dispatch Console connects to the Dimetra IP Compact system via a Site router. A control room can be connected local to the Dimetra IP Compact system over LAN.

The Dispatch Console supports, amongst others, the following features

- Talk group Calls
- Talk group patch
- Individual Calls
- Announcement Calls
- Side Wide Calls
- Assignable Talk groups
- Activity Log
- Emergency Operation
- Status Message Display
- Alphanumeric Text Messaging Service (ATS)
- Console Intercom Call
- Supervisory Console
- Console Multi-Select
- Console Patch
- Conventional Channel Patch

2.11 Conventional Channel Gateway – CCGW (optional)

This gateway allows up to 4 conventional channels to be connected via the console dispatch subsystem for TETRA/Conventional cross-communication.

The router used for a CCGW is an ST2500 and in this application is fitted with a four port analogue module to support four conventional channel interfaces.

2.12 Redundant Site Link for Option for Control Room (optional)

In a system incorporating optional Redundancy or Geographical Redundancy the E1 connection to a remote control room can also be redundant. In these cases the ST2500 control site router incorporates a second E1 module which supports the redundant site link.

Redundant site links are not compatible with the CCGW function within the same control site router

2.13 Remote Control Room Option (optional)

This option allows to connect control rooms which are not co-located to the switch. The connection to the Dimetra IP Compact system is done over a fractional E1 link. The bandwidth of this link depends on number of active calls, selected and unselected audio resources, and number of applications running on the consoles. The bandwidth has to be calculated on an individual basis.

2.14 Base Stations

In this section the Motorola Base Stations MTS 2 and MTS 4 (Motorola TETRA Station) are described.

Base Stations consist functionally of the following main components:

- Base Radio (BR)
- TETRA Site Controller (TSC)
- Environmental Alarm System (EAS)
- Radio Frequency Distribution System (RFDS)
- Power Supply Unit (PSU)

Base Radio (BR)

The BR provides a high powered RF interface. The high power unit can provide an adjustable RF power level up to 25 Watts after combining or 40 Watts without transmit combining.

Each BR utilizes TDMA technology to provide 4 channels on a 25 kHz carrier. Various configurations are available to meet capacity requirements ranging from 4 to 32 channels. A single MTS2 can accommodate up to two BRs. A single MTS 4 cabinet may hold up to four BRs. For greater than four BRs, an expansion cabinet is available for the MTS 4. A single MTS2 cabinet may hold up to two BRs. For more than two BRs, an MTS4 is required.

The BR also incorporates diversity reception for increased talk-back range, performance and reliability. A combined three-receiver board is provided with each BR to allow for 2 or 3 branch antenna diversity.

TETRA Site Controller (TSC)

The TETRA Site Controller (TSC) is the control unit of the Base Station and controls the operation of the Base Radios. It communicates with the switch components over a fractional E1 interface. With E1 interface, drop and insert as well as link redundancy and ring structures are supported. The TSC also contains a time and frequency reference module. The module includes a high stability oscillator to provide the frequency reference and GPS receiver to provide the timing reference.

The TSC is capable of providing all call processing functions necessary to enable the Local Site Trunking of the MTS, if the MTS should become disconnected from the switch.

A TSC can control up to 8 Base Radios. Optionally a redundant TSC can be provided.

Environmental Alarm System (EAS)

The MTS cabinet is equipped with a lockable door with alarm contacts. The MTS provides connections for 15 external alarm inputs as well as 2 alarm/control outputs.

These can be used as input for signals of external sensors, like smoke detectors, intrusion detectors, power failure etc.. The messages are transferred by the TSC to the switch.

Radio Frequency Distribution System (RFDS)

The RFDS uses different types of transmission couplers, in order to combine the output signals of the BRs to one single signal for the transmitting antenna.

MTS-2 base stations use hybrid combiners, which have small weight and small dimensions. These are only few demanding regarding the adjacent channel distances.

MTS-4 base stations use cavity combiners to ensure a low-loss interconnection of up to eight BRs to one antenna.

Furthermore the RFDS contains duplexers and pre-selectors

The integrated duplexers allow using the same antenna for the receiving and transmission signals. These contain a low-noise amplifier, the receiving branch splitter as well as digital power monitoring for VSWR measurement.

When using pure receiving antennas (diversity) additionally pre selectors are used.

Power Supply Unit (PSU)

The Power Supply Unit provides power to all of the units within the MTS. The PSU accepts 115/230 V AC or -48V DC inputs. In addition the PSU provides the facility to charge an optional external battery supply and to automatically switch to this battery source in the event of input power failure.

MTS Connections

With the build-in E1 interface, drop and insert as well as link redundancy and ring structures are supported.

Multiple Base Stations can be lined up without a ring or lined up in a ring structure. The ring structure provides redundancy due to the fact that if there is one failure in the ring still all Base Stations in the ring remain connected to the switch and will be kept in wide trunking mode.

For site link redundancy, a single Base Station can be connected with two different links to the switch. If one of the links fails, the other link will take over. In case of a link failure the traffic will be re-routed.

3 Licenses

3.1 Site License

For each four MTS sites, one of these licenses is necessary.

3.2 DGNA License (optional)

Dynamic Regrouping is implemented using the DGNA (Dynamic Group Numbering Assignment) service and gives a Network Manager or a Dispatcher the ability to dynamically reorganise talk groups and implement “storm plans”. It works by allowing one or more subscribers to be assigned or removed from talk groups. This enables the Network Manager or the Dispatcher to reorganise talk groups in response to changing operational circumstances. Each subscriber will remember the talk group settings it held before dynamic reorganisation and will revert to the original group when it receives a “cancel regroup” command.

3.3 Zone Historical Report License (included)

Historical reports can be generated for system-wide activity. These reports present statistical data that is gathered over predefined time intervals for the purpose of monitoring and analyzing sites, channels, talk groups and subscribers.

3.4 ZoneWatch License (included)

ZoneWatch is a performance management tool for monitoring air traffic. It allows a system manager to analyse traffic patterns for load distribution and troubleshoot subscriber and site problems. The ZoneWatch main window displays all of the watch windows for the selected watch profile.

3.5 Zone Dynamic Report License (optional)

Dynamic Reports provide near-real-time data collection and display so that usage trends and patterns of activity in a specific zone can be effectively monitored and reported. The reporting interval can be set to 15 seconds, 60 seconds or 15 minutes. The reports show data for up to 100 time intervals.

The report to be displayed is defined using the Dynamic Reports configuration dialog box. The report is displayed in a graphical format. Once displayed the graph is dynamically updated after every elapsed time interval and displays data for up to 100 intervals. A snapshot of the report may be saved (either as a graphic (HTML) or as raw data (CSV)) or may be printed.

3.6 1000 user License

For each 1000 subscribers operating on the system, one of those licenses is required

3.7 Affiliation Display License (optional)

Affiliation Display is a performance management tool used to view real-time affiliation and disaffiliation information for subscribers, talk groups, and sites. It can be used, for example, to determine how and when radio users access the system, and where members of a talk group are located.

4 Dimetra IP Compact Services and Features

4.1 Dimetra IP Compact Basic Functionality

The Dimetra IP Compact system is a digital TETRA trunking radio system with a maximum utilization of available channel resources.

In a trunked radio system such as TETRA, the radio channels are in a common pool and the TETRA system automatically allocates the radio channels to the radio users at the beginning of each call. This automatic channel allocation from a common pool is called trunking and systems using this method are called trunked mobile radio systems.

TETRA is based on digital Time Division Multiple Access (TDMA) technology. One 25 kHz wide TETRA carrier occupies four time slots or channels for communication. At one Base Station the control channel and the first 3 traffic channels are carried by the first RF carrier frequency. Further traffic channels are carried on further frequencies. Hence TETRA is more frequency efficient than analogue conventional systems.

The usage of a control channel for the call set up allows advanced access procedures depending on the priority of users and services. This includes the systems capability of user and/or resource pre-emption.

Contrary to analogue operating radio systems the Dimetra IP Compact system enables apart from group calls also full-duplex individual calls, full-duplex telephone calls, an efficient data communication as well as a better voice quality.

The allocation of traffic channels is basically controlled by the MSO. When a group call is set up the system allocates traffic channels only at the Base Stations required to reach all active talk group members. Traffic channels at other sites remain free to handle other calls.

4.2 Digital Trunked Radio Call Set Up

A call set up request of a radio user, e. g. for a group call, is signalled by pressing PTT. This request is transmitted to the MSO over the Control Channel.

The system checks if the user is authorized for the group call and assigns temporarily a traffic channel at all Base Stations required for that communication. In addition this signalling is sent periodically over the control channel, in order to make possible a "Late entry" for other participants. The radios of all group members switch immediately to this temporarily assigned traffic channel. This happens within shortest time. For the participant this fast assignment appears like the operation of an analogue channel. After finishing of the group conversation all user radios of the group shift back automatically to the organization channel, thus these channel resources are available again.

4.3 Dynamic Site Assignment

When a call is set up the system allocates traffic channels only at the sites required to reach all active talk groups members. Traffic channels at other sites remain free to handle other calls. Motorola's Dimetra IP Compact can handle more traffic, with the same number of resources, than could be handled by an

equivalently sized system which does not track the location of all talk group members.

Furthermore, the system already knows the location of each subscriber, so this Dynamic Site Assignment can be achieved without polling all sites at call set up to determine the location of the talk group members. This saves time and avoids extra control channel traffic.

4.4 Call handover and Automatic Site Selection

It is important that subscribers roaming between sites do not suffer loss of communications in progress. Dimetra IP Compact supports call hand-over for all classes of call. The system automatically transfers calls in progress over to the new site. This greatly improves communication quality and ease of operation for users in a multi-site wide area system.

The criteria for handover between base stations are based on both field strength and signal quality. Each base station broadcasts information about its adjacent sites, such as their site identities and the frequencies of their control channels. Each subscriber then uses this information to maintain a list of sites, ranked according to their signal strength. A site selection algorithm in the subscriber causes it to register with a new site at the most advantageous time.

4.5 Preferred Sites

Motorola's Dimetra IP Compact system can modify the automatic site selection algorithm so that a subscriber will stay affiliated to its preferred site as long as signal strength is adequate, even if an adjacent site has a stronger signal. This resolves the potential problem where most members of a talk group work on a single site, but some members operate further out, where the signal from an adjacent site may be stronger. The Preferred Site feature allows these outlying subscribers to stay affiliated to the same site as the other members of their talk group. Therefore, during a group call, resources from the adjacent sites are not unnecessarily tied up.

Dimetra IP Compact enhances the operation of Automatic Site Selection by allowing each subscriber to be programmed with a list of up to 32 preferred locations.

4.6 Dimetra IP Compact Voice Service

The Motorola Dimetra IP Compact System supports the following voice services:

- Group call
- Emergency call
- Individual call
- Telephone interconnect call

Beside the features for subscribers, the dispatcher can handle several groups or individual calls simultaneously. Furthermore dispatchers have additional possibilities like dispatcher priority, which allows interrupting the communication of a mobile device.

4.6.1 Group call

The group call service allows a subscriber or a dispatcher to establish a one-to-many communication with a group of users known as a talk group.

The membership of a talk group is not a static membership configured within the infrastructure, but is determined by the radio users who have elected to be a member of the talk group at that time. Subscribers must affiliate with a talk group in order to be a member of a talk group. Once a talk group is assigned to a Dispatch Console, the Dispatch Console becomes a member of that talk group. A Dispatch Console may be a member of multiple talk groups.

The group call service is a semi-duplex service. Semi-duplex transmission means that only one user can transmit traffic in a call at any time. The system gives transmit permission to a single user.

Furthermore the Dimetra IP Compact System supports dynamic regrouping as well as announcement calls (multi group calls).

A group call will be the most used call type. When a subscriber initiates a group call, the system allocates a single traffic channel at each site where there are members of the same talk group. This way, many users will receive a call via one traffic channel.

4.6.2 Emergency Call

An emergency call can be raised as a group call or as an announcement call. If an emergency call is initiated by a user, the priority of this call is raised to the highest priority level of the system. The system can be configured in two ways, for the case that all traffic channels are busy at the time an emergency call is initiated:

- First position in the queue

The Initiator of the Emergency call will be moved to the first position of the queue, so that he gets talk permission immediately if a traffic channel becomes available.

or

- Ruthless pre-emption

The system identifies and clears the lowest priority call in progress and then uses this traffic channel for the emergency call.

4.6.3 Individual Call

This service allows subscribers and Dispatch Consoles to initiate and receive semi-duplex or full-duplex TETRA Individual calls. This is a one-to-one communication with only the two parties involved in the call able to hear the communication.

4.6.4 Telephone Interconnect Call (included in the offer)

The telephone interconnect call service gives full duplex communication between a subscriber and a Private Automatic Branch eXchange (PABX) or Public Switched Telephone Network (PSTN) user. PSTN access is via a PABX. The service allows a subscriber to initiate a telephone interconnect call. A PABX and

PSTN users can initiate a telephone interconnect call to a subscriber as well. During call set up, call-progress tones are provided to the calling party.

4.7 Dimetra IP Compact Data Service (included in the offer)

The Dimetra IP Compact System supports several data services using the following interfaces:

- STS (Status Transfer Service)
- SDTS (Short Data Transport Service) ETSI-standard
- TCP/IP - Short Data receive & transmit
- PDS (Packet Data Service) ETSI-standard
- TCP/UDP/IP - IP Data from / to User terminals

4.7.1 Status

Usually Radio users transmit regularly the same information to the dispatcher, like "in operation" or "busy". The status message service allows a subscriber to send such pre-coded status message to the Dispatch Console system, without usage of a traffic channel.

The user's send status message is delivered to all Dispatch Consoles that have the affiliated or targeted talk group of the subscriber assigned. The status message is not sent to subscribers that are members of the talk group. At the Dispatch Consoles the radio user's address, the group address, the time and the code number or the text according to this code number is shown.

4.7.2 Short Data Service (included in the offer)

The Dimetra IP Compact system supports point-to-point and point-to-multipoint short data messaging of up to 140 characters. Short data messages can be sent between subscribers (subscriber-to-subscriber), or can be sent between a subscriber and a fixed host.

Short data traffic can be delivered concurrently with voice traffic or packet data traffic.

4.7.3 Packet Data Service (included in the offer)

The Packet Data Service (PDS) is a bearer service that allows IP hosts to communicate using the Internet Protocol (IP).

Access to the PDS is via the Peripheral Equipment Interface at the subscribers and via an IP connection to the GGSN in the infrastructure.

The Packet Data Service is supported by the GGSN (Gateway GPRS Support Node)- Router, together with the PDG (Packet Data Gateway). The GGSN is the responsible router within the IP-Network and supports also DHCP (Dynamic Host Configuration Protocol) which simplifies the connection of the Customer Enterprise Networks (CENs) of separate organisations.

The implementation of the Packet Data Service within the Dimetra IP Compact system is very effectively realized:

- If there is a large data volume to transmit, it is possible to use multiple Packet Data Slots for this transmission (Multi Slot Packet Data). Furthermore it is possible to increase and decrease the number of Packet Data Slots dynamical.
- If the data volume is not so large, different users can share one Packet Data Channel.
- It is also possible to share channels between voice and data traffic. These shared channels are known as Dynamic Data Channels and are normally dedicated for the Dimetra Packet Data Service, but they can be pre-empted for voice calls.

4.7.4 Data Applications (optional)

Based on Data Services several applications can be developed. The Data Service is than used as a kind of data highway transporting data from one point to another.

The list below shows examples of possible applications:

- Status message
- Predefined text messages
- Short, programmable text messages
- Computer Aided Dispatch system
- Group messages
- Point-to-point messages
- Emergency messages
- Vehicle locator
- Email
- Update of databases
- File transmission
- Data transmission for telemetry and remote control
- Data transmission Passenger Information Systems

4.8 Dimetra IP Compact Additional Features

4.8.1 Late Entry

Late Entry is service that always supplements the group call, emergency call and announcement call service. While a call is in progress on a traffic channel, late entry signalling is sent periodically on the main control channel. This allows subscribers that failed to decode the initial call set up signalling (for whatever reason) to join a call in progress.

4.8.2 Talking Party Identification

Whenever a subscriber or Dispatch Console is transmitting, the ID of this talking party is always forwarded to the other (receiving) subscriber and Dispatch Consoles. If the talking party changes through normal conversation or through interruption, then the ID of the new talking party is again forwarded to the other subscribers or Dispatch Consoles in the call.

4.8.3 Calling Line Identification Presentation

Calling Line Identification Presentation (CLIP) is a TETRA service that always supplements the Telephone Interconnect Call service. It provides a (called) subscriber with the identity of a calling PABX or PSTN user if the calling party identity is present in the call set up from the external exchange. It also provides the exchange with the Direct Dial In (DDI) number associated with the calling subscriber for subscriber-originated calls.

4.8.4 Busy Queuing and Queuing Priority

The Dimetra IP Compact system supports the sophisticated handling of important calls. The system supports queuing of voice calls whenever a traffic channel is required and no traffic channels are available. If there is no traffic channel available at one or more of the sites required for the call, the call will be placed in a queue. The position in the queue depends on the priority of that call. The system provides 10 levels of priority where level 1 is the highest and reserved for emergency calls. Levels 2-10 can be assigned to individuals and talk groups. When the required traffic channels for the call become available, the calling party is automatically called back to indicate that the call has now been set up and has initial transmit permission.

4.8.5 Collection of call data

The Dimetra IP Compact system creates ATIA (Air Traffic Information Access) packets containing information about the radio communications within the system. This information can be forwarded to an optional billing system.

5 System Capacity

Dimetra IP Compact consists of a single switching zone and has the following system capacity:

- The system supports up to 25 Base Stations with up to 307 traffic channels in total
- Range of Individual Short Subscriber Identities (ISSIs) is from 1 to 13,999,999
- Range of Group Short Subscriber Identities (GSSIs) is from 1 to 13,999,999
- The maximum number of provisioned users is 10,000
- The maximum number of talk groups is 1,000
- Maximum number of telephony channels is up to 60
- Maximum number of Dispatch Consoles is up to 20
- Maximum number of Network Management Terminals (NMT) is up to 5
- Maximum number of Conventional Channels per system is 32 (based on 8 remote dispatch locations with 1 x CCGW)

6 Terms and Abbreviations

API

Application Programming Interface

ATIA

Air Traffic Information Access

BR

Base Radio, transmitting and receiving unit of Motorola Base Stations.

Diversity

This procedure uses two and/or three receiving antennas to improve the received signal in the Base Station.

DMO

Direct Mode Operation, mode of operation where radio users can communicate by using frequencies not controlled by the network, that is, without using a Base Station.

E1

Wide Area Network Standard communications protocol, corresponding ITU.G702/703/704, used to connect Base Stations to the switch.

EAS

Environmental Alarm System, Alarm contacts of the Motorola Base Station for individual usage

ETSI

European Telecommunications Standards Institute, European standards organization that produces European standards which are applied and accepted in the area of telecommunications.

GPS

Global Positioning System

GSM

Global System for Mobile Communications

GSSI

Group Short Subscriber Identity, ID to address talkgroups (groups of users)

IP

Internet Protocol, network layer protocol in TCP/IP stack that offers a connectionless internetwork service

ISSI

Individual Short Subscriber Identity, ID used to address individual users

MS

Mobile Station

MSO

Mobile Switching Unit, switching centre of the Dimetra IP Compact system

MTS

Motorola TETRA Station, Motorola Basestation available in two variants: MTS2 und MTS4

PDCH

Packet Data Channel, a traffic channel reserved for packet data transmission in TETRA systems

PDS

Packet Data Service, function used for packet data transmission in TETRA systems

PABX

Private Automatic Branch Exchange

PEI

Peripheral Equipment Interface (application interface), describes the interface of a radio for applications (ETS 300 392-5).

PSTN

Public Switched Telephone Network

PSU

Power Supply Unit, part of the Motorola Base Station

RFDS

Radio Frequency Distribution System, Unit of the Motorola Base Station used to combine RF receiving and transmission signals between base Radios and Antennas and enables diversity.

SDS

Short Data Service, function used for transmission of Short Data Messages within TETRA systems.

TETRA

TErrestrial Trunked RAdio, standard by ETSI which defines a digital system for land mobile radio communication.

TDMA

Time Division Multiple Access, digital transmission technique in which several signals are interleaved in time for transmission over a common channel.

TSC

TETRA Site Controller, Control unit of the Motorola Base Stations