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TETRAPOL FORUM

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Foreword

This document is the Publicly Available Specification (PAS) of the TETRAPOL land mobile radio system, which shall provide digital narrow band voice, messaging, and data services. Its main objective is to provide specifications dedicated to the more demanding PMR segment: the public safety. These specifications are also applicable to most PMR networks.

This PAS is a multipart document which consists of:

Part 1   General Network Design

Part 2   Radio Air interface

Part 3   Air Interface Protocol

Part 4   Gateway to X.400 MTA

Part 5   Dispatch Centre interface

Part 6   Line Connected Terminal interface

Part 7   Codec

Part 8   Radio conformance tests

Part 9   Air interface protocol conformance tests

Part 10   Inter System Interface

Part 11   Gateway to PABX, ISDN, PDN

Part 12   Network Management Centre interface

Part 13   User Data Terminal to System Terminal interface

Part 14   System Simulator

Part 15   Gateway to External Data Terminal

Part 16   Security

Part 17   Guide to TETRAPOL features

Part 18   Base station to Radioswitch interface

Part 19   Stand Alone Dispatch Position interface

1. Scope

Interoperability between PMR systems requires a common inter-system interface. This network-to-network interface is referred to as the ISI.

The ISI shall both permit communications between independently operated systems and protect each system in the event of any failure or unauthorised use of the other system.

The ISI protocol is considered here between two TETRAPOL systems, or between a TETRAPOL system and another digital PMR system. Between a TETRAPOL system and another digital PMR system, the ISI may also act as a gateway with protocol conversion and filtering.

This document corresponds to sub-part 10.1 of the TETRAPOL inter-system interface which is divided into three sub-parts:

- Part 10.1 ISI Technical requirements
- Part 10.2 ISI Architecture
- Part 10.3 ISI Protocol design

This sub-part establishes the technical requirements of the TETRAPOL inter-system interface. It first describes the TETRAPOL interoperability model. Secondly, it defines some requirements needed to ensure that the TETRAPOL services can be provided over an inter-system interface. Third, it specifies the interoperability between TETRAPOL systems and the interworking between a TETRAPOL system and other digital PMR systems.

2. Normative references

This PAS incorporates by dated and undated reference, provisions from other publications.These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this PAS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1]   PAS 0001-1-1: "TETRAPOL Specifications; General Network Design; Reference Model".

[2]   PAS 0001-12: "TETRAPOL Specifications; Network Management Centre; NMC Interface protocol".

[3]   PAS 0001-16-1: "TETRAPOL Specifications; Security; Security mechanisms and Key Management".

[4]   ETS 300 172 (1995): "Private Integrated Services Network (PISN); Inter-exchange signalling protocol; Circuit mode basic services".

[5]   ETS 300 239 (1995): "Private Integrated Services Network (PISN); Inter-exchange signalling protocol; Generic functional protocol for the support of supplementary services" [ISO/IEC 11582 (1995, modified)].

[6]   CCITT Recommendation X.25 (1984): "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

[7]   Draft prETS 300 392-3: "Radio Equipment and Systems (RES); Trans-European Trunked Radio (TETRA); TETRA Interworking; Basic Operation".

[8]   ITU-T Recommendation E.164: Numbering Plan for the ISDN Era.

[9]   ITU-T Recommendation E.213: "Telephone and ISDN Numbering Plan for Land Mobile Stations in Public Land Mobile Networks (PLMN)".

[10]   ITU-T Recommendation X.121: "International Numbering Plan for Public Data Networks".

[11]   ITU-T Recommendation Q.921: "ISDN User-Network interface; Data Link Layer specification".

[12]   ETS 300 170: "Private Telecommunication network (PTN); Inter-exchange signalling protocol; Data link layer protocol".

[13]   ITU-T Recommendation T.50: "Information Technology; 7-bit coded character sets for information transmission; International Alphabet n°5".

3.   Definitions and abbreviations

3.1.   Definitions

For the purpose of ISI, the following definitions apply:

Call master SwMI: The switching and management infrastructure (SwMI) in charge of the synchronisation of the call establishment over ISI and the call release procedures between SwMIs.

Destination SwMI: A SwMI to which a call is routed over the ISI from the call master SwMI.

Handover: The process of keeping a seamless on-going service while switching channels.

Home SwMI: The individual home SwMI of a system terminal is the SwMI that is designated by the country code and network code of its long individual explicit address. The group home SwMI of a network group or a regional operational group is the SwMI that is designated by the country code and network code of its long group address. Federal groups have no unique home SwMI.

Incoming call: A call that is originated outside of the local system. A call over ISI is said to be an incoming call for a SwMI when its establishment propagates from the ISI to the SwMI.

Interoperability: The ability of a SwMI to provide the same service to all system terminals conforming to the appropriate protocol standard, regardless of their home system or manufacturer.

Interworking: The abilrity of several SwMIs to exchange information through the inter-system interface, so that their system terminals can communicate together with a similar service.

Intervening network: A network used to interconnect two SwMIs at the inter-system interface.

Migration: The process of moving the attachment of a radio terminal from one SwMI to another.

Originating SwMI: The SwMI in which the calling user is registered when requesting a call establishment.

Outgoing call: A call that is originated from the local system. A call over ISI is said to be an outgoing call for a SwMI when its establishment propagates from the SwMI to the ISI.

Participating SwMI: A SwMI that is involved in the coverage of a call, as defined before the call activation.

Radio terminal: System terminal connected to the infrastructure by a radio link.

Reference point: A conceptual point at the conjonction of two non overlapping functional groups.

Roaming: The process of moving the attachment of a radio terminal from one location area to another within one system.

Short subscriber identity: An identity that uniquely identifies a subscriber (individual user or group of users) within a sub-domain of the addressing plan.

System Terminal: A service access reference point provided to the user by the System. System terminals (ST) are Radio terminals (RT), Line connected terminals (LCT), Stand alone dispatch positions (SADP).

3.2.   Abbreviations

For the purpose of ISI, the following abbreviations apply:

A/I	Air Interface
ANF	QSIG Additional Network Feature
BC	Broadcast Call
BCD	Binary Coded Decimal Number
BN	Base Network
CNA	Coded Nature of Address
CNM	Central Network Management centre
DC	Dispatch Centre
DGNA	Dynamic Group Number Assignment
ECH	Emergency Open CHannel
GC	Group Call
GSSI	Group Short Susbscriber Identity
HLR	Home Location Register
IC	Individual Call
IRI	Inter Radio Switch Interface
ISI	Inter System Interface
ISSI	Individual Short Subscriber Identity
KMC	Key Management Centre
LAC	Local Area Code
MCC	Mobile Country Code
MM	Mobility Management
MOCH	Multisite Open CHannel
MPC	Multiparty Call
MS	Mobile Station
NC	Network Code
NMC	Network Management Centre
NPI	Numbering Plan Identifier
OG	Operational Group
OMC	Operation and Maintenance Centre
PAS	Publicly Available Specification
PDU	Protocol Data Unit
PINX	Private Integrated Services Network EXchange
PMR	Private Mobile Radiocommunications
PSTN	Public Switched Telecommunications Network
PTT	Push-To-Talk
QSIG	Signalling at the Q reference point for the Private Signalling System PSS1
RFGI	Hierarchical Individual Short Number
RSW	RadioSWitch
RT	Radio Terminal
SAP	Service Access Point
SD	Short Data Service
SF	Short Functional Address
SN	Short Number
SSI	Short Subscriber Identity
ST	System Terminal
SwMI	Switching and Management Infrastructure
TC	Trunk Code
TON	Type Of Number
USI	Universal Subscriber Identity
VLR	Visitor Location Register

4. TETRAPOL interoperability model

A TETRAPOL system may inter-operate with other systems as follows:
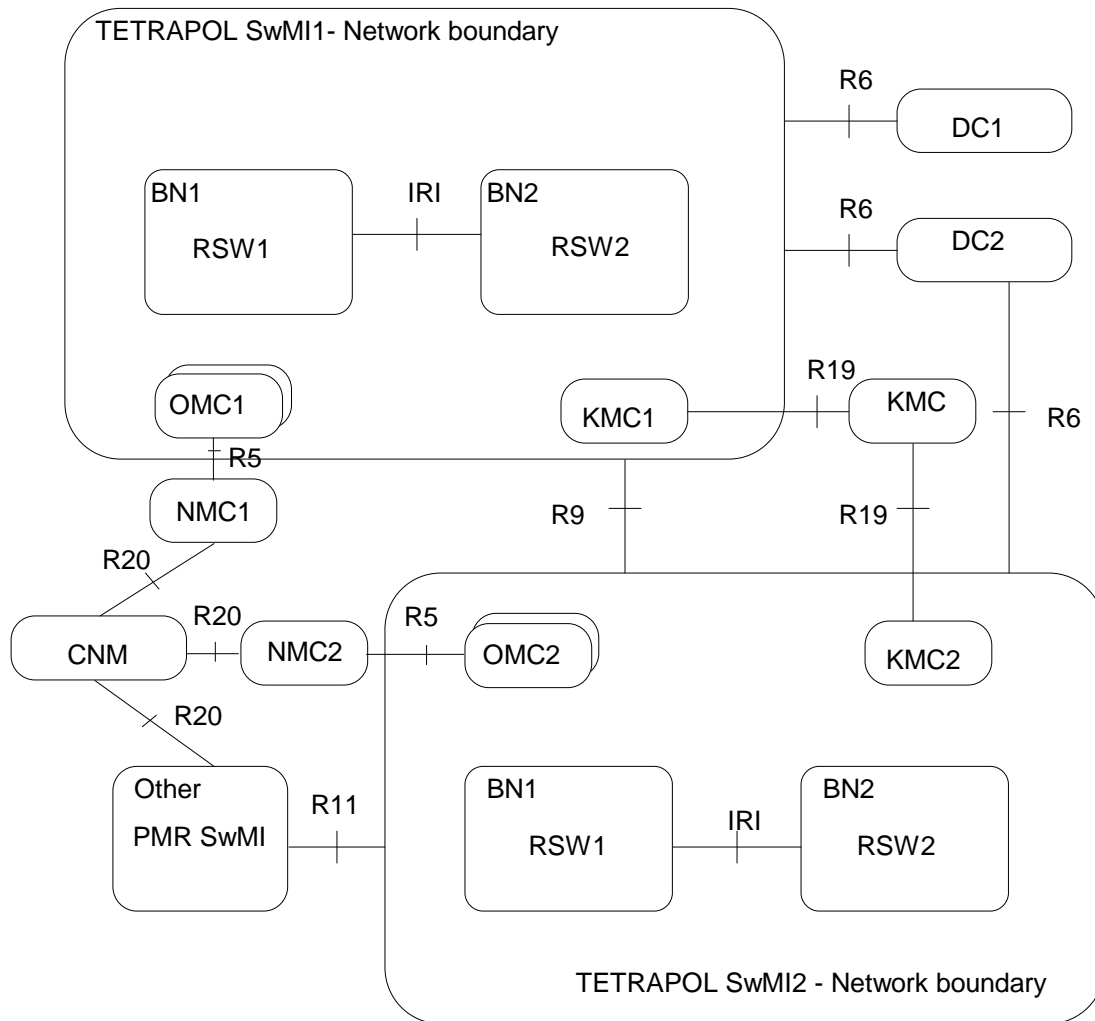
Figure 1: TETRAPOL interoperability model

4.1. Reference points

Within the TETRAPOL Switch and Management Infrastructure (SwMI1), an Inter-RSW Interface (IRI) is shown between two base networks (BN1 and BN2). The IRI interface is not standardised in this document, so that there shall be no reference point for the IRI. The TETRAPOL SwMI1 shall own its local Key Management Centre (KMC1), its local Network Management Centre (NMC1) which shall be connected to one or several Operation and Maintenance Centres (OMC1).

The centralized CNM and KMC shall facilitate the central management of interworking between several SwMIs, through respectively R20 and R19 interface.

Two kinds of direct Inter-system interfaces (ISI) shall be considered on the model:

- R9: TETRAPOL SwMI1-TETRAPOL SwMI2 interface
- R11: TETRAPOL SwMI2 interface to another digital PMR SwMI with protocol conversion

Two kinds of R6 interface to a dispatch centre (DC) may be considered on the model:

- The dispatch centre DC1 may be considered as another PMR system;
- The dispatch centre DC2 may act as a QSIG transit between two TETRAPOL SwMIs.

4.2. IRI and ISI Interface definitions

The IRI defines an interface between two Base Networks of a TETRAPOL SwMI. The services provided over the ISI shall be a subset of those offered over the IRI.

The ISI defines an interface as follows:

1) Between TETRAPOL systems with same frequency compatible radio terminals

- The migration of terminals between TETRAPOL systems is the main issue;
- The terminals shall operate with both systems.

2) Between TETRAPOL systems with non compatible radio terminals, e.g. due to different frequency bands

- Common operational groups and inter-system calls are the main interworking issues.

3) Between a TETRAPOL system and another digital PMR system

- The A/I protocol and codec are different: groups and inter-system calls are the main issues.

4) Between two TETRAPOL systems with different software versions

- The ISI interface shall behave as if the software were the same for all common services;
- New or enhanced services shall be properly handled over ISI.

The ISI shall not have the knowledge of a sub-decomposition of a system, i.e the ISI shall neither take into account the IRI, nor the internal topology of a TETRAPOL system.

5. ISI service requirements

5.1. Purpose and assumptions

This clause describes the overall services over the Inter-system Interface as seen from a TETRAPOL system point of view.

The services shall appear to the users as if they were in the same system, i.e. the ISI shall provide a seamless service, enabling the services to be provided transparently accross several systems.

It is assumed that calls to or from a TETRAPOL terminal may originate or terminate in other systems from different domains.

The ISI protocol shall not allow one system to control the physical resources of another.

5.2. Connection between systems

5.2.1. ISI connexions

The ISI shall provide the services in order to establish, maintain and release calls between two or more SwMIs and to transfer non call related information. This shall be partly dealt with by the QSIG layer 3 protocol, as defined in PAS 0001-16 [3] and ETS 300 239 [5], and it may be partly dealt with by the X.25 layer 3 protocol, as defined in ITU-T Recommendation X.25 [6].

The inter-system call control services shall be built above QSIG basic services and QSIG generic functions. The interface of the ISI services shall be considered as QSIG Additional Network Features (ANF).

The inter-system service providing remote access to a terminal location database, whether home location register (HLR) or visitor location register (VLR), shall either be built as an ANF above X.25 when the interworking SwMIs provide an optional X.25 access, or be built as the same ANF, but above QSIG. Non call related transactions shall either be dealt with through X.25 layer 3 packet data protocol, or through QSIG layer 3 circuit mode protocol when X.25 is not available between SwMIs. Both QSIG and X.25 shall be the basis for the same common non-call-related ISI mobility and location ANF.

ISI call related connexions may be allocated for the complete duration of a call. The ISI service access point shall provide enough information for supporting message trunked calls and quasi-transmission trunked calls. The ISI shall be able to handle half-duplex calls. There shall be no pre-emption of the ISI resources.

5.2.2. QSIG bearer service

QSIG is the connection oriented layer 3 of a protocol stack for private integrated services network exchanges (PINX).

Transit systems may appear at the QSIG plane. There shall be no transit SwMI between two SwMIs at the ISI plane: QSIG transit systems shall behave transparently from the ISI point of view. There shall be no limit to the number of QSIG transit systems over ISI.

The ISI logical channel connections shall be allocated on demand.

The intervening network shall provide a link access capability necessary for the support of the QSIG service. It may be provided as an ITU-T Q921-LAP-D layer 2 access point as defined in ITU-T Recommendation Q.921 [11] and ETS 300 170 [12] with an agreed bearer data rate and quality of service, the details of which shall be an agreement between network operators. The QSIG common channel signalling procedures are defined in terms of messages exchanged over a data link connection within the D-channel of the private inter-network exchange link, which may be allocated on-demand or permanently.

5.2.3. X.25 bearer service

X.25 layer 3 packets shall be transmitted over link access protocol frames, depending on the data link layers and bearer services available between SwMIs. The ISI service access points shall provide for the X.25 addressing within each system.

5.2.4. Call topology

An inter-system call shall be set-up so that it centered around one SwMI. This SwMI is referred to as the call master SwMI.

The call master SwMI shall be the central point SwMI which is responsible for the synchronisation of the call set-up procedures between SwMIs. It may also be in charge of the global arbitration of the request-to-transmit. It shall be in charge of the synchronisation of the call release procedures between SwMIs at the termination of the call.

Although the call master SwMI shall control the call processing, it shall not control the users or group of users participating in the call, unless it colocates both the call master functionalities and the home database functionalities.

The call master SwMI shall be elected according to some of the following criteria:

- C1: Minimise the number of weakness in the call topology;
- C2: Minimise the number of ISI traffic channel allocations;
- C3: Minimise the ISI signalling traffic during call set-up;
- C4: Balance the number of ISI access points simultaneously used per SwMI;
- C5: Minimise the ISI traffic after call set-up;
- C6: Optimise the distance between the call master SwMI and some of the databases of the subscribers involved in the call.

Some appropriate rules for an easy election of the call master SwMI shall be considered in order to systematically satisfy some of the previous criteria:

- Private communications shall have their originating SwMI as their call master SwMI.

Two possible alternatives shall be considered for group communications, depending on the participating users:

- The call master is the call originating SwMI (default alternative)
  In this case, the criteria C1, C2, C3 are implicitly guaranted to be minimised;
- The call master is the home SwMI of one of the called user or called group of users or participating users;
  The criteria C5 and C6 may be implicitly optimised in that case, depending on whether there exist some users involved in the call and registered in the home SwMI. In this case, the home SwMI and the originating SwMI are statistically often the same SwMI.

It shall be up to the originating SwMI to decide which of the two alternative call masters to elect. However, the call originating SwMI may consult any HLR before choosing the call master SwMI. When another digital PMR system is involved in a call among TETRAPOL SwMIs, the TETRAPOL SwMIs shall thus be able to decide and/or accept in a flexible way how to elect a common call master for the inter-system call, even if that PMR system can only accept restrictive election rules.

5.2.5. Inter-system planes

The different inter-system planes are described thereafter for private communications and group communications.

Two options are shown for point-to-point and point-to-multipoint calls: first, on figure 2, the call master SwMI is the call originating SwMI, then, on figure 3, the call master SwMI is not the call originating SwMI. Both options shall be supported by a TETRAPOL SwMI. The default option is the call originating SwMI option on figure 2.

The case when a group communication is established over a pre-defined area is also considered on figure 4.

In this sub-clause, a subscriber may be either an individual user or a group.
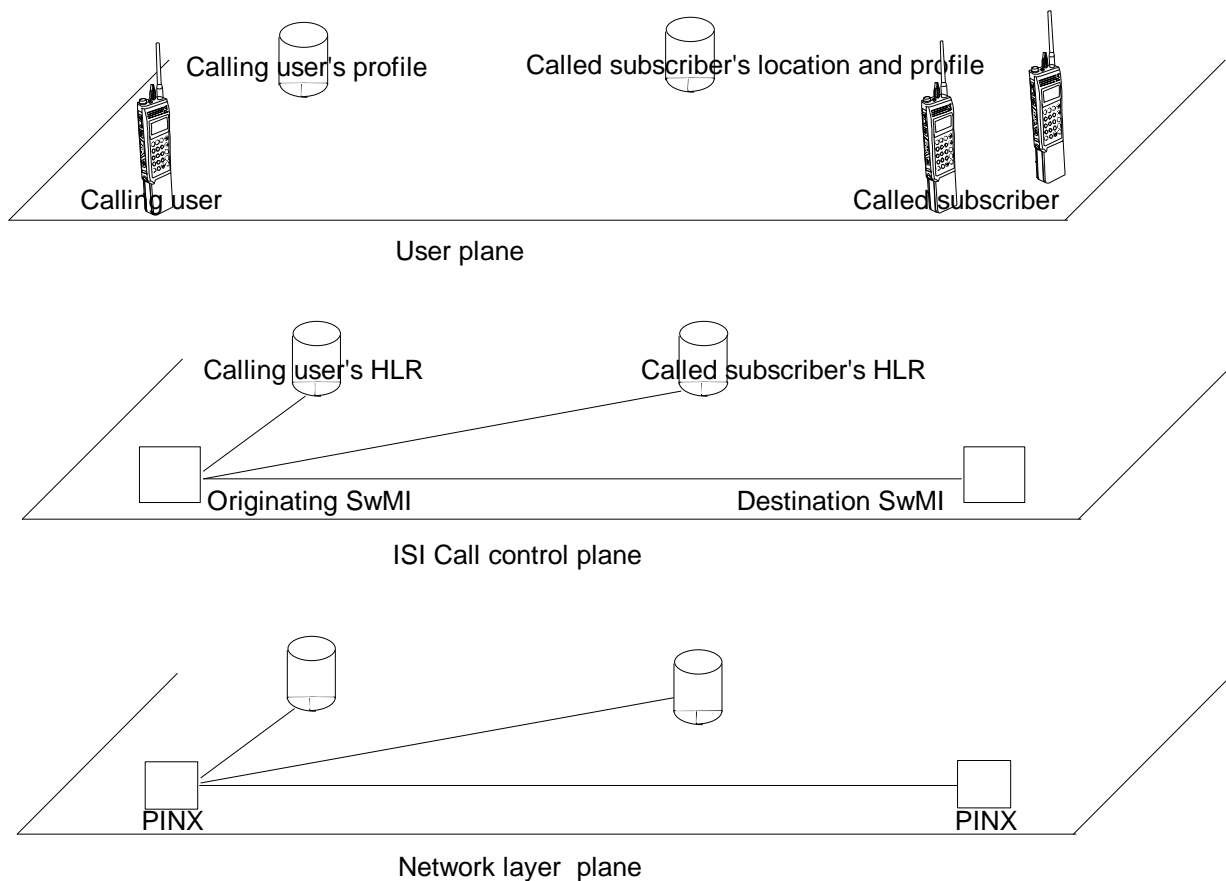
Figure 2: Inter-system planes when the call master is the call originating SwMI

Figure 2 describes the different planes for a point-to-point or a point-to-multipoint call, between an originating SwMI where the calling user is registered and one destination SwMI where some users are registered. The called subscriber may be either an individual called user or a called group. Multiple destination SwMIs may also be considered. The call master SwMI is the originating SwMI. The calling user, the called subscriber and their HLRs may be spread over several systems.

On the call control plane, the link between the originating SwMI and the destination SwMI is a connection oriented service. The links between the originating SwMI and the service control points, such as databases, are a connectionless service. The possible access to a visiting database is not shown.

On the network plane, all QSIG links are connection oriented circuit mode links between the QSIG Private Interworking Network eXchanges (PINX). The ISI call control link between service switching points, referred to as PINX, is allocated a QSIG traffic channel. The database access link may be based on QSIG, in which case it shall not use a QSIG traffic channel. Otherwise, the database access links may be based on X.25 packet layer protocol.

Calling user's profile

Called subscriber's location and profile

Calling user

Called subscriber

User plane

Calling user's HLR

Called subscriber's HLR

Originating SwMI

Call master SwMI

Destination SwMI

ISI Call control plane

PINX

PINX

PINX

Network layer plane
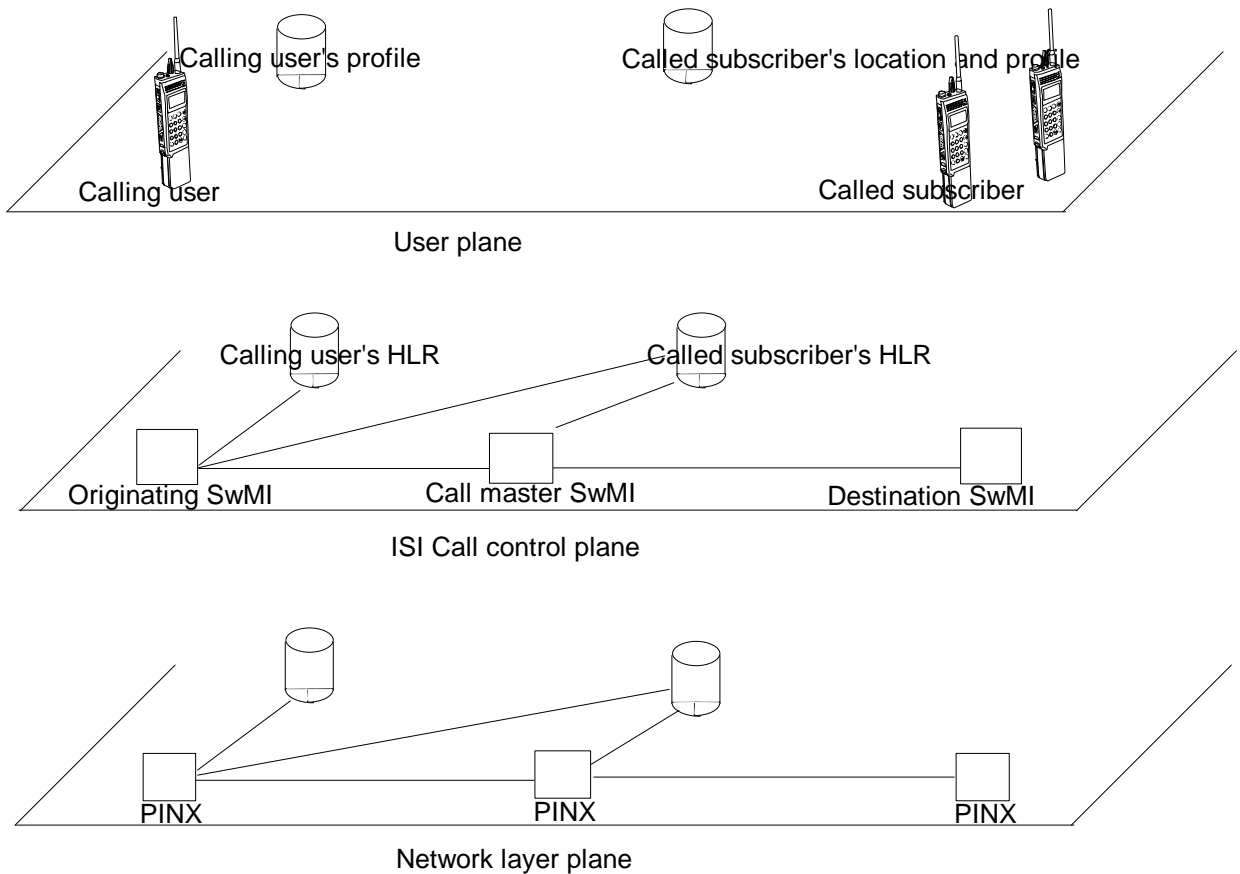
Figure 3: Inter-system planes when the call master is not the call originating SwMI

The different planes for a point-to-point or point-to-multipoint call between an originating SwMI where the calling user is registered, a different call master SwMI and one destination SwMI where a called subscriber is registered are described on figure 3. The called subscriber may be an individual user or a group of users. Multiple destination SwMIs may also be considered.

On the call control plane, the link between the originating SwMI, the call master SwMI and the participating SwMI is a connection oriented service. The links between the SwMIs and the service control points such as databases are a connectionless service. The possible access link to a visiting database is not shown.

On the network plane, all QSIG links are connection oriented between all Private Interworking Network eXchanges (PINX). The ISI call control link is allocated a QSIG traffic channel, whereas the database access links have no need for a traffic channel. The database access link may rely either on QSIG or on X.25 packet layer protocol.

(Group, coverage, partition)

Calling user   Participating users

User plane

Group HLR

Participating SwMI   Participating call master SwMI   Participating SwMI

ISI Call control plane

PINX   PINX   PINX

Network layer plane
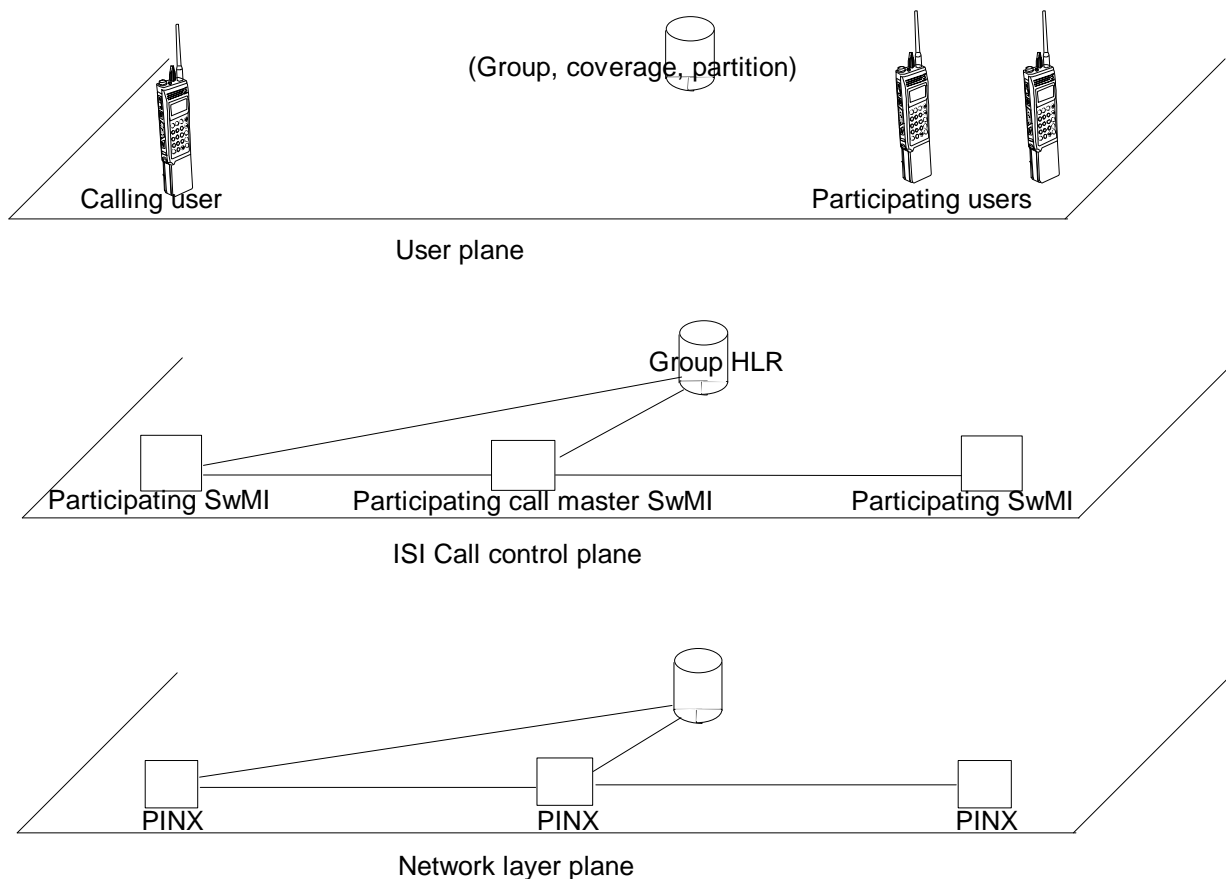
Figure 4: Inter-system planes for a group communication over a pre-defined area

Figure 4 describes the different planes for a group communication established over a pre-defined coverage area. Two categories of users shall be considered: the users that have the right to establish and clear the call for the group, the group members who are allowed to participate in the call if they are located in the selected area.

On the call control plane, the call attributes, including group and coverage area, are retrieved by the call master SwMI, that establishes the ISI link to other participating SwMIs. On the QSIG plane, all links are connection oriented between all Private Interworking Network eXchanges (PINX). The ISI call control link is allocated a QSIG traffic channel. The database access link may be based on QSIG, in which case it shall have no QSIG traffic channel. Otherwise, the database access links may be based on X.25.

5.3.   User services over ISI

5.3.1.   Circuit mode voice call related services

Most circuit mode services shall be provided over ISI as enumerated in table 13 and table 17.

The ISI shall be able to map similar services from different systems.

The ISI shall be able to support all combinations of basic services, encryption options, supplementary services as defined thereafter, depending on the remote system.

The services shall be secured enough to recover from a breakdown of an ISI link or a temporary unability to contact a distant HLR.

The ISI shall cope with call establishment contentions and simultaneous transmission requests from different mobiles participating in the same call but on different systems.

The ISI shall not support Inter-system handover.

5.3.2. Data services over ISI

The ISI shall support the data services enumerated thereafter in table 13 and table 17, depending on the remote system.

5.4. Mobility management over ISI

5.4.1. Terminal location

The ISI shall provide access to the functions related to the management of the user mobility across systems.

The ISI shall support the transactions about a user profile and a terminal location registration with a home location register from a remote system.

The system where the terminal is actually registered shall be provided with the requesting ISI service access point. If there are more than one ISI service access point per system, then the requesting ISI service access point shall be provided with unambiguous information so that it can route a call to the correct destination ISI service access point.

5.4.2. Individual migration

A radio terminal may be served by different SwMIs, providing different services.

The ISI shall support the migration of terminals within the TETRAPOL domain.

The inter-system interface shall support the following services when a terminal migrates to another SwMI:

- Terminal attributes download to the visited system, including user profiles and group memberships;
- Registration and de-registration with an update of remote databases, including individual HLR, group HLRs, VLRs.

Whenever a terminal migrates in a system, it shall register in a cell of a base station from a base network of the new system. The location data shall be stored in a roaming register of the VLR. The roaming register update shall trigger a request for an update of the migration register of that VLR within that system, which shall in turn update its user profile data from the individual HLR over the ISI. The individual HLR shall then update the location of the terminal.
If the terminal was previously in another visited system, its user profile shall be removed from the migration register in the previous VLR. The roaming register in the previous VLR shall be cleared as well.
- If the terminal is a member of a group, then some information may optionnaly be sent over ISI to the group HLR, depending on whether the group HLR maintains a list of all participating SwMI or whether the group HLR builds the list of paticipating SwMIs upon request.
- the ISI shall propagate the update request of its migration register in its actual VLR.

5.4.3. Group mobility and group migration

The inter-system interface shall support the following services when members of a group are migrating or when the group management is changed from one SwMI to another one.

- Group mobility management of its individual members, including HLR update.
- Group attributes downloading.
- Group data update from a visited SwMI to a remote HLR or from an individual HLR to a group HLR.
- Global groups management, transfer of control from one database within a home SwMI to another. It is the responsibility of the local operator to handle access control. However visiting RT attributes shall be recognized.

- Visiting group downloading, dynamic regrouping supplementary services shall cope with the ISI and mobility data.

5.5. Worldwide addressing plan through ISI

5.5.1. Requirements and conventions over ISI

5.5.1.1. Addressing requirements over ISI

For ISI connectivity, each subscriber shall have a unique identification address valid in the whole TETRAPOL domain, and the SwMIs shall be able to determine the location of the subscriber based on that address. The identification of a subscriber, the diallable directory number allocated to a subscriber, and their optional separation from the addressing of the terminals and the network access points of attachment is out of the scope of this clause.

This clause defines a worldwide addressing plan to be used for system terminal identities between different TETRAPOL systems and other digital PMR systems. This addressing plan is used by the TETRAPOL system in A/I applicative messages and ISI primitives and may differ from the directory numbers entered at the terminal applicative man machine interface.

The addressing scheme for TETRAPOL ISI shall meet the following requirements:

- A TETRAPOL terminal address shall make it possible to unambiguously route a call over ISI;
- It shall make it easy to address the subscriber profile information in both its home and visited location registers;
- The worldwide addressing plan shall support a uniform TETRAPOL addressing mode;
- The addressing plan should facilitate interworking with other digital PMR sub-addressing plans;
- It may be compatible with an ISDN addressing sub-plan from ITU-T Recommendation E.164 [8], ITU-T Recommendation E.213 [9], or ITU-T Recommendation X.121 [10];
- Each address shall be unique across the complete TETRAPOL domain, each short address being unique within its system;
- The addressing plan should be easely translated into a comprehensive and easely understood decimal numbering plan at the terminal man-machine interface and in the international alphabet N°5 ITU-T T.50 [13];
- It shall allow for the expansion of the size of the subscriber population.

In order to address all subscribers from several systems, the TETRAPOL identities are organised into the following categories of system terminal addresses, as defined in PAS 0001-1 [1]:

- Explicit or implicit individual address;
- Group address;
- Address from another digital PMR sub-addressing plans.

The ISI shall support neither any list address nor any sub-address, but may support a fleet management.

The ISI shall support the following address types.

Table 1: Address types over ISI

Address type	Address length	CNA address type identifier
TETRAPOL long functional address	variable	4
TETRAPOL long individual address	12 quartets	5
TETRAPOL long group address	12 quartets	5
Universal address	variable	7

The long address length may vary from 32 bits to 128 bits, not including the CNA type identifier.

5.5.1.2. Bit ordering and address coding

The following conventions are held for the coding of the different TETRAPOL identities:

The different parts of an identity are shown in the tables in order of significance.

The most significant part of an identity shall be on the left part of the figures and the least significant on the right.

The length of the fields of an address shall be provided in bits, quartet or octet units. The length of the significant fields are an integer number of quartets or octets in order to minimize the address length over the Air.

Whether the fields shall be interpreted as binary values or binary coded decimals (BCD) is out of the scope of this clause. There shall be no bit discriminating binary and BCD coding, so that a BCD interpretation can be always considered for a TETRAPOL individual address.

The CNA address type identifier shall be appended to the actual address whenever needed, e.g. on the Air Interface.

5.5.2. TETRAPOL long functional address type

A TETRAPOL long functional address shall be mapped onto the following pattern:

Table 2: Long functional address

3bit CNA	4bit length	4bit Prefix	12bits		variable
100	Length	0000	MCC	NC	SF

where:

- CNA value shall set to 100b in order to discriminate the functional addresses from other types of addresses;
- Length shall provide the total quartet length of the subsequent fields of the address. Its value shall be greater than 0111b quartets;
- Prefix shall be set to 0000b for an inter-system functional address, i.e. a functional address to be interpreted in a remote SwMI;
- MCC and NC shall caracterise the country code and network code where the short functional address shall be locally interpreted. Their values shall comply with the ones used over the Air Interface.
- SF shall represent a short individual functional address with no sub-address attached to it. The SF length shall be greater than 12 bits.

5.5.3. TETRAPOL long individual and group address type

5.5.3.1. General rule for long explicit addressing

A TETRAPOL long individual or group address shall be used within a TETRAPOL system and over the inter-system interface using the following pattern:

Table 3: Long explicit address

3 bit CNA	8bits	4bits	36bits
101	MCC	NC	SN

where:

- CNA is the coded nature of the following address. It shall be set to 101b for TETRAPOL long individual and group addresses.

- MCC shall be the country code of the network where the short number can be interpreted
        The country code may specify the destination geographic area of a call.
Its values may be allocated in accordance with the COUNTRY_CODE Information Element of the Air Interface Protocol.

- NC shall be a national destination code, that identifies the network in its country.
   Values may be allocated per country in accordance with the SYSTEM_ID Information Element of the Air Interface Protocol of that system.
- SN shall be a short number valid within one TETRAPOL system as defined in PAS 0001-1 [1].

MCC and NC values shall be agreed between all network operators of the TETRAPOL domain so that they be the same in all systems. MCC values may optionnaly be considered as the binary encoding of the Country Code (MCC) from the ITU-T Recommendations defined in ITU-T Recommendation E.164 [8], ITU-T Recommendation E.213 [9], ITU-T Recommendation X.121 [10], or optionnaly be a private encoding of all TETRAPOL system codes belonging to the same isolated domain. The operators of interconnected systems shall commit themselves to preserve the coherence of the addressing plan of their TETRAPOL domain.

When the SN field is a short individual address, the long explicit address shall be a long individual address used for private communications and some supplementary services ; when the SN field is a short group address, the long address may be used to uniquely identify a group in a group communication over ISI.

5.5.3.2. TETRAPOL long individual address

This address shall be use to uniquely identify a system terminal over the ISI, in accordance with the addressing plan from PAS 0001-1 [1].

Table 4: Long individual address

3 bit CNA	8bits	4bits	4bits	32bits
101	MCC	NC	TON	ISSI

where:

- CNA shall be set to 101b for a TETRAPOL long address type;
- MCC and NC shall be set in accordance with the country code and network code of the home system;
- ISSI is the TETRAPOL individual short subscriber identity, that can be interpreted in the home system ; in its home system only, the ISSI may optionnaly be decomposed and interpreted according to the local rules.
- TON is the type of short number and it shall be set to a value allowed for homeindividual addresses.

Table 5: TON address field

	4bit	TON	
b3	b2	b1	b0

- with the following constraint on the bits: (b3=0) or (b1=0 and b2=0)

- NOTE: TON values from 0h to 9h are allowed for individual addresses.

5.5.3.3. TETRAPOL long network group identities

The network group identities shall be used for a group address that shall not be hierarchically parsed. This kind of address may be used in group calls. It shall also be used for addressing a group from another PMR SwMI.

Table 6: Long network group identity

3 bit CNA	8bits	4bits	4bit TON	32bits
101	MCC	NC	1010	GSSI

where:

- CNA shall be the address type code for long addresses. It shall be set to 101b;
- MCC and NC shall be set in accordance with the country code and network code of the group home system;
- TON is the type of short number and it shall be set to 1010b when the GSSI value cannot be further interpreted as a hierarchical address;
- GSSI is a group short subscriber identity. When TON equals 1010b, the GSSI shall not be decomposed and further interpreted according to local rules.

5.5.3.4. TETRAPOL long regional operational group address

This type of address shall be used in order to uniquely identify a regional operational group from a SwMI over the ISI. It may also be used to identify a talkgroup number. All regional operational group attributes shall be stored in the database of one home SwMI only. This type of address may be used for all kinds of group communications.

Table 7: Long operational group address

3 bit CNA	8bits	4bits	4bit	32bits
101	MCC	NC	1100	GSSI

where:

- CNA shall be the address type code for long addresses. It shall be set to 101b;
- MCC and NC shall be set in accordance with the country code and network code of the home system;
- TON is the type of short number and it shall be set to 1100b for operational groups;
- GSSI is a group short subscriber identity, from which an operational group may be extracted.

The GSSI may optionnaly be decomposed so that the group short address be as described in table 8.

Table 8: Long operational group address optionnal decomposition

3bit CNA	8bit	4bit	4bit TON		20bits	12bits
101	MCC	NC	110	0	TC	Group_ID

where:

- TC shall be a trunk code of the group: all values of this code are reserved. It may contain some information related to some attributes of a group in a multi-site open channel or a talkgroup, e.g. the scope of the group_ID.

- Group_ID may be the operational group identifier as defined in the GROUP_ID Information Element in the Air Interface Protocol.

5.5.3.5. TETRAPOL long federal group address

This type of address shall be used to identify a federal group shared among several SwMIs. The federal group identifier values shall be pre-arranged between all network operators and shall be recognised by all databases and directories as such. This type of address may be used for all group communications.

Table 9: Long federal group address

3 bit CNA	8bit MCC	4bit NC	4bit TON	32bits
101	0h	0h	1110	GSSI

where:

- CNA shall be the address type code for long addresses. It shall be set to 101b;
- MCC and NC shall be set to not significant values, as federal groups shall be interpretable in all systems;
- TON is the type of short number and it shall be set to 1110b for federal groups shared among several systems;
- GSSI is a short federal group identity, from which some information may be retrieved in all systems.

The GSSI may optionnaly be decomposed so that the group short address be as described in table 10.

Table 10: Long federal group address optional decomposition

3bit CNA	8bit MCC	4bit NC	4bit TON		20bits	12bits
101	0h	0h	111	0	TC	Group_ID

where:

- MCC and NC may be non significant when the identity is a federal group;
- TC shall be a trunk code of the group: all values of this code are reserved. It may contain some information related to some attributes of an open channel or a talkgroup
- Group_ID may be the operational group identifier as defined in the GROUP_ID Information Element   in the Air Interface Protocol.

5.5.4.   Universal address type

Addresses out of the TETRAPOL domain, such as other PMR ones, or PSTN, ISDN, GSM ones, shall be dealt with the following universal address type.

This universal address type includes a numbering plan identifier in order to accomodate addresses from different domains. The type of address may be used for all kinds of private communications and group communications.

Table 11: Universal address

3 bit CNA	4 bits	4 bits	USI length <=120bits
111	Length	NPI	USI

where:

CNA is the 3 bit address type code

- CNA shall be the same discriminator as in the Air Interface with some specific extended values for the ISI. The addresses that do not comply with the other TETRAPOL address types shall belong to the TETRAPOL universal sub-addressing plan;
- CNA shall be set to 111b for a TETRAPOL universal address;
- Other values are allocated alongside with those of the CNA field of the ADDRESS Information Element of the Air Interface protocol.

Length is the 4 bit length of the address in octets.

NPI is a 4 bit numbering plan identifier with values range as follows:

Table 12: NPI field values and supported address types

Numbering plan identifier	Supported address type	SI Length
0	Unknown	variable
1	Dispatch	36bits
2	X.400 (NOTE 1)	
3	PABX (NOTE 1)	
4	PSTN/ISDN(NOTE 2)	80bits (NOTE3)
5	APCO (NOTE 4)	48 bits
6	TETRA (NOTE 4)	48 bits
7	UPT (NOTE 4)	80bits (NOTE3)
8 to E	Reserved	
F	Extended numbering plans	

NOTE 1: NPI=2 and NPI=3 are reserved during an interim version of the TETRAPOL ISI and A/I.

NOTE 2: The ISDN address does not include any sub-address.

NOTE 3: 80 bit address without segmentation.

NOTE 4: Reserved use for APCO (TIA APCO Project 25), TETRA (ETSI Trans European Trunked Radio); UPT (Universal Portable Telecommunications from the ETSI Intelligent Network Capability Sets).

USI is a universal subscriber identity used for addresses out of the TETRAPOL domain. It shall be not more than 120 bit long.

5.6. Priority rules over ISI

The ISI service access point shall request the allocation of the inter-system resources during the call establishment, according to some priority rules regarding the type of service, the external call priority, the calling user's priority and the internal resource allocation priorities.

As the priority scheme is system dependent, the following rules shall apply:

There shall be a priority conversion scheme over ISI between a TETRAPOL system and other PMR systems. The priority conversion scheme shall be an operator pre-arrangement.
- A monotony rule of the priority shall apply: the priority of the call shall increase along with its value; It is recommended that a priority value be dedicated for emergency calls.
- Between TETRAPOL SwMIs, there shall be no modification of the priority values over ISI : the call master SwMI shall provide all priority values during the call set-up and they shall apply as such in the destinations SwMIs, unless a supplementary service is invoked. The external call priority and the retention priority shall be conveyed over the ISI from the call master SwMI to the destination SwMIs.
- During the call active phase of an inter-system call in a non-call master SwMI, a transmission request originating from a terminal actually located in the same SwMI as the talking party shall not be forwarded over ISI unless its transmission priority is strictly higher than that of the talking party.

5.7.   Security requirements over ISI

The threats to cope with over ISI are those of a stand alone SwMI in addition to the threats on the ISI gateway, as defined in PAS 0001-16 [4].

5.8.   Conveying additional information over ISI

As there is a specific R5 interface connecting a network management centre to a SwMI as defined in PAS 0001-12 [2], network management information shall not be transmitted over ISI.

A specific ISI version number shall be provided at each ISI service access point and conveyed over the ISI to the partner ISI service access point as a short data message.

Special information can be carried either in stand alone messages or be part be some call control messages.

6.   Interoperability between TETRAPOL systems

6.1.   Introduction

This clause specifies the basic services supported over the inter-system interface between TETRAPOL SwMIs. The basic services are specifed from the SwMI ISI service access point, for both incoming and outgoing calls. A complete inter-system call requires at least an outgoing ISI service in the originating SwMI and an incoming one in another SwMI.

This clause also specifies how the supplementary services are dealt with the basic services.

6.2.   Incoming call

6.2.1.   Individual call

6.2.1.1.   Presentation

An individual call shall be set up from the ISI as an incoming point-to-point private communication when the calling user is located in a remote SwMI.

6.2.1.2.   Extension of service over ISI

Both users may be located either in their home system or in a visited system.

The calling user shall be able to reach a called user that is registered in another SwMI by providing the called user identity. Though both users may have the same home SwMI and the calling user may not have migrated, the ISI shall provide a long individual address at the incoming side.

Some signalling information shall be passed over the ISI during the duration of the call.

6.2.1.3.   ISI needs for the incoming side

The ISI service access point from the incoming side shall provide a long TETRAPOL address, so that the call be routed in the destination SwMI. The incoming ISI service access point shall be able to locate the called user in the SwMI.

The call master SwMI shall be the originating SwMI, here it shall be the remote SwMI.

Some transit functions between base networks in the SwMI may be needed to join the called user in its actual base network.

The requests to transmit shall be sent over the ISI. The anti-talkative mechanism may apply for one or both users.

6.2.1.4. Normal procedures

The ISI incoming individual call service access point shall be triggered by the other side of the ISI, providing the requested call data, including the called user address and the call external priority.

If the called user is not a migrated one, a location request shall be sent to its HLR, as identified by its address. If the called user is a migrated one, a location request shall be sent to the migration register in the VLR within the visited SwMI.

When the actual location of the called user is known, the ISI service access point shall request the SwMI's call set-up procedure, providing the called user address and call external priority according to the local priority scheme.

The ISI shall be told when the call is established in the destination SwMI and shall then proceed into the call active state. It shall then forward the requests-to-transmit over the ISI.

When the ISI is informed that the call shall be released, it propagates the information to the other user.

6.2.1.5. Exceptional procedures

The individual incoming call service shall be permanently activated over some agreed ISI connections, unless a network management operation temporarily deactivates them.

The SwMI may reject an incoming call for the following reasons (non exhaustive list):

- Called user address is unknown;
- Called user can not be located;
- Called user is migrating to a third party system;
- Called user is forwarded to a third party outside of the system;
- Called user can not answer to the call request (busy or not authorised over the ISI);
- The system is unable to make the call for internal reasons;
- The network management authority forbids this call to take place over the ISI;
- Security issues have to be dealt with.

From the incoming side point of view of the ISI , if the called user is transfered, then the local part of the ISI call shall be released with an appropriate error code.

Apart from security procedures and fall back mode services, there shall be no other interaction with any supplementary service, that shall behave properly if it is invoked.

6.2.2. Talkgroup

6.2.2.1. Presentation

A talkgroup shall provide an inter-system multipoint call service between the members of an operational group, that may be spread over several SwMIs within a predefined geographical area.

6.2.2.2. Extension of service over ISI

The talkgroup attributes,the trunked resources allocation in the SwMIs and the optional ISI resources allocation shall be pre-arranged between the NMC in the SwMIs, and the local OMCs prior to the talkgroup first activation. The call shall be identified with a talkgroup number valid in all SwMIs involved in the talkgroup. The area selection supplementary service shall apply for geographic area covering several SwMIs. The call master SwMI of the the talkgroup shall maintain the list of all participating SwMIs.

The talkgroup shall allow for quasi-transmission trunking in the participating SwMIs and over the ISI. The quasi-transmission trunking over ISI may apply to the ISI logical resources only, not to mention the underlink physical resources allocation rules. The optional talkgroup trunking attributes shall have the same identifier in all SwMIs.

6.2.2.3. ISI needs for the incoming side

The incoming side is referring here to the side of the inter-system interface between two participating SwMIs, which has not be designated as the master SwMI side for the talkgroup activation and transmit request resolution.

The ISI shall propagate all activation requests, deactivation indications, requests-to-transmit, transmit cease, transmit interrupt and transmit indication for the talkgroup number. Incoming information shall be routed to one central point per talkgroup referred to as the local ptt master SW.

6.2.2.4. Normal procedures

A participating user triggers the talkgroup activation with the talk-group number over ISI to the call master SwMI, then the ISI propagates the inter-system requests to transmit.

The talk-group deactivation indication shall be propagated from the call master SwMI to the other participating SwMIs.

6.2.2.5. Exceptional procedures

A talkgroup shall be created by an operator before being activated.

The talkgroup shall be activated upon request for transmission from a talkgroup participant.

Deactivation of the talkgroup shall happen whenever the call master SwMI requests it.

A participant SwMI may ignore an incoming message when a higher priority conflicting information is being processed. Priority beetween signalling messages is as follows:

- Transmit interrupt request;
- Transmit granting;
- Request to transmit;
- Cease indication;
- Talking party identification;
- Activation confirm/indication;
- Activation request;
- Deactivation confirm/indication;
- Deactivation request.

6.2.2.6. Fault handling

In any case of a loss of service over the ISI, the incoming side shall wait for the initiative of the call master SwMI side. The local portion of the call may however continue on its own, until the complete call can resume. Such a fall back scenario may be considered when there is no more ISI reply on an activation request.

6.2.3. Multisite open channel

6.2.3.1. Presentation

A multisite open channel (MOCH) service over ISI shall set up a multigroup addressed multipoint call service over a geographic area that is covered by several SwMIs. An emergency open channel (ECH) is seen from the ISI as a MOCH with emergency external priority and extra attributes.

6.2.3.2. Extension of service over ISI

The call attributes and the optional trunking method of both the SwMI resources and the ISI resource shall be provided at the incoming call set up.

A trunking structure shall be the same in all participating SwMIs in order to favour easy trunking method over optimum resource allocation.

There shall be either a pre-arranged call master SwMI or an election at call set-up. The incoming ISI service access point shall consider that the destination SwMI to which it is attached is different from the call master SwMI.

6.2.3.3. ISI needs for the incoming side

The incoming side of the ISI shall be able to recognise an open channel call type and shall extract the multisite open channel identifier and the participating operation groups from the l group address. It shall then set-up the open channel with the same multisite open channel identifier and the corresponding area selection. It is an option that all systems share a common coverage identifier value as defined on the Air Interface.

Coherence between databases and OMCs is an optional feature of federal groups. Call coverage may depend on:

- which SwMI establishes the call;
- which SwMI are involved in the call;
- what area selection is applied in each system;
- where the participating users are located.

6.2.3.4. Normal procedures

The incoming ISI service access point shall route the request within the SwMI and then shall trigger the multi-site open channel establishment.

The ISI shall propagate the inter-system requests to transmit.

The ISI service is closed upon request from any participating SwMI, that owns the right to clear the call.

6.2.3.5. Exceptional procedures

The incoming call shall be permanently activated over some agreed ISI connection, not to mention some operator temporarily deactivation of some of the open channels.

The SwMI may reject an incoming call for the following reasons (non exhaustive list):

- Called group is unknown;
- The system is unable to arrange the call for internal reasons;
- The network management entity prevents the call establishment over ISI.

6.2.3.6. Fault handling

In any case of a loss of service over the ISI, the incoming side shall wait for the initiative of the originating side. The local portion of the call may however continue on its own, until the complete call can resume.

6.2.4. Broadcast call

6.2.4.1. Presentation

The broadcast call over the ISI shall set-up a one-way point-to-multipoint call service over a geographical area that is covered by several SwMIs. The participating users shall be addressed with a broadcast group. The transmission is granted to and hold by the calling user.

6.2.4.2. Extension of service over ISI

The ISI incoming service access point shall ignore any permission to transmit.

6.2.4.3. ISI needs for the incoming side

No specific need.

6.2.4.4.   Normal procedures

See multi-site open channel over ISI.

6.2.4.5.   Exceptional procedures

If the incoming side of the ISI receives a request to transmit, it shall ignore it.

6.2.5.   Group call

6.2.5.1.   Presentation

A group call over ISI is a point to multipoint group addressed call between an originating SwMI and the SwMIs where the called group members are actually located. The called users are addressed through the ISI with a group address, either a network group address or a federal group address.

6.2.5.2.   Extension of service over the ISI

The outgoing group call service shall be able to locate all participating SwMIs and route the call to them over the ISI.

6.2.5.3.   Normal procedures

Incoming group call shall be forwarded through the ISI to the local call control entity, which shall in turn locate the called users within the system and propagate the call set-up. The ISI shall propagate the transmit requests and cease operations.

6.2.5.4.   Exceptionnal procedures

deactivationThe incoming call shall be permanently activated over some agreed ISI connection, not to mention some operator temporarily deactivation of some of the group calls.

The SwMI may reject an incoming call for the following reasons (non exhaustive list):

- The called group is unknown;
- The system is unable to arrange the call for internal reasons;
- The network management entity prevents the call establishment over ISI.

6.2.5.5.   Fault handling

In any case of a loss of service over the ISI, the incoming side shall wait for the initiative of the originating side.

6.3.   Outgoing call

6.3.1.   Individual call

6.3.1.1.   Presentation

An individual call shall be set up as an inter-system outgoing point-to-point private communication between a calling user and a called user, when the called user is located in a remote SwMI.

6.3.1.2. Extension of service over ISI

The originating SwMI shall be able to request the HLR of the called user for its actual location. Both calling and called users may be either in their home or visited SwMI.

If the called user's system is unknown or if no outgoing service access point is available, then the call set-up shall fail.

The call control entity shall route the call to the nearest interface to the destination SwMI.

The call originating SwMI shall be the call master.

6.3.1.3. ISI needs for the outgoing side

The outgoing side of the ISI shall be able to locate the called user's system and take into account any terminal migration, call transfer or forwarding. The call control in the originating SwMI shall be able to handle either a long address of a remote called user or a short address of a user that has migrated to another SwMI.

6.3.1.4. Normal procedures

The SwMI shall determine whether the called user is outside of the system. In that case, it shall route the call over the dedicated ISI connection to the destination system, providing the long address of the called user and the external call priority. When the destination SwMI is through connected, then the local call control shall proceed to the call active state. The ISI service access point shall convey any permission to transmit information during the call duration. The originating SwMI shall synchronize the call release.

6.3.1.5. Exceptional procedures

The individual call service over ISI shall be activated as long as the SwMI is not put in a stand alone mode.

The SwMI may reject an outgoing call for the following reasons (non exhaustive list):

- Called user not located;
- No available ISI connection;
- The system is unable to arrange the call for internal reasons;
- Security issues have to be dealt with.

If the call is diverted to another SwMI, e.g. due to a call transfer or a call forwarding on busy, the ISI outgoing service access point shall receive a release request with a specific error code and an appropriate information element. The ISI service access point shall then re-route the call as if the host address where the actual called user.

Apart from security procedures and stand alone fall back mode service, there shall be no other interaction with any supplementary service, that shall behave properly if it is invoked.

6.3.2. Talkgroup

6.3.2.1. Presentation

A takgroup shall provide an inter-system multipoint call service between the members of an operational group over a pre-defined geographic area that is covered by several SwMIs.

6.3.2.2. Extension of service over ISI

The coverage of the talkgroup shall be either defined implicitly as a list of SwMIs with a list of local base networks or explicitly as a list of SwMIs, a list of base networks in each SwMI, and a list of BS in each base network.

A call master SwMI shall be designated when the talkgroup is defined.

The talkgroup shall provide quasi transmission trunking for radio and SwMIinternal resources ; the ISI traffic channel may be allocated on-demand per talkgroup activation or permanently allocated as an operator option.

Local interpretations of the global group identification shall not interfere with other local group identifications.

6.3.2.3. ISI needs for the outgoing side

For inter-system purpose, a federal group identification shall be used

The HLR for the talkgroup shall provide the outgoing side of the ISI with a list of all distant SwMIs involved in the call.

6.3.2.4. Normal procedure

The activation requests and the permission to transmit shall be arbitrated and notified to all participating SwMIs by the call master SwMI,

6.3.2.5. Exceptional procedure

All participating SwMIs, whether call master SwMI or not, shall have the same exceptional procedures.

6.3.2.6. Fault handling

6.3.3. Multisite open channel

6.3.3.1. Presentation

A multi-site open channel shall provide a multipoint functional group addressed call service over a pre-defined geographic area that is covered by several SwMIs.

6.3.3.2. Extension of service over ISI

The originating SwMI shall know the list of other SwMIs to which the call set-up shall be routed to. The coverage of the call shall be either defined implicitly as a list of SwMIs plus a list of local base networks or explicitly as a list of SwMIs, a list of base networks in each SwMI, and a list of base stations in each base network. The originating SwMI shall arbitrate the requests to transmit coming from the other participating SwMIs.

The call attributes and the optional trunking method of both the SwMIs resources and the ISI resource shall be provided to the ISI access point.

6.3.3.3. ISI needs for the outgoing side

The ISI needs shall be the same as described in the incoming side clause.

For inter-system purpose, a network group identification or a federal group identification may be used as a functional group address.

The HLR for the group shall provide the outgoing side of the ISI with a list of all SwMIs involved in the call.

Local interpretations of the global group identification shall not interfere with other local group identifications.

6.3.3.4. Normal procedure

The outgoing ISI service access point shall route the call to the destination SwMIs so that they set it up. The originating side of the multisite open channel shall be the call master SwMI. The call shall be released upon request from any participating SwMI.

6.3.3.5. Exceptional procedure

The outgoing multisite open channel shall be permanently activated over some agreed IIS connections, not to mention some operator temporary deactivation.

The ISI service access point may reject an outgoing call for the following reason (non exhaustive list):

- Called operational groups are invalid;
- The network management entity prevents the call establishment over the ISI.

6.3.3.6. Fault handling

Whenever the system is unable to arrange the inter-system call to a SwMI, it shall proceed with a partial set-up.

6.3.4. Broadcast call

6.3.4.1. Presentation

The broadcast call over the ISI shall set-up a point-to-multipoint call service over a geographical area that is covered by several SwMIs. The participating users shall be addressed with a broadcast group.

6.3.4.2. Extension of service over ISI

The originating SwMI shall retain the permission to transmit.

6.3.4.3. ISI needs for the outgoing side

The outgoing side shall broadcast the call release to the destination SwMIs.

6.3.4.4. Normal procedures

Similar to the open channel procedure over ISI.

6.3.4.5. Exceptional procedures

If the outgoing side of the ISI receives a request to transmit, it shall ignore it.

6.3.5. Group call

6.3.5.1. Presentation

An group call over ISI is a point to multipoint group addressed call going out from an originating SwMI to some SwMIs where the group members are actually located. The called users are addressed through the ISI with a group address, either a network group address or a federal group address.

6.3.5.2. Extension of service over the ISI

When some of the group members are registered in a SwMI which is different from the originating SwMI, then the group home SwMI shall provide the list of all participating SwMIs. It is the ISI role to route the call set-up to all these SwMIs, then propagate all information to and from the call master SwMI.

6.3.5.3. Normal procedures

The outgoing group call request shall be routed over the ISI to the participating SwMIs as found at the group location transaction with the group HLR. The call control shall then proceed to the call active phase and the ISI shall provide for the arbitration of the transmission requests. When the call master SwMI receives a relase request, it shall disconnect the call.

6.3.5.4. Exceptionnal procedures

The outgoing group call shall be permanently activated over some agreed ISI connection, not to mention some operator temporarily deactivation of some of the group calls.

The ISI service access point may reject an outgoing call for the following reasons (non exhaustive list):

- Called group is unknown;
- The system is unable to arrange the call for internal reasons;
- The network management entity prevents the call establishment over ISI.

6.3.5.5. Fault handling

In any case of a loss of service over the ISI, the outgoing side shall initiate an ISI re-establishment.

6.4. Supplementary services over ISI

The ISI shall provide a generic support for the transport of the supplementary services, independently or in correlation with the teleservices. Supplementary services shall be conveyed over the ISI as QSIG facilities.

6.5. Mobility services over ISI

A TETRAPOL SwMI shall be able to request user profile and location information from a database of another SwMI over the ISI. It shall answer any request, maintain the information about the terminal registration and de-registration depending on its HLRs, and maintain the information about the terminals depending on its VLRs.

6.6. TETRAPOL services over ISI

This clause describes the teleservices, basic services and supplementary services that shall be supported between two TETRAPOL SwMIs over ISI.

TETRAPOL services are divided into several groups:

- The voice teleservices provide end-to-end clear speech or encrypted speech services as if they were used in one system;
- The supplementary services availability over ISI is shown;
- The data services over ISI are shown;
- Mobility service makes it possible to update the databases;
- Some security services are needed to ensure correct authentication and cyphering.

A service is marked ✓ when it is available as a network service.
A service is maked Basic when it is a basic ISI service.
A service is marked Ext when it is an extended ISI service.
A service is marked N/A when it is not available over the ISI.
A service is marked X when it is irrelevant over the ISI.

Table 13: Services provided over TETRAPOL ISI at the R9 reference point

Availability of services over ISI	TETRAPOL network services	Services provided over TETRAPOL ISI
Voice teleservice (clear or encrypted)		
Individual call	✓	Basic
Multiparty call	✓	Basic
Group call	✓	Basic
Emergency call	✓	N/A
Multi site open channel	✓	Basic
Broadcast call	✓	Basic
Talkgroup	✓	Basic
Supplementary services		
Adaptative area selection	✓	N/A
Ambience listening	✓	N/A
Area selection	✓	Ext
Automatic call back	✓	Ext
Call authorised by dispatcher	✓	X
Call barring	✓	Basic
Call forwarding unconditionally	✓	Basic
Call transfer	✓	Basic
Call waiting	✓	N/A
Calling party identification	✓	Basic
Discreet listening	✓	N/A
Dynamic group number assignment	✓	Basic
Dynamic regrouping	✓	Basic
Include call	✓	Ext
Intrusion	✓	N/A
Late entry	✓	Ext
Preemptive priority call	✓	Basic
Priority call	✓	Basic
Talking party identification	✓	Basic
Data services		
Broadcast without acknowledgment	✓	Ext
Connection oriented packet data	✓	Basic
Short data messaging	✓	Ext
Circuit mode data service	✓	Basic
Connectionless packet data	✓	Ext
Status transmission	✓	Ext
X.400 messaging	✓	X
TCP/IP access	✓	X
Mobility services		
Registration/Deregistration	✓	Basic
Security procedures		
Terminal-network authentication	✓	X
Networks mutual authentication	✓	Basic
Enable/disable	✓	Basic
Attach/detach	✓	Basic

Confidentiality (Encryption)	✓	Basic
Key management	✓	Basic
Integrity of information	✓	Basic
Replay protection	✓	Ext
Secure terminal management	✓	X
Gateway secure operations	X	Basic

7. Interworking between a TETRAPOL system and other digital PMR systems

7.1. Provision

This clause defines some generic interworking requirements between a TETRAPOL system and other digital PMR systems assuming they fully comply with all the relevant QSIG standards.

A complete interworking specification will not be available until these systems publish their future specification of the inter-system interface. Therefore detailed annexes are a place holder for more requirements on a system-to-system basis.

7.2. Vocoded and encrypted speech conversions

The TETRAPOL ISI service access point may need to convert the foreign burst into the TETRAPOL encoded voice traffic data , depending on the vocoder. This situation depends on the type of remote system and the type of vocoded speech, thus it is an implementation issue. The encryption mechanism over ISI may be different from the encryption mechanism within each system. Regardless of the synchronisation of all the encryption mechanisms, a conversion of the encryption scheme may be considered at each ISI service access point.

7.3. Inter-system protocol specifications

The inter-system-interface between a TETRAPOL SwMI and another PMR system shall rely on the QSIG ANF as defined in Draft prETS 300 392-3 [7]. The extensions of the QSIG Additional Network Features, that are specific to TETRAPOL system terminals, may be carried over the ISI to the other PMR SwMI, that may either recognise the TETRAPOL standard or consider them as proprietary information elements.

7.4. Call identifier

A call identifier shall be used to uniquely identify a call. The call identifier shall be allocated at call set-up time by the call master SwMI.

The connection identifier is a local reference on an ISI link. It shall be allocated by the ISI/QSIG service access point upon the establishment of a QSIG connection.

The mapping between call identifier, connection identifier and call control instance shall be handled by the protocol control sub-entities.

7.5. TETRAPOL specific information elements

Capabilities for passing TETRAPOL specific information elements as unstructured data to visited PMR SwMIs shall allow the system to have a flexible mechanism for providing such a service.

The ISI shall not support in-band signalling, unless it is end-to-end signalling, in which case it is transparent over the ISI.

Annex A (Normative)   TETRAPOL interworking with TETRA through the ISI

A.1   TETRAPOL-TETRA common services over ISI

The following pages provide a comparison between TETRAPOL-TETRA candidate services for a common Inter-system Interface.

ISI interworking shall be marked Basic (resp. Ext) when TETRAPOL provides the service interworking with TETRA as a basic feature (resp. Extended feature).
A service is marked N/A when it is not available in the specification.
A service is marked X when it is irrelevant over the ISI.
A service is marked ✓ when it is available as a network service.

Table A.1: Services provided over TETRAPOL ISI at the R11 reference point

Availability of services over ISI	TETRAPOL network services	TETRA network services	Interworking over ISI
Voice teleservice (clear or encrypted)			
Individual call	✓	✓	Basic
Group call	✓	✓	Basic
Multiparty call	✓	N/A	N/A
Emergency call -	✓	N/A	N/A
Multi site open channel	✓	N/A	N/A
Broadcast call	✓	✓	Basic
Talkgroup	✓	N/A	N/A
Supplementary services			
Ambiance listening	✓	✓	N/A
Area selection	✓	✓	Ext
Call authorised by dispatcher	✓	✓	X
Call barring	✓	✓	Basic
Call forwarding unconditionally	✓	✓	Basic
Call me back	✓	✓	Ext
Call transfer	✓	✓	Basic
Call waiting	✓	✓	N/A
Calling party identification	✓	✓	Basic
Discreet listening	✓	✓	N/A
Dynamic group number assignment	✓	✓	Ext
Include call	✓	✓	Ext
Intrusion	✓	N/A	N/A
Late entry	✓	✓	Ext
Priority call	✓	✓	Basic
Talking party identification	✓	✓	Basic
Data services			
Mobility services			
Registration/deregistration information	✓	✓	Ext
Enable/disable	✓	✓	Ext
Security procedures			
Interworking security	✓	✓	Ext

History

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