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TETRAPOL Specifications
Part 11: Gateway to External Networks;
SubPart 1:Gateway to X.25 Network

Reference

Keywords

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Contents

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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

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1. Scope

The purpose of this specification is to specify the interface between the Radio Switch and an X.25 network. The interface corresponds to reference point R16 as defined in PAS 0001-1-1 [4].

The profile of layers 1 to 3 concerns the connection of the RSW to an X.25 network.

This part also applies to EDT, X.400 MTA, KMC and DC interfaces.

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] 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".

[2] ITU-T Recommendation V.24: "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit terminating equipment (DCE)".

[3] ITU-T Recommendation V.28: "Electrical characteristics of asymmetric connector circuits for transmission by double current".

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

[5] ISO 2110: "Information technology - Data communication - 25 pole DTE/DCE interface connector and contact number assignments".

[6] ITU-T Recommendation X.224 | ISO 8073: "Open Systems Interconnection; Transport; Protocol specification".

3. Definitions and abbreviations

3.1. Definitions

For the purposes of this PAS, the following definitions apply:

Base Network (BN): elementary network which is the smallest entity able to operate in normal network connected mode and to provide all nominal services and features available in normal network connected mode. It includes one RSW and one or more BSs and corresponds to a geographical subdivision of the coverage of a network.

X.400 MTA: Message Transfer Agent of an external Message Handling System, not managed by the system.

3.2. Abbreviations

For the purposes of this PAS, the following abbreviations apply:

BN	Base Network
BNLM	Base Network Local Messaging
BS	Base Station
CD	Carrier Detect

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CTS	Clear To Send
CUG	Closed Users Group
DC	Dispatch Centre
DCE	Data Circuit terminating Equipment
DCP	Data Connection reference Point
DIAG	DIAGnosis
DISC	DISConnect
DM	Disconnect Mode
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EDT	External Data Terminal
EDT-DCP	EDT Data Connection reference Point
EG	Earth Ground
EXAM	EXternal Application Messaging
FCS	Frame Check Sum
FRMR	Frame Reject
FS	Fast Select
I	Information
ID	IDentifier
IPM	Inter-Personal Messaging
ISS	Internal System Signalling
KMC	Key Management Centre
LAP-B	Link Access Procedure Balanced
LC	Logical Channel
LG	Logic Ground
MHS	Message Handling System
MTA	Message Transfer Agent
NSDU	Network Service Data Unit
OMC	Operation and Maintenance Centre
OSI	Open System Interconnection
PAS	Publicly Available Specification
PI	Protocol Identifier
PMR	Private Mobile Radiocommunications
RC	Receiver Clock
RD	Receive Data
REJ	Reject
RNR	Receive Not Ready
RR	Receive Ready
RSW	Radio SWitch
RTS	Request To Send
SABM	Set Asynchronous Balanced Mode
SAP	Service Access Point
SDP	Submit/Delivery Protocol
ST	System Terminal
SVC	Switched Virtual Circuit
TC	Transmitting Timing DCE
TD	Transmit Data
TPDU	Transport Protocol Data Unit
UA	Unnumbered Acknowledge
VC	Virtual Circuit
X.400-DCP	X.400 MTA Data Connection reference Point

4. Overview

The physical, data link and network levels are represented on the following figure:

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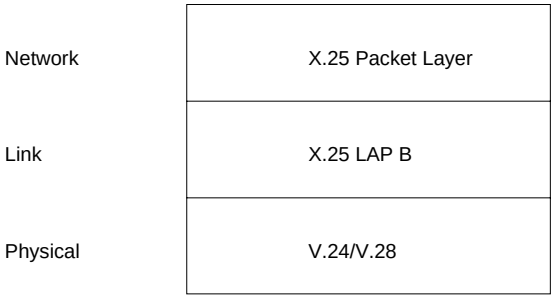

Figure 1: Communication layers

The physical layer is described in Clause 5.

The data link layer is described in Clause 6.

The network layer is described in Clause 7.

5. Physical level

5.1. Presentation

The RSW shall connect to the X.25 network via a synchronous link established permanently.

Rate: 19 200 bit/s

Mode: full duplex

The junction circuits shall conform to ITU-T Recommendations V.24 [2] and V.28 [3].

The RSW operates as DTE.

The X.25 network operates as DCE.

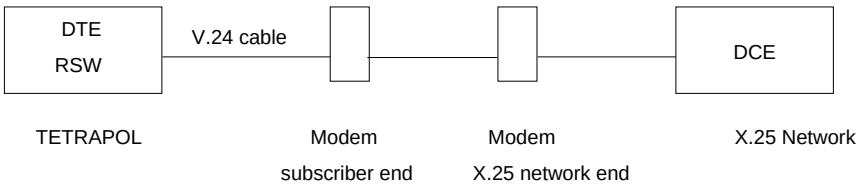

Figure 2: The Radio Switch is a subscriber of the X.25 network.

5.2. RSW to X.25 network connection cable

The cable shall conform to ITU-T Recommendations V.24 [2] and V.28 [3].

ISO 2110 [5] standardised 25-pin connectors shall be used at either end of the cable:

- male connector at RSW end;
- female connector at modem end.

The junction circuits used are indicated on figure 3. The cable shall link together pins with the same number (1 → 1, 2 → 2, ...)

The RSW Transmitting Timing DCE (114) and the RSW Receiver Clock (115) shall be provided by the subscriber end modem.

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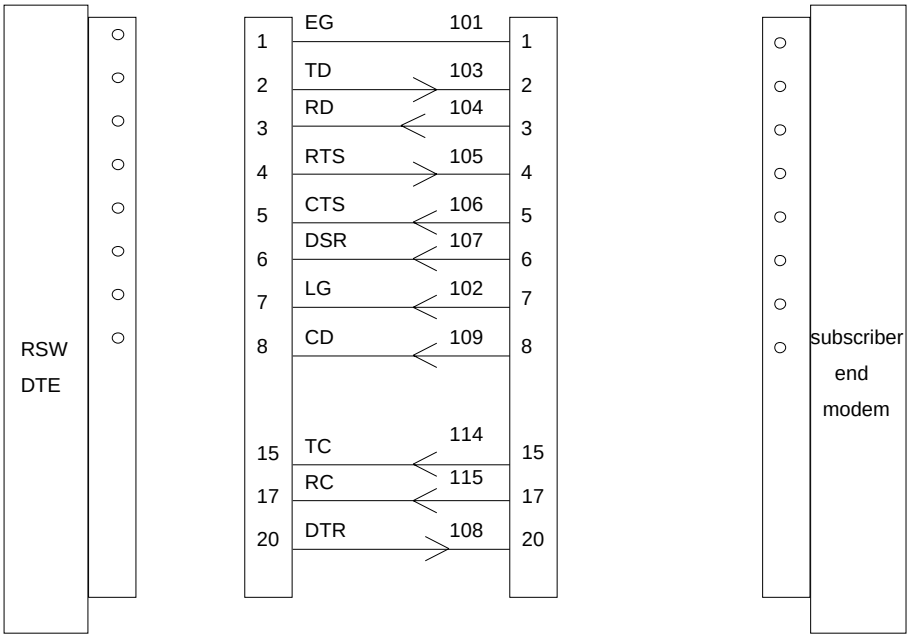

Figure 3: RSW to X.25 network connections

Table 1: Circuits used in the V24 interface between the RSW and X.25 network

RSW DTE	X.25 network DCE	Signal Number	Pin Number	Signal Name	Use of the signal
		101	1	EG	Earth Ground
		102	7	LG	Logic Ground
→		103	2	TD	Transmitted DataRSW → X.25 network
←		104	3	RD	Received DataX.25 network → RSW
→		105	4	RTS	Kept closed while the RSW is working
←		106	5	CTS	Confirms that the RTS is closed
←		107	6	DSR	Circuit permanently closed
→		108	20	DTR	Status permanently closed
←		109	8	CD	Circuit permanently closed
←		114	15	TC	Transmitting timing DCE supplied by X.25 network
←		115	17	RC	Receiver clock supplied by X.25 network, RSW receiver clock

5.3. V.24 Interface signals management

5.3.1. V.24 Interface directions for use

The junction signals used for the V.24 interface shall be:

RTS, CTS, DSR, CD, TD, RD, TC, RC, EG, LG, DTR.

These signals shall be activated in such a way as to ensure that a full duplex link is permanently established between the RSW and X.25 network.

5.3.2. Connection phase

The X.25 network shall set DSR to the closed position.

The RSW shall set the DTR signal to the closed position.

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5.3.3. Data Transfer phase

At initialisation:

- the subscriber modem shall set the CD signal to the closed position and shall permanently supply the TC and RC clocks;

- the RSW shall keep the RTS signal set at the closed position, which makes the subscriber modem set the CTS to the closed position.

As long as the CD remains in the closed position and the TC time base is active, the RSW can send data on the TD circuit. The RSW does not manage the CTS signal in order to transmit.

As long as the CD remains in the closed position and the RC time base is active, the RSW can receive on the RD circuit.

5.3.4. Disconnection phase

Opening the CD for more than one second shall disconnect the link.

6. Data Link level

6.1. Presentation

The X.25 network-RSW data link level shall conform to the LAP-B procedure specified in ITU-T Recommendation X.25 (1984) [1].

6.2. Use of the X.25 standard by the RSW

The RSW operates as DTE.

The X.25 network operates as DCE.

The base mode is LAP-B modulo 8.

Table 2: X.25 parameters

Parameters	Value	Description
T1	[1600 ms]	Timer between 2 retransmissions
T2	not processed	Timer between reception and acknowledgement
T3	not processed	Timer for inactivity reporting; Level 2 towards Level 3
N2	[10]	Maximum number of attempts
N1	[2104 bits]	Maximum number of bits in an I frame or [263] octets (see note)

This length makes it possible to transmit 256 user octets, plus the packet header (3 octets), the address field, the command field and the FCS (2 octets) of level 2.

When the frame is longer than the maximum allowed, the RSW ignores it.

Maximum number k of I frames outstanding: = [7]

Multilink procedure: not used (only one physical medium).

Minimum number of flags between frames: ITU-T Recommendation X.25 (1984) [1] (not configurable)

If two frames are separated by a single flag, the RSW can, in some cases, consider the second frame to be invalid.

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Case of the N1 parameter: the maximum number of bits in a frame is directly determined by the length of the data packets chosen.

6.3. Initialisation of the LAP-B Link

To initialise the link, the RSW shall send a command to call up the Set Asynchronous Balanced Mode (SABM) with bit P set to 1.

The X.25 network shall respond an Unnumbered Acknowledge (UA), with the corresponding F bit (bit F equals bit P).

The RSW and the X.25 network can then exchange Information frames (I).

6.4. Distinctive features of the Link level

For the RSW:

- transmission of Receive Ready (RR) commands (bit p=1) and RR responses;
- no Receive Not Ready (RNR) frame transmission (dimensioning buffers in transmission, but processing on reception);
- in DTE mode no Frame Reject (FRMR) transmission;
- in reception, FRMR is processed but its information field is ignored;
- the Disconnect (DISC) frame can be sent;

- level 1 filters incomplete frames, level 2 does not send RR frames.

7. Network level

The network level shall supply a Switched Virtual Circuit (SVC) service which shall conform to CCITT Recommendation X.25 (1984) [1].

7.1. Network level options

The RSW operates as DTE.

The X.25 network operates as DCE for all types of communication.

Maximum packet size: 256 octets.

No negotiation of packet size.

Packet numbering is done with modulo 8.

DCE timers are specified in ITU-T Recommendation X.25 (1984) [1], Annex D.

DTE timers defined in ITU-T Recommendation X.25 (1984) [1], Annex D shall be set to:

T 20 = [60] s

T 21 = [180] s

T 22 = [60] s

T 23 = [60] s

The anticipation window is 3.

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All virtual circuits shall be switched (SVC) and bidirectional.

Logical channel 0: Not used

The RSW forbids the use of expedited data.

Bit D (delivery confirmation bit): forbidden

Bit Q (data qualifier bit, priority): forbidden

Occurrence of bits D or Q in packets of call data or data received by the RSW prompts the RSW to release the virtual circuit.

Bit M (More Data Bit):

Bit M is used for reassembling packets in a single NSDU, within the maximum NSDU size limit of 4 Ko.

7.2. Network level options

In accordance with the CCITT Recommendation X.25 (1984) [1], level 3 may not transmit some protocol elements, but shall however be capable of receiving them. This is the case of the Receive Not Ready (RNR), Reject (REJ) and Diagnosis (DIAG) packets:

- the RSW ignores Diagnosis packets;
- the RSW can send a reinitialisation packet if it is transmitting or a release packet in other cases when it receives a REJ packet;
- the RSW blocks the virtual circuit on reception of an RNR, as described in ITU-T Recommendation X.25 (1984) [1].

Only SVC type virtual circuits are bidirectionally switched. There are no permanent virtual circuits.

Among standard X.25 additional services, two are taken into account:

- fast select without restriction (FS);
- closed user groups (CUG).

Only the closed user group service as specified in X.25 shall be implemented.

The RSW belong to two CUGs:

- the System internal private group, reference 1 (reserved for communications between System subscribers);
- the System external private group, reference 0 (reserved for communications between RSW and X.400 MTA).

The basic format is chosen.

Conforming to ITU-T Recommendation X.25 (1984) [1], the CUG references are local to the RSW. They shall be the same in every RSW.

The length of the parameter field of additional services depends on the nature of the application:

- Closed User Group (CUG) service;
- Fast Select (FS) service for Internal Signalling (ISS) services in the System.

Channels for outgoing calls are chosen in ascending order by X.25 network and in descending order by the RSW.

7.3. X.25 network addressing plan

Defined in ITU-T Recommendation X.25 (1984) [1].

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7.4. User call data

User call data shall be conveyed without modification by the X.25 network, between the calling party and the called party.

The System divides this field into two parts: PI and ISS.

7.4.1. Description of PI

PI identifies the higher level protocol. It corresponds to the TPDU-PI (Protocol Identifier) described in ITU-T Recommendation X.224 [6], Annex B.

PI is encoded in the first four octets of the user call data.

In the RSW, the OSI transport entity which uses X.25 services is identified by the values designated in the standard, i.e.: 03 01 01 00 for the four PI octets.

7.4.2. Description of ISS

ISS (Internal System Signalling) contains system internal signalling data when Fast Select (FS) has been requested by Additional Services;

ISS maximum size is limited to 124 octets.

For messaging exchanges between RSW and EDT, between RSW and KMC or between RSW and X.400 MTA, only the PI field is present in the call data.

For exchanges from RSW to RSW or from RSW to DC, call data can contain both PI and ISS fields.

8.3 RSW use of virtual circuits

The RSW manages several types of virtual circuits.

VC1: A switched virtual circuit shall be permanently established between an RSW and the EDT on the Base Network. This virtual circuit is used by the messaging services.

VC2: A switched virtual circuit shall be established on request between an RSW and another RSW each time System internal signalling or X400 messages are to be exchanged. A virtual circuit release timer makes it possible to re-use the same virtual circuit a few seconds later for other exchanges. This is outside the scope of TETRAPOL.

VC3: A switched virtual circuit shall be established on request between an RSW and an X.400 MTA server, for the transfer of X400 messages.

VC4: A switched virtual circuit shall be permanently established between an RSW and its OMC (Operation and Maintenance Centre). This virtual circuit is used to transmit Base Network operating information. This is outside the scope of TETRAPOL.

VC5: A switched virtual circuit shall be established on request between each RSW and the KMC.

VC6: A switched virtual circuit shall be permanently established between an RSW and DC.

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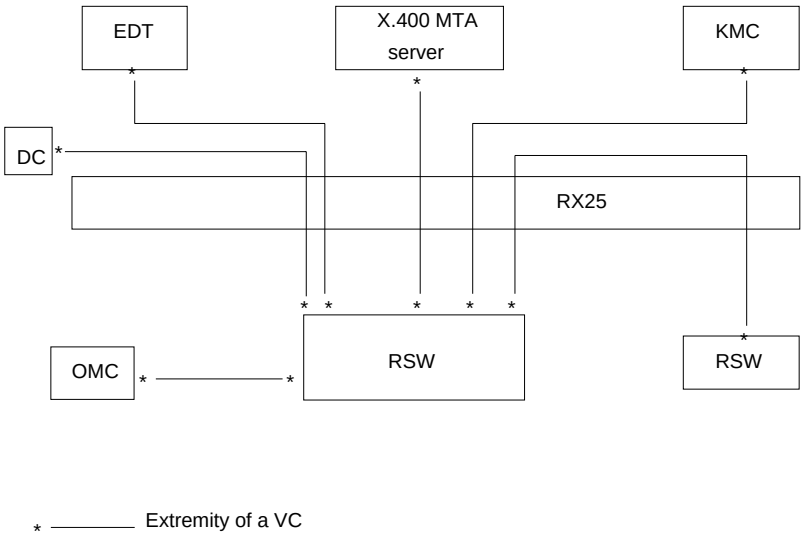

Figure 4: X.25 network connections

Table 3: Summary table of virtual circuits

Type of virtual circuit	Extremity Origin.	Extremity recipient.	User Application	Number of VC required	
VC1	RSW	EDT	Messaging	SVC permanently established	1
VC2	RSW	RSW	Signalling	equal number of RSWs in simultaneous dialogue with the local RSW	N
VC3	RSW	X.400 MTA	X.400 Messaging	equal number of X.400 MTA servers in simultaneous dialogue with the local RSW	(1)
VC4	RSW	OMC	Operation	SVC permanently established	1
VC5	RSW	KMC	Encryption	SVC established on request	1
VC6	RSW	DC	Operation and signalling	SVC permanently established	1

Table 4: Summary of frames sent and received

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Frame	Abbreviation	C = Command R = Response	RSW O	 R
Set Asynchronous Balance Mode	SABM	C	Y	N
Unnumbered Acknowledge	UA	R	N	Y
Disconnect	DISC	C	N	Y
Disconnected Mode	DM	R	N	Y
Information	I	C	Y	Y
Receive Ready	RR	R	Y	Y
Receive not Ready	RNR	R	N	Y
Reject	REJ	R	Y	Y
Receive Ready	RR	C	Y	Y
Receive not Ready	RNR	C	N	Y
Reject	REJ	C	N	Y
Frame Reject	FRMR	R	N	Y

Table 5: Summary of packets sent and received

Packets		Abbreviation	RSW	
X.25 network → RSW	**RSW → X.25 network MSW**		**O**	**R**
Incoming call	Call	call	Y	Y
Communication established	Communication accepted	cf-call	Y	Y
Release indication	Release request	rel	Y	Y
Release confirmation	Release confirmation	cf-rel	Y	Y
Data	Data	data	Y	Y
Interruption	Interruption	IT	N	N (1)
Interruption confirmation	Interruption confirmation	Cf-IT	N	N (1)
Receive ready	Receive ready	RR	Y	Y
Receive not ready	Receive not ready	RNR	N	Y
	Reject	REJ	N	N (2)
Reinitialisation indication	Reinitialisation request	reini	Y	Y
Reinitialisation confirmation	Reinitialisation confirmation	cf-reini	Y	Y
Resume indication	Resume request	resume	Y	Y
Resume confirmation	Resume confirmation	cf-resume	Y	Y
Diagnosis		diag	N	N (3)

NOTE 1: the switch starts reinitialisation

NOTE 2: prompts service user release

NOTE 3: unknown

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Annex A (Normative): Format of the call packet sent and received by the RSW

The switch attached to the originator RSW node shall complete the calling address in the call packet transmitted by the originator RSW (the RSW sends to the X.25 network switch the calling sub-address and the address called).

The switch attached to the receiver RSW node shall suppress the address called in the incoming call packet transmitted to the RSW (the X.25 network switch shall transmit to the RSW the sub-address called and the calling address).

A.1. RSW → X.25 network subscriber

Calling party: RSW

Called party: EDT or X.400 MTA

0 0 0 1	Number of Logical Channel	
0 0 0 0	1 0 1 1	call packet
Y Y Y Y	X X X X	address length (calling = Y; called = X)
called address (X.25 network address)		
calling sub-address (X.25-RSW subaddress)		
0 0 0 0	0 0 1 0	Additional service length (note 1)
0 0 0 1	0 0 1 1	CUG: basic format (optional)
0 0 0 0	Z	CUG value (note 2)
0 0 0 0	0 0 1 1	PI = OSI
0 0 0 0	0 0 0 1	
0 0 00	0 0 0 1	
0 0 0 0	0 0 0 0	

NOTE 1: Length is equal to 2 if CUG service is selected and 0 if not.

NOTE 2: CUG is optional, z is the CUG value.

Figure A.1: Call packet sent by RSW to X.25 network subscriber

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A.2 X.25 network subscriber → RSW

Calling party: X.400 MTA server or KMC

Called party: RSW

0 0 0 1	Number of Logical Channel	
0 0 0 0	1 0 1 1	call packet
Y Y Y Y	X X X X	address length (calling = Y; called = X)
called address (X.25-RSW address)		
calling sub-address (X.25 network sub-address)		
0 0 0 0	0 0 1 0	Additional service length (note 1)
0 0 0 0	0 0 1 1	CUG: basic format (optional)
0 0 0 0	Z	CUG value (note 2)
0 0 0 0	0 0 1 1	PI = OSI
0 0 0 0	0 0 0 1	
0 0 00	0 0 0 1	
0 0 0 0	0 0 0 0	

NOTE 1: Length is equal to 2 if CUG service is selected and 0 if not.

NOTE 2: CUG is optional, z is the CUG value.

Figure A.2: Call packet received by RSW to X.25 network subscriber

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A.3 RSW → RSW

Call packet sent by an RSW:

Calling party: RSW1

Called party: RSW2

0 0 0 1	Number of Logical Channel	
0 0 0 0	1 0 1 1	call packet
Y Y Y Y	X X X X	address length (calling = Y; called = X)
called address (X.25-RSW2 address)		
calling sub-address (X.25-RSW1 sub-address)		
0 0 0 0	0 1 0 0	Additional service length (note 1)
0 0 0 0	0 0 0 1	FS: Fast Select (optional)
1 0 0 0	0 0 0 0	
0 0 0 0	0 0 1 1	CUG: basic format (optional)
0 0 0 0	Z	CUG: value (note 2)
0 0 00	0 0 1 1	PI = OSI
0 0 0 0	0 0 0 1	
0 0 0 0	0 0 0 1	
0 0 0 0	0 0 0 0	
		ISS: Internal Signalling (optional)

NOTE 1: Length depends on the requested services.

NOTE 2: CUG is optional, z is the CUG value.

Figure A.3: Call packet sent by RSW to RSW

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History

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