Recommendation X.352

INTERWORKING BETWEEN PACKET SWITCHED PUBLIC DATA NETWORKS

AND PUBLIC MARITIME MOBILE SATELLITE

DATA TRANSMISSION SYSTEMS

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

(a) that the Maritime Satellite is now being operated by the International Maritime Satellite Organization (INMARSAT);

(b) that interworking between the Maritime Satellite Service and public data networks is required;

(c) that Recommendation X.350 specifies general interworking requirements for data transmission in Public Mobile Satellite Systems and Recommendation X.353 outlines the routing principles for interconnecting Public Mobile Satellite Systems with public data networks;

(d) that Recommendation X.25 specifies the interface between data terminals and data circuit-terminating equipment for terminals operating in the packet mode on public data networks, and that Recommendation X.75 specifies detailed procedures applicable to call control between public networks providing data transmission services;

(e) that the physical link between a mobile earth station and a data switching exchange (DSE) will only exist on a temporary basis, i.e. so long as a virtual call exists between the ship and the DSE;

(f) that Recommendation X.141 provides guidance with respect to general principles for the detection and correction of errors in public data networks,

unanimously recommends

that the following interworking principles and interface conditions should apply for operations at the network layer in the packet mode between a mobile DTE and a public data network.

1 Definitions

For definitions of terms used in relation with data transmission in public mobile satellite systems, see Recommendation X.350.

For the purpose of this Recommendation the **mobile satellite data switching exchange (MSDSE)** is defined as the functional interface between the public mobile satellite data transmission system and a packet switched public data network.

The MSDSE provides the following functions:

- interworking between the signalling systems used in the public mobile satellite data transmission system and the PSPDN;
- routing and call control for calls to and from mobile earth stations;
- charging.

The composition of the public maritime mobile satellite data transmission system for interconnection with a packet switched PDN is shown in Figure 1/X.352.

The Packet Switched Data Access Unit (PSDAU) provides a means of interconnecting a mobile DTE with the terrestrial packet switched public data network, through a mobile earth station and coast earth station equipped with packet switched data facility.

Figure 1/X.352 - T0702170-87

Figure 2/X.352 - T0702261-88

2 Interface conditions

The following interfaces need to be specified for interworking and call control purposes:

- the interface between the mobile DTE and the PSDAU (mobile local circuit);
- the interface between the PSDAU and the mobile earth station (mobile local circuit);
- the interface between the mobile earth station and the coast earth station including the interface to the network coordination station (mobile satellite circuit);
- the interface between the coast earth station and the MSDSE (mobile terrestrial circuit);
- the interface between the MSDSE and a packet switched PDN.

The interfaces are shown for layers 1, 2 and 3 in Figure 2/X.352.

2.1 Interface between the mobile DTE and the Packet Switched *Data Access Unit (PSDAU)*

2.1.1 Layer 1 (physical layer) between the mobile DTE and the PSDAU may be realised by the use of the interfaces defined in:

- Recommendation X.21;
- Recommendation X.21 *bis*;
- Recommendation V.24 and V.25.

The Recommendation X.21 interface should be included in new PSDAU designs. The Recommendation X.21 *bis* interface (or the Recommendation V.24 interface) may be used for existing designs.

The basic requirements of the layer 1 interface are:

i) For calls originating in the mobile DTE the interface should provide for the following functions:

- it should enable the DTE to provide the mobile earth station with the address of the coast earth station through which the call is to be established, and the access-request code of the packet switched data service.

Note 1 - The address of the call DTE is provided as part of the level 3 procedure.

Note 2 - The PSDAU should provide an indication of call progress

a) visually, for use by an operator; and/or

b) as call progress signals to the DTE when the attempt to establish the mobile satellite circuit fails. The *call progress* signals to be used are given in ¤ 6.1. Such call progress signals to the DTE may not be possible always, e.g. when the DTE interfaces the PSDAU in accordance with Recommendation V.24.

ii) For calls originating in a PDN the interface should allow for automatic connection of the mobile DTE to the circuit.

Interchange circuits shall be provided in order to meet these requirements. The required interchange circuits are defined in the Recommendations applicable to the interface used. The control of these interchange circuits shall be such as to ensure proper establishment and clearing of the mobile satellite circuit. It should also be observed that since mobile satellite circuit is established on a call by call basis, it must be ensured that the mobile DTE acquires synchronism to the element timing of the PDN before the full procedure on layer 2 is established. Until synchronism is obtained the DTE should send contiguous 1s.

See also Recommendation X.32.

2.1.2 Layer 2 should be in accordance with ¤ 2 of Recommendation X.25. The extended control field (modulo 128) may be used if required.

Note - For reasons given in Recommendation X.141 it may be advantageous to use the selective reject (SREJ) command.

The mobile DTE should start sending the flag sequence as soon as synchronism with the MSDSE has been established.

2.1.3 Layer 3 should be in accordance with ¤¤ 3 through 7 of Recommendation X.25.

Default values for network layer parameters such as number of virtual connections, use of extended packet sequence numbering, window size, packet size and throughput may be defined by the service provider.

Composition of the address field of the *call request* packet is given in ¤ 4 of this Recommendation.

2.2 Interface between the PSDAU and the mobile earth *station*

This interface is to be defined under the responsibility of the service provider.

2.3 *Interface between the mobile earth station (mobile satellite circuit)*

The set-up and clearing procedures for the maritime satellite circuit are to be defined by the service provider in accordance with the interworking procedures defined in ¤¤ 2.1 and 2.4.

The mobile earth station and the coast earth station must be transparent for layers 2 and 3 of Recommendation X.25.

Note - Forward error correction may be employed on the mobile satellite circuit in order to improve the bit error performance. See Recommendation X.141.

2.4 *Interface between the coast earth station and the MSDSE (mobile terrestrial circuit)*

The mobile terrestrial circuit must be transparent for layers 2 and 3 of Recommendation X.25.

Interworking between the coast earth station and the international circuit interconnecting the MSDSE with a PDN should take place as follows:

i) For mobile originated calls the coast earth station should provide the MSDE with the INMARSAT mobile number (see Recommendation E.215/F.125) of the calling mobile earth station for insertion in the calling DTE address field of the *call request* packet. This information will be provided to the coast earth station as part of the signalling procedure for setting up the mobile satellite circuit and will be available before layer 3 has been established between the mobile DTE and the MSDSE.

Note - If it is impractical to implement this procedure, the INMARSAT mobile number could be obtained from the calling DTE address in the *call request* packet.

The coast earth station must also give an indication to the MSDSE that the set-up of the mobile satellite circuit has been completed so that layers 2 and 3 of the protocol can be established.

ii) For incoming calls from a PDN the MSDSE must transfer the INMARSAT mobile number contained in the *call request* packet to the coast earth station in order to set up the mobile satellite circuit. When the mobile satellite circuit has been set up, the coast earth station must provide the MSDSE with a signal indicating that setting up of layers 2 and 3 may commence.

In the event of unsuccessful call set-up of the mobile satellite circuit, the coast earth station must indicate to the MSDSE the reason for call set-up failure so that the MSDSE may return the appropriate call progress signal (and diagnostic code) in the *clear request* packet. The call progress signals to be used are given in ¤ 6.2.

iii) The MSDSE should start sending the flag sequence as soon as the coast earth station has indicated that the mobile satellite circuit has been established and through-connected by the coast earth station.

If the flag sequence has not been received from the mobile DTE within a given time-out period of 6 seconds, the MSDSE should initiate clearing of the satellite circuit.

In order to ensure full call control by the MSDSE also for mobile originated calls, the MSDSE may initialize layer 2 by sending the SABM command as soon as the flag sequence has been detected.

iv) If the mobile satellite circuit is interrupted (see ¤ 7.2) or abnormally cleared (e.g. priority over-ride), an indication should be given to the MSDSE so that the terrestrial part of the virtual circuit may be cleared with an appropriate *call progress* signal.

The MSDSE must be capable at any time to receive an indication from the coast earth station that the satellite circuit has been cleared or interrupted.

v) the MSDSE must also be capable of indicating to the coast earth station that the mobile satellite circuit can be released.

2.5 *Interface between the MSDSE and a packet switched PDN*

This interface should correspond to Recommendation X.75.

3 Detailed call set-up and clearing procedures

Examples of call set-up and clearing procedures and interworking between various system elements are given in Annex A.

4 Composition of the call request packet at the mobile DTE

4.1 The general format of the *call request* packet shall be as defined in Recommendation X.25.

4.2 The called DTE address shall be composed as follows for calls to subscribers of a PDN:

- prefix 0;
- the international data number of the called DTE in accordance with Recommendation X.121.

4.3 The calling DTE address composed as defined in Recommendation X.350 should always be inserted in the *call request* packet.

4.4 For the maritime mobile service, the calling DTE address to be inserted by the MSDSE in the call request packet should be composed of the DNIC (111S) associated with the ocean area in which the ship is located and the relevant T digit followed by the INMARSAT mobile number and, if present, the optional digit specifying a specific mobile DTE.

4.5 Some MSDSEs may offer access to special terminations using abbreviated addresses. The called DTE address shall in such cases consist only of the abbreviated address (see Recommendation X.350). All such abbreviated addresses will have a first digit different from 0 in order to distinguish them from calls to an international data number. If the required termination is in a PDN the MSDSE must perform all necessary digit conversion to the international data number associated with the required termination before the call can be forwarded into a PDN.

5 Clearing of the mobile satellite circuit

If more than one virtual call exists, the MSDSE must not initiate clearing of the mobile satellite circuit when detecting a clearing condition for one of the virtual calls.

If only one virtual call exists when a clear packet is received from either of the parties, the MSDSE shall start clearing of the HDLC LAPB link as follows:

i) If the clearing was initiated by the PDN, clearing of the HDLC LAPB link should commence when either of the following conditions has been met:

- a *DTE clear confirmation* or a *clear request* packet has been received from the mobile DTE;
- timer T13 (Annex D to Recommendation X.25) has expired.

Note 1 - Before clearing of the HDLC link the MSDSE may issue a clear indication packet with diagnostic code No. 50 (timer expired for clear indication).

Note 2 - It is desirable to have a smaller value than 60 seconds on timer T13 for mobile satellite applications in order to reduce the traffic load on the satellite circuits. The minimum value is for further study.

ii) If the clearing was initiated by the mobile DTE, the MSDSE should forward the *clear request* packet into PDN and immediately return a *DCE clear confirmation* packet to the mobile DTE without awaiting the return of any *clear confirmation* packet from the PDN. As soon as the *clear confirmation* packet has been sent to the mobile DTE clearing of the HDLC link should commence.

Note - In order to allow the DTE to place a new call immediately after clearing of the last existing virtual call, the clearing of the HDLC link may be delayed by a short time-out period. If the clearing was initiated from the PDN, the timer should be started when the *DTE clear confirmation* packet is received from the mobile DTE. If the clearing was initiated by the mobile DTE, the timer should be started when the *DCE clear confirmation* packet is sent to the mobile DTE. If a new *call request* packet is received from either of the parties during this time-out period, the satellite circuit should not be cleared. The time-out should be short in order to avoid undue holding of the satellite circuit in those cases where no further calling is intended.

An indication that the physical link may be cleared should be provided to the coast earth station as soon as the MSDSE has entered the disconnected phase. The actual clearing of the mobile satellite circuit would then be undertaken by the coast earth station.

Note - With the above procedures clearing of layers 1 and 2 is always initiated by the MSDSE and interworking between different layers would not be required in the mobile DTE. The procedures for handling clearing failures associated with the mobile satellite circuit are to be defined by the service provider.

6 Relationship between call progress signals, diagnostic codes and unsuccessful call events of the mobile satellite circuit

6.1 *Ship originated calls*

When consistent with the layer 1 capabilities of the interface to the PSDAU, the PSDAU should provide *call progress* signals to the mobile DTE in accordance with Table 1/X.352.

TABLE 1/X.352

Call progress signals to be provided by the mobile earth station to the mobile DTE

Event (see Note)	Call progress signal (Recommendation X.96)
Out of order (e.g. continuity check fails)	Out of order
Congestion	Network congestion
Request not acceptable	Access barred
No response to the request message	Network congestion

Note - Some of these events are detected by the mobile earth station and some are signalled from the coast earth station (or the network coordination station).

6.2 *Incoming call from a PDN*

The coast earth station should indicate to the MSDSE the reasons for unsucessful call set-up of the mobile satellite circuit. The *call progress* signal and diagnostic code to be returned by the MSDSE to the PDN is given in Table 2/X.352.

For coding of the clearing cause field see Recommendation X.25.

7 Satellite circuit interruption supervision

7.1 *General*

The satellite circuit may be interrupted due to several causes, e.g. antenna blockage at the mobile earth station, the mobile earth station is no longer within satellite coverage, the mobile earth station is faulty. The interruption condition is to be defined by the service provider.

Interruption supervision should be undertaken both by the mobile earth station and by the coast earth station (or by the MSDSE). The interruption supervision should be associated with each physical link.

TABLE 2/X.352

Satellite system event to be indicated by the coast earth station to the MSDSE and associated clearing cause and diagnostic code

Satellite system event	Clearing cause (*call progress* signal, Recommendation X.96)	Diagnostic code
Mobile station busy	Number busy	No additional information (No. 0)
Out of order (e.g. continuity check failure)	Out of order	No additional information (No. 0)
No response from the mobile station	Ship absent	No additional information (No. 0)
No DTE at the mobile station	Incompatible destination	No additional information (No. 0)
Non-existing number	Not obtainable	Invalid called address (No. 67)
Insufficient number of digits	Not obtainable	Invalid called address (No. 67)
Wrong format of called number	Not obtainable	Invalid called address (No. 67)
Access barred	Access barred	No additional information (No. 0)
Network congestion	Network congestion	No additional information (No. 0)
Congestion at coast earth station	Network congestion	No additional information (No. 0)
Priority override (see Note)	Network congestion	No additional information (No. 0)
Satellite system outage	Network congestion	No additional information (No. 0)
Coast earth station outage	Network congestion	No additional information (No. 0)

Note - Priority override indicates that the particular mobile satellite circuit has been cleared in order to service a call with distress priority.

7.2 *Actions to be taken by the MSDSE*

Upon detecting an interruption of the mobile satellite circuit the MSDSE shall send *clear request* packets on each virtual circuit affected with the clearing cause Ònetwork congestionÓ to the PDN. The *clear indication* packet should be sent to the mobile DTE in order to facilitate clearing if the interruption only exits in one direction of transmission. However, the MSDSE should not wait for a *DTE clearing confirmation* packet from the mobile DTE.

Since the MSDSE has no means of further monitoring of the mobile earth station (and the interruption condition), a subsequent call to that mobile DTE should be handled in the normal way. If the mobile earth station does not respond to the call, the clearing cause indication should be Òship absentÓ (see Table 2/X.352).

Note - Because of the reasons given above, the restart procedure of Recommendation X.25 does not apply.

7.3 *Actions to be taken by the mobile DTE*

For further study.

ANNEX A

(to Recommendation X.352)

Call set-up and clearing procedures

for telephone type channels

A.1 *Introduction*

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This annex describes possible procedures for call set-up and clearing of layers 1, 2 and 3 between a mobile DTE operating in the packet mode and an MSDSE using telephone type channels between the PSDAU and the coast earth station. Definition of procedures for this case is important becuase then packet switched data transmission may be offered with existing mobile earth station designs with only the addition of a PSDAU.

Since the physical link (layer 1) is subdivided into three parts (see Figure 1/X.352), information equivalent to that on the C and I leads (or the corresponding leads of the interface defined in Recommendation X.21 *bis*) needs to be provided also on the mobile satellite circuit so that the coast earth station can fully control the establishment and clearing of that circuit. This can be done in the INMARSAT standard-A system by using the inband continuity signals and clearing signals specified for telephony (both are single frequency tones with frequency 2600 Hz).

Even though the procedures defined below are based on telephone signalling, similar procedures would apply for data transmission on dedicated data channels (or combined digit channels for speech and data). The C and I lead information could then be provided as status bit multiplexed together with the digital data on the T and R circuits (see also Recommendation X.51). Continuity of the maritime satellite circuit could then be established before layer 1 is extended to the DTE and the MSDSE. Moreover, clearing of layer 1 can be done independently of the higher layers, enabling the coast earth station and the ship earth station to fully control establishment and clearing of the maritime satellite circuit.

A.2 Mobile originated call in the INMARSAT Standard A

Figure A-1/X.352 shows the full call set-up and clearing procedures for all layers of the call control and data transfer protocol between the MSDSE and a mobile DTE for a mobile DTE originated call in the INMARSAT Standard-A system.

The following signals are exchanged between the coast earth station, the mobile earth station and the network coordination station using the common channel signalling system defined by INMARSAT:

- *request message* (sent by the mobile earth station to the called coast earth station);
- *request for assignment* (sent by the called coast earth station to the network coordination station);
- *assignment message* (sent by the network coordination station to both the mobile earth station and the coast earth station for indicating the mobile satellite circuit on which the call is to be established).

Note - The coast earth station and the network coordination station may send other messages in order to indicate unsuccessful call set-up e.g. access barred, congestion).

In order to verify the mobile satellite circuit, the coast earth station initiates a continuity check of the assigned circuit. The mobile terrestrial circuit should not be set up before the continuity test has been completed. If the continuity test fails, the circuit will be cleared by the coast earth station.

For the procedure between the coast earth station and the MSDSE only those signals required for transfer of interworking information are shown.

A.3 *Incoming call from a PDN to a Mobile earth station in INMARSAT standard-A*

Figure A-2/X.352 shows the call set-up and clearing procedures for an incoming call from a PDN.

Figure A-1/X.352 - T0702180-87

The address (i.e. the call mobile earth station number) as contained in the *call request* packet is transferred to coast earth station. The maritime satellite circuit is established by the method defined in the INMARSAT standard-asyth similar to those of ¤ A.2. At the mobile earth station the continuity signal is turned off when the on-hook signal is returned by the PSDAU so that the *call connected* state can be signalled to the MSDSE.

The *call connected* packet is returned to the PDN when the *call accepted* packet is received from the mobile DTE.

An unsuccessful call may be detected by the coast earth station at several stages during call set-up:

- from indications given by the network coordination station (e.g. mobile station busy, congestion);

- failure to establish continuity of the mobile satellite circuit (e.g. no response from the ship).

The coast station should in such cases provide an appropriate indication to the MSDSE so that a *clear request* packet may be returned to the PDN.

Figure A-2/X.352 - T0702190-87