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SERIES E: OVERALL NETWORK OPERATION,
TELEPHONE SERVICE, SERVICE OPERATION AND
HUMAN FACTORS

Operation of the international service

Description of INMARSAT existing and planned systems

ITU-T E.300-series Recommendations – Supplement 7

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Supplement 7 to ITU-T E.300-series Recommendations

Description of INMARSAT existing and planned systems

Summary

This supplement gives the highlights of the INMARSAT Standard A, B and C maritime communications systems and of the INMARSAT aeronautical satellite communications (initial) system.

Source

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FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Description of INMARSAT existing and planned systems

1 Standard A system

The INMARSAT Standard A communications system has enabled INMARSAT to provide maritime communications following the organization's inception in February 1982. The primary function of the Standard A system is to provide telephone, telex and some data services together with distress and safety-related traffic.

1.1 The Standard A system consists of the following major elements in an ocean region:

- a) the network coordination (NCS);
- b) coast earth station (CES);
- c) ship earth station (SES); and
- d) the space segment.

1.1.1 Three network coordination stations are provided in the Standard A system, one in each ocean region, managing central resources such as allocating traffic channels on a demand assigned basis and coordinating signalling and control traffic.

1.1.2 Each coast earth station serves as a gateway to and from the terrestrial network to ship earth stations within the coverage area of the satellite. The types of terrestrial network interfaces at a coast earth station are provided at the discretion of the coast earth station operator.

1.1.3 The ship earth station interfaces the CES via the space segment at L-Band, and consists of two portions: above-deck equipment and below-deck equipment. The above-deck equipment consists of an antenna with stabilization and automatic steering equipment enabling the antenna beam to remain pointed at a satellite, regardless of course and ship movements. The below-deck equipment consists of an antenna control unit, communications electronics used for transmission, reception, access control and signalling, and telephone and teleprinter equipment. Optional equipment for low-speed data, high-speed data, facsimile, etc., can be installed with the below-deck equipment. Before joining the Network, SESs have to successfully complete the prescribed commissioning tests.

1.1.4 The space segment consists of three operational satellites, one in each ocean region, together with three spare satellites provided on a 1-for-1 basis. The operational satellites are in a geostationary orbit and provide global coverage up to 75° latitude.

1.2 The satellite channels needed to establish communication services and associated signalling in the Standard A system are described below:

1.2.1 *Common TDM carrier*

The common TDM carrier (or common signalling channel) is transmitted by the NCS and is received by all CESs and SESs in the respective ocean region for the reception of signalling messages from the NCS.

1.2.2 *Coast earth station TDM carrier*

Each coast earth station transmits a TDM carrier at a frequency which is uniquely associated with the station. The TDM carrier carries signalling messages to the NCS and telegraph channels to ship earth stations. Twenty-two 50-baud telex channels and an out-of-band signalling channel are time-division multiplexed on the TDM carrier in the shore-to-ship link.

1.2.3 *Ship earth station TDMA channel*

There is a ship-to-shore TDMA channel, paired to the CES TDM carrier, for the corresponding ship-to-shore twenty-two 50-baud channels. SESs transmit their telex channels in bursts in this channel, with burst timing derived from the "unique word" in the CES TDM carrier.

1.2.4 *Request channels*

Request messages are transmitted by ship earth stations as random access bursts. Each coast earth station monitors the two ship-to-shore channels and processes only those call requests addressed to it.

1.2.5 *FM/SCPC channels*

Frequency modulated single channel per carrier channels are used for the transmission of voice, data and analog and digital facsimile. Telephone channels are assigned on demand by the network coordination station.

1.2.6 *High Speed Data (HSD) channels*

High-speed 56 kbit/s data transmission is also possible, but in the ship-to-shore direction only, from specially equipped SESs to specially equipped CESs.

1.3 The following services are provided by each CES:

- a) telephone calls on a ship-to-shore, shore-to-ship and ship-to-ship basis; the channels may be used for facsimile or data at the user's discretion;
- b) telex calls on a ship-to-shore, shore-to-ship and ship-to-ship basis;
- c) optional services which may be provided at the discretion of the respective CES operator:
 - i) group calls, i.e., calls to groups of SESs, using only a shore-to-ship channel (telephony or telegraphy). The SESs in the group may be selected on the basis of:
 - national identity,
 - fleet,
 - ocean area,
 - similar interest;
 - ii) high-speed data 56 kbit/s ship-to-shore direction only.

2 **Standard B system**

2.1 The Standard B system has been designed to provide more efficient utilisation of satellite power and bandwidth resources for INMARSAT's mainstream services (telephone and telex), to provide digital data services, and to provide the capability of fulfilling future maritime ISDN service requirements.

2.2 The Standard B system consists of the following major elements in an ocean region, in addition to the satellites:

- a) the network coordination station (NCS);
- b) coast earth stations (CESs); and
- c) ship earth stations (SESs).

2.2.1 Three network coordination stations are provided in the Standard B system, one in each region, managing central resources such as SCPC traffic channels when demand assigned operation is used, and coordinating signalling and control traffic.

2.2.2 Each coast earth station provides the interface between the terrestrial network and the mobile ship earth stations within the coverage area of the satellite. Coast earth stations operate at C-band (although an L-band capability is also required for NCS signalling purposes). The terrestrial network interfaces provided at CESs are at the discretion of each CES operator.

2.2.3 The mobile ship earth station interfaces with the CES via the space segment at L-band; multi-channel ship earth stations are planned as an addition to the baseline system.

2.3 SESs wishing to operate in a particular ocean region do not have to register with a particular CES on a log-on/log-off basis once they have met the requirements of the commissioning tests. All relevant SES and service information is provided to the CES during initialisation signalling procedures.

2.4 The satellite channels used for communication services and signalling in the Standard B system are described below:

2.4.1 *Voice (V) channels* are single-channel-per-carrier (SCPC) digital channels supporting a voice coding rate of 16 kbit/s with Adaptive Predictive Coding (APC). These channels also support voice band data (including facsimile) up to 2400 kbit/s information rate, and sub-band signalling (for service address and, in the future, ISDN signalling).

2.4.2 The *Data (D) channel* is an SCPC digital channel supporting a data information rate of 9.6 kbit/s. These channels also support Group 3 facsimile and sub-band signalling.

2.4.3 *CES TDM channel* are used to carry CES signalling messages to SESs, including channel assignments, telex (ITA2) and data (IA5 asynchronous) at 300 bit/s information rate.

2.4.4 *NCS TDM channels* are used to carry NCS signalling messages to SESs and CESs including call announcements and channel assignments and Bulletin Board information so that additional or alternate signalling channels can be implemented to meet operational needs.

2.4.5 *SES TDMA channels* are used to carry SES telex (ITA2) or data (IA5) at 300 bit/s information rate.

2.4.6 *SES Request channel (SESREQ)* is a random access (Aloha) channel used to carry SES signalling information, specifically the request signals which initiate a ship-originated call transaction to CESs (including satellite spot-beam identification).

2.4.7 *SES Response channel (SESREP)* provides SES signalling information to CESs, specifically the SES response information required to facilitate a shore-originated call (including satellite spot-beam identification).

2.4.8 *CES/NCS Inter-Station Signalling channel (ISS)* enables signalling information to be exchanged between CESs and NCSs for call and network management purposes.

2.5 The following services are available at each CES:

- a) telephone calls on a ship-to-shore, shore-to-ship and ship-to-ship basis;
- b) telex calls on a ship-to-shore, shore-to-ship and ship-to-ship basis;
- c) broadcast of shore originated telephone or telex calls when addressed with any of the following:
 - the SES's unique mobile ship earth station number,
 - an "all ships" identity,
 - a national identity,
 - a fleet group identity,
 - a general group identity;
- d) voice band data services, including facsimile;
- e) digital data services, including Group 3 facsimile.

2.6 Further services determined in the future for ISDN applications will be added as a feature of this system once they have been clearly defined.

3 Standard C system

3.1 The Standard C communications system has been designed allowing the operation of the smallest ship earth station in the INMARSAT system and thus enabling the smallest vessels to avail themselves with satellite communications. Its primary communications function is text and data transmission to and from ships. It has been designed to interface with the International Telex Network on a store-and-forward basis as well as a range of terrestrial data networks. It is also able to carry an oceanwide broadcast only service known as the Enhanced Call group (EGC).

3.2 The Standard C system consists of the following main elements in an ocean region:

- a) the network coordination station (NCS);
- b) coast earth station (CES); and
- c) ship earth station (SES).

3.2.1 Three network coordination stations are initially provided in the Standard C system, one in each ocean region, managing central resources such as traffic channels and coordinating signalling and control traffic.

3.2.2 Each coast earth station serves as a gateway to and from the terrestrial network to ship earth stations within the coverage area of the satellite. The types of terrestrial network interfaces at a coast earth station are a national matter.

3.2.3 The ship earth station consists of a DTE which provides the user interface and a DCE which provides the interface to the satellite network. In the ship-to-shore direction, a message is formatted in the DTE and then transferred to the DCE for transmission. In the shore-to-ship direction, the DCE receives the complete message from the radio channel before passing it to the DTE. The mobile ship earth station may be equipped for access to marine safety information carried by the enhanced group call service, or a separate receive-only terminal for EGC calls may be used. Using the distress priority message, a ship operator may transmit a ship-to-shore distress alert. Upon receipt of this message, the addressed coast earth station will immediately provide confirmation of the message being received. This distress alert message provides the ability to include the position of the vessel. A ship earth station wishing to operate in a particular ocean region must log in to the NCS in that region.

3.3 The Standard C system consists of 5 main channel types which are described below.

3.3.1 The *NCS common channel* is transmitted continuously by the NCS. All mobile ship earth stations registered as operational in a particular ocean region must tune to this channel when not engaged in message transfer. This channel provides the following functions: message announcements, message confirmations, frequency reference for all ship earth stations and EGC message transmission.

3.3.2 *NCS-CES signalling links* pass information between the NCS and CESs concerning the operational status of the network. This link is used to transfer EGC messages from a CES to the NCS for subsequent transmission on the NCS common channel. It also relays signalling information to ship earth stations and CESs.

3.3.3 *Message channels* are used by SESs to transfer their message traffic to a CES. The message channel is assigned by the CES.

3.3.4 *Signalling channels* are used by SESs to transmit signalling information to a CES. Each CES has one or more of these channels assigned to it.

3.3.5 The *NCS-NCS signalling channel* is an inter-ocean-region data connection between the three NCSs. This link is used for updating SES log-in status.

3.4 The following services are provided on a mandatory basis by each CES:

- a) store-and-forward telex;
- b) Enhanced Group Call message handling and distress message handling.

4 Aeronautical system (Initial system)

4.1 The INMARSAT aeronautical satellite communications system will provide two-way voice and data communications for aircraft operating within the coverage area of a set of geostationary satellites. Since the system capabilities will evolve with time, the initial set of capabilities and functions are designated "Initial system". The additional capabilities and functions which may be added due to traffic demand and technological evolution will form the "Enhanced system".

4.2 The Aeronautical system consists of the following major elements in an ocean region:

- a) the network coordination station (NCS);
- b) the aeronautical ground earth station (GES); and
- c) the mobile aircraft earth station (AES).

4.2.1 Network coordination stations will be provided as part of the “Enhanced system” to manage central resources such as allocating traffic channels on a demand assigned basis. Due to the limited number of GESs involved in the initial aeronautical system the provision of NCS facilities has not been considered necessary.

4.2.2 Aeronautical ground earth stations interface to and from the terrestrial network to mobile aircraft earth stations within the coverage area of a specific satellite. The types of terrestrial network interfaces at the GES are provided at the discretion of the GES operator.

4.2.3 The mobile aircraft earth station (AES) interfaces with the space segment at L-band, and interfaces within the aircraft with the Aircraft Communications Addressing and Report System (ACARS) and other data equipment and with aircraft crew and passenger voice equipment.

4.3 An AES wishing to operate in a particular ocean region must register with a GES in the Initial system. The procedure known as the log-on/log-off of an AES provides the GES with the ability to manage the number of AESs receiving one forward P-Channel (Pd) and transmitting on each R-Channel (Rd), thus controlling the queueing delays and burst collision probabilities. Provision exists in the Initial system for the log-on handover of a particular AES to another GES which may work to a different satellite ocean region. The handover can be initiated on an automatic or manual basis depending on the type of AES and the specific requirements of the aircraft at that time.

4.4 The aeronautical Initial system is configured with the following main channel types:

4.4.1 *P-channel (ground earth station-mobile aircraft earth station)*

The P-channel is a TDM channel which is used to provide system management and medium speed data services in the ground-to-air direction. Once the AES has logged on, it is directed to tune to this P-channel over which both system management information and other data can be passed. In the Initial system, the communication links between GESs in the same ocean area will be by means of P channels.

4.4.2 *R-channels (mobile aircraft earth station-ground earth station)*

The R-channels are a set of random access channels which are used for log-on, system management and some short user messages.

4.4.3 *T-channels (mobile aircraft earth station-ground earth station)*

The T-channel which is a TDMA channel is used to pass longer messages from the aircraft.

4.4.4 *C-channel (ground earth station-mobile aircraft earth station)*

The C-channels are established and cleared by circuit switching signalling procedures, to provide voice traffic capabilities between the GES and AESs. The channel format allocates the bulk of the channel capacity for circuit switched voice or data service, and also provides a low-rate “sub-band” channel for signalling and some data.

4.4.5 *NCS-GES links*

Plans to provide NCSs under the Enhanced system will require the provision of NCS-GES channels which will be based on the P-channels used for inter-GES communications in the Initial system.

4.5 The four main application areas for the Aeronautical system are:

- i) air traffic services;
- ii) aeronautical operations control;
- iii) aeronautical administrative communications;
- iv) aeronautical passenger communications.

The availability of a particular service in a given area will be dependent upon the facilities offered by the respective GESs.

- 4.5.1 Voice services in the Initial system will be primarily in the air-to-ground direction and will enable passengers and air crew to set up telephone calls through GESs which offer the telephony service.
- 4.5.2 For data, connection mode and connectionless mode, open systems interconnection (OSI) network layer services will be provided, based on a connectionless link layer protocol. Circuit mode data service may be provided as an option.
- 4.5.3 Telex service will be available as an option in the aeronautical system.

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