

PUBLIC MOBILE TELEPHONE SERVICE WITH AIRCRAFT

(Question 74/8)

(1986-1990)

1. Introduction

1.1 This report deals with the general principles of a public mobile telephone service to aircraft and, in particular, with operational and technical characteristics which are important for satisfactory operation.

1.2 Public mobile telephone systems considered in this report are defined as aircraft systems for public correspondence which are connected to the international public switched telephone network (PSTN).

1.3 Several systems are in operation or are under consideration by different administrations to provide this service. Terrestrial systems offer some advantages over satellite-based systems. Satellite systems will have greatest application over large bodies of water or land masses that cannot be served by land-based systems. Frequency reuse in a terrestrial system, using cellular-like geometry, can yield far more channels than satellite coverage, even assuming multiple satellite spot beams. In heavily populated areas where a high volume of local aircraft movement requires high channel capacity, terrestrial systems will be the most practical.

1.4 Features of the terrestrial system developed in Japan are presented in Annex I.

1.5 Features of the terrestrial experimental system currently operated in the United States and Canada and as proposed for implementation in Australia are given in Annex II.

1.6 Outline features of the terrestrial system selected for interim use in the United Kingdom, and forming one of the approaches under review by the European Telecommunications Standards Institute (ETSI) for use in Europe, are given in Annex III.

2. General operational considerations for public mobile telephone service with aircraft

2.1 The system should be fully compatible and capable of interfacing with the international public switched telephone network, and simple in operation.

2.2 An adequate number of channels should be provided to meet the foreseeable demand for the service.

2.3 The system should be modular in design, with the capability of meeting single or multiple channel requirements.

2.4 The Quality of Service should be comparable to that of the public switched network (voice and data).

2.5 The system should provide, in so far as possible, uninterrupted coverage throughout the designated service areas with the capability of coordinated operation across national borders.

2.6 A capability to call to and from aircraft is desirable.

2.7 Automatic setting-up and administrative handling of calls to and from the mobile stations should be provided.

2.8 The system must have no adverse influence on the safe operation of the aircraft.

3. System technical characteristics for public mobile telephone service with aircraft

3.1 Frequency band

3.1.1 The WARC MOB-87, under footnote 731B, allocated the frequency bands 1 593 - 1 594 MHz and 1 625.5 - 1 626.5 MHz also to the aeronautical mobile service in Region 1 (except Syria and Tunisia) on a primary basis and in Regions 2 and 3 (and Syria and Tunisia) on a secondary basis. The service is limited to public correspondence with aircraft and is subject to the provisos in footnotes 731A and 731D, that it shall not claim protection from or cause interference to stations of the aeronautical radionavigation and radionavigation services, as applicable, or cause harmful interference to stations of the fixed service operating in the countries listed in footnote 730 (see also Recommendation No. 408 MOB-87).

3.1.2 Although WARC MOB-87 allocated the 1 593 - 1 594 MHz and 1 625.5 - 1 626.5 MHz under certain conditions for terrestrial systems, Recommendation 408 noted that these frequencies would be adequate for pre-operational and experimental systems, and would cause considerable difficulties in some countries. In addition, Recommendation 408 also invited the CCIR to identify technically preferred alternative frequency bands for a future world-wide terrestrial system. Thus, decides 4.6 of Decision 81 directs IWP 8/14 to determine what technically preferred alternative frequency bands could be allocated for such a system.

3.1.3 Recommendation No. 408(MOB-87) also invited the CCIR to study urgently the necessary sharing criteria between terrestrial APC systems operating in the bands 1 593 - 1 594 MHz and 1 625.5 - 1 626.5 MHz and the other services in the same and adjacent frequency bands.

3.1.4 Interference considerations with the Global Positioning System (GPS) are addressed in Report 766, and for the RDSS in Report 1050, Annex II.

3.1.5 The terrestrial systems as referenced under items 1.4 and 1.5, and described in Annexes I and II operate in band 9 in the 800 MHz to 900 MHz frequency range.

3.1.6 The terrestrial system as referenced under item 1.5 and described in Annex III utilizes the frequency band as defined in section 3.1.1.

3.2 Modulation

3.2.1 Various types of modulation, for example, FM, PM, ACSSB (Amplitude Companded SSB), SSB-AM, GMSK (Gaussian Minimum Shift Keying) and BLO-QPSK (Band Limited Offset-QPSK) with TDMA option have been proposed. Each method has advantages and disadvantages in communication quality, spectrum efficiency and economy. Further study is needed to aid in reaching international agreement regarding the types of modulation to be used.

3.3 Signalling

3.3.1 A completely automatic public mobile telephone system for use with aircraft requires an advanced signalling method for call control and channel acquisition.

3.3.2 Examples of such signalling systems are contained in Report 742.

3.4 Voice and data encoding

3.4.1 To be determined.

3.5 Airborne equipment

3.5.1 Size and weight of equipment should be minimal.

3.5.2 If possible, the equipment should make provision for other communication functions.

3.5.3 The airborne equipment must be electromagnetically compatible with other aircraft systems in accordance with appropriate regulatory requirements.

3.5.4 The system should have minimal impact on aircraft engineering, maintenance and operations.

3.6 Propagation and Doppler shift considerations

3.6.1 Annex IV presents an analysis of propagation and Doppler shift considerations.

4. Conclusion

4.1 It is recognized that this report represents only an initial step in defining the operational and technical factors to be considered regarding a public mobile telephone service with aircraft. Further study is needed on many aspects of the proposed system to facilitate arriving at international standards.

4.2 APC-systems operating in the band 1 559 - 1 625.5 MHz may cause interference to the GPS, GLONASS and RDSS system, and the reception of signals in the radionavigation service operating in the same band. This subject requires further study.

4.3 APC-systems operating in the band 850 - 895 MHz in Region 1 could cause interference to the Pan-European digital cellular radio network (GSM). Currently, however, this band cannot be used in Region 1 for APC systems.

ANNEX I

PUBLIC MOBILE TELEPHONE SYSTEM WITH AIRCRAFT IN JAPAN

1. Introduction

In Japan, a public mobile telephone system with aircraft has been developed. This system is economically realized through partial joint operation with the land mobile telephone (cellular) network. Moreover it is configured in the form of an integrated mobile communication system.

2. Operational features

Operational features are as follows:

- fully automatic direct-dial operation in conjunction with the public switched telephone network (PSTN);
- roaming : location registration and remote file access;
- hand-off;
- speech/non-speech service;
- service for not only airlines but also for general aviation use;
- coverage of almost all regular domestic air routes.

3. System functions

The system configuration is shown in Fig. 1.

The system functions are as follows:

- the system is composed of mobile station equipment installed on board aircraft and land station equipment on the ground;
- the land station equipment consists of the following components:
 - transmitters and receivers for transmission of various signals over a radio path;
 - mobile control station equipment for controlling the speech path set-up;
 - exchange equipment for connecting the mobile network and public switched telephone network (PSTN);
- the mobile control station and exchange equipment are used in common with the land mobile telephone system;
- speech path set-up control for both air-to-ground and ground-to-air calls is realized by a single radio channel, and the control messages are fully digitized;
- speech quality that meets the requirements for public telephone service is obtained.

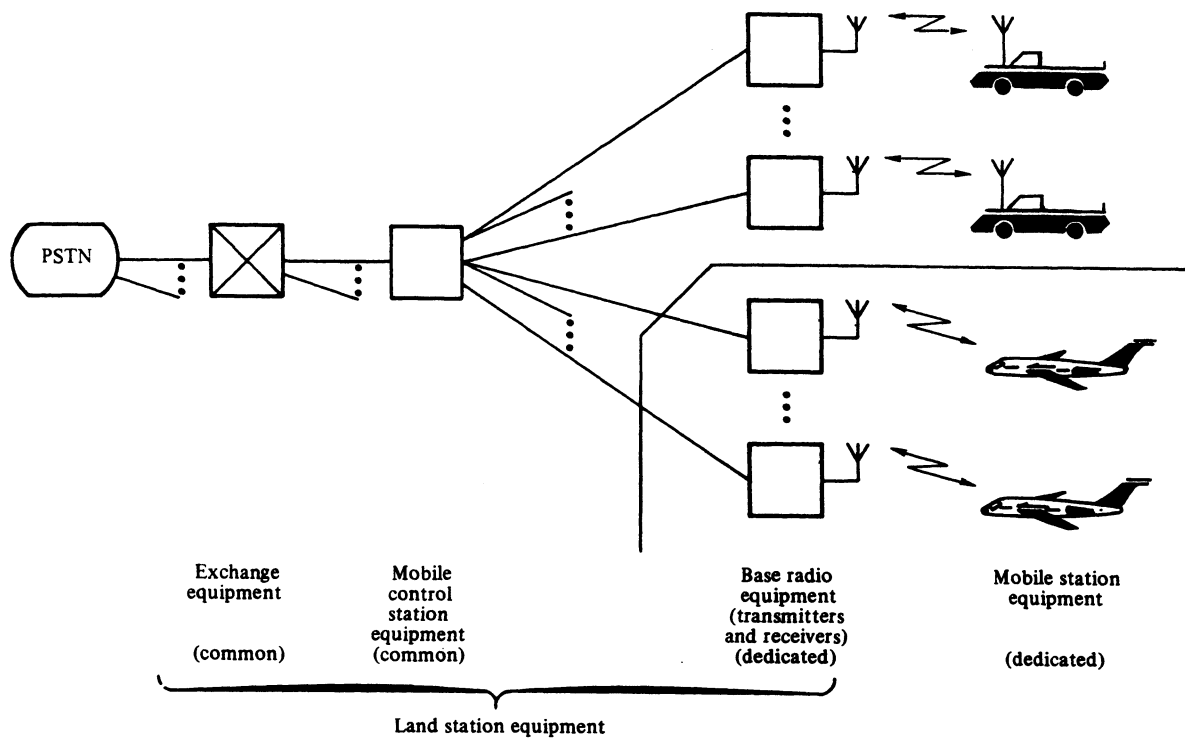


FIGURE 1 – System configuration

4. Technical characteristics

Technical characteristics are based on the land mobile telephone (cellular) system (see Report 742-1 and Ogawa, 1987).

The major characteristics are shown in Table I.

TABLE I – Technical characteristics

Frequency (MHz)		800-900
Channel spacing (kHz)		25
Total number of duplex channels		80
Type of modulation		PM
Power output (W)	Base station	40
	Mobile station	10

The modulation type is phase modulation, which is better than SSB-AM in that less receiver input power is required, especially for non-speech digital signal transmission. Also, transmission quality degradation due to Doppler shift is negligible and equipment cost is low.

5. Operations

This system began operation in 1986.

REFERENCES

OGAWA, K. [Oct. 1987]. Present and future mobile communications services, JTR, pp. 65-93.