FIRs need only meet one equipment standard and common operating procedure.

b) There must be a "seamless" transition from the service provided by one signatory (or group) and another signatory (or group) and through to various civil aviation administrations (CAAs). These transition arrangements are being developed in RTCA Special Committee 165.

c) It is possible that when ATS communications in a particular FIR are provided via a satellite service provider, they will be provided through one GES, i.e. the one designated by the CAAs. This will be reflected in the operating instructions for pilots which will indicate which GES to use for each FIR so that the ATS communications situation is unambiguous for the pilots. However, the AES, as currently defined, can only log-on to one GES at any time and therefore all data traffic (but not voice) must be passed via this GES. This may create complications if the airline has made commercial arrangements to pass its commercial traffic through another GES. One of the system design enhancements under study is the provision of a second log-on capability.

d) There will be a need for transparency between system operators (i.e. INMARSAT, TMI, AMSC, etc.) so that aircraft whose communications transfer from one system to another will also maintain continuity in ATS. This will require a high degree of both administrative and operational co-ordination. This topic is currently being considered in RTCA.

e) Requirements for communication services, "availability" and "time-to-restore" are such that it may be necessary for the service providers to provide fully redundant operation. This will have considerable impact on system design and will have to be reflected in the cost for the services.

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APPENDIX D

GUIDING PRINCIPLES ON INSTITUTIONAL AND LEGAL ASPECTS OF THE FUTURE AIR NAVIGATION SYSTEMS

1. The territorial sovereignty of States and their rights and responsibilities to control operations of aircraft and enforce safety regulations in their territory must not be compromised.

2. The communications, navigation, and surveillance (CNS) systems must be accessible to all States without discrimination.

3. The CNS/air traffic management (ATM) arrangements have to preserve the regulatory role of ICAO for the adoption of Standards and Recommended Practices.

4. The CNS service providers should adhere to appropriate ICAO Standards and should meet additional requirements stipulated by the user States.

5. ICAO's responsibility for co-ordination and use of aeronautical mobile-satellite (R) service (AMS(R)S) spectrum allocation must continue to be recognized.

6. The provision of CNS system services should be open to competition among all providers complying with ICAO Standards.

7. The existing institutional arrangements and legal regulations should be preserved wherever practicable.

Note.- The above principles were prepared and presented by the ICAO Secretariat to the Tenth Air Navigation Conference (1991).

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APPENDIX E

GUIDELINES TO ASSESS THE ADEQUACY OF PROVISION OF AERONAUTICAL MOBILE-SATELLITE SERVICE (AMSS) FOR AIR NAVIGATION SERVICES

Guideline a): Universal accessability to air navigation safety services must be available without discrimination

Guideline b): The rights and responsibilities of States to control operations of aircraft within their sovereign airspace must not be compromised

Guideline c): Arrangements must preserve, facilitate and not inhibit ICAO responsibility for the establishment of appropriate Standards, Recommended Practices and procedures (SARPs) in accordance with Article 37 of the Convention on International Civil Aviation

Guideline d): Arrangements must ensure the ability to protect safety communications from harmful interference

Guideline e): Arrangements must be adequately flexible to accommodate presently defined services and a range of future services

Guideline f): Arrangements must facilitate the certification by States of those service providers whose services comply with ICAO SARPs for the aeronautical mobile-satellite (R) service (AMS(R)S)

Guideline g): Institutional arrangements should not prevent competition among different service providers that comply with ICAO SARPs

Guideline h): ICAO's responsibility for co-ordination and use of AMS(R)S spectrum allocation must continue to be recognized

Guideline i): Arrangements must recognize States' responsibility and authority to enforce safety regulations

Guideline j): Arrangements must ensure guaranteed priority of aeronautical mobile-satellite safety communications over aeronautical non-safety and non-aeronautical mobile-satellite communications in accordance with ICAO SARPs

Guideline k): Arrangements must be in place so that service providers, operating in the same area, co-operate to ensure that space segment resources are made available to handle AMS(R)S service

Guideline l): Arrangements should enable all AMSS functions (ATS, AOC, AAC and APC) to be provided through common avionics equipment in the aircraft

Guideline m): Arrangements should make all four identified satellite services (ATS, AOC, AAC and APC) available through any given satellite in any region of the world

Guideline n): Adequate arrangements should be made for recovery in the event of a significant malfunction or catastrophic failure of the satellite system

Guideline o): Policies governing charges levied on users must not inhibit or compromise the use of satellite-based service for safety messages

Guideline p): Existing governmental or inter-governmental agencies, modified if necessary, should be used to the extent practicable

Guideline q): Arrangements should allow the introduction of satellite services on an evolutionary growth basis

Guideline r): Arrangements should provide for the determination of liabilities

Guideline s): Arrangements must retain ATS authority to co-ordinate and maintain control, directly or indirectly, over aeronautical mobile-satellite communications according to message priorities established in the ITU Radio Regulations

Note.- The above guidelines were prepared by the FANS (Phase II) Committee and presented by the ICAO Secretariat to the Tenth Air Navigation Conference (1991).

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APPENDIX F

GLOBAL POSITIONING SYSTEM

1. Global Positioning System (GPS)

1.1 System description

1.1.1 GPS is a continuous, global satellite navigation system under active development by the United States. The system has the capability to provide geodetic position and velocity in three dimensions, plus highly accurate time. Satellites will be in 12-hour circular orbits, all inclined at 55° to the equator; the total number for the operational "Block 2" configuration will be twenty-one plus three working spares in six orbital planes.

1.1.2 A GPS user determines his position by processing range measurements to four satellites. The range to the satellite is found by accurately measuring the transit time of signals transmitted by the satellite. Since the user clock is not synchronized with the satellite clocks, an error is introduced in the range measurement (pseudo range). By measuring pseudo ranges to four satellites and computing the satellite positions using ephemeris data transmitted by the satellites, the user equipment determines its three-dimensional position and time. The user velocity is determined in a similar way by measuring range rates to four satellites.

1.1.3 Satellite transmissions consist of two carrier frequencies, 1 575.42 MHz (L1) and 1 227.6 MHz (L2) modulated by two pseudo-random noise codes, (precision code (P-code) and a coarse-acquisition code (C/A code)), and a 50 bits/s navigation message containing data such as satellite ephemeris, propagation correction data, clock bias and system status information. The satellite data messages are periodically updated by the master control station based upon information from five globally dispersed monitor stations. The P-code signal is transmitted on the L1 and L2 carrier frequencies while the C/A code is only available on the L1 frequency.

1.1.4 GPS provides both a standard positioning service (SPS) and a precise positioning service (PPS). The SPS will be provided in the clear to any user, does not require any cryptographic means and will be made freely available to civil, commercial and other users internationally. The level of accuracy for the SPS will be set at 100 m horizontal and 157 m vertical at 95 per cent probability, together with timing accuracy relative to Co-ordinated Universal Time (UTC) to within 385 ns (95 per cent probability). The PPS is a military position/navigation service providing accuracies higher than SPS accuracies through use of cryptography.

1.2 Technical characteristics

Satellites	21 plus three operational spares; 12 hour circular orbits (26 000 km radius); 55° inclination; 6 orbit planes			
Ground control	Five globally dispersed monitor stations (downlink) Three globally dispersed ground antennas (uplink) One master control station			
Number of users	Unlimited			
Spectrum	Link 1 : L1		1575.42	MHz
		C/A code	1.023	Mbits/s
		P-code	10.23	Mbits/s
		Navigation message	50	bits/s
	Link 2 : L2		1227.6	MHz
		P code	10.23	Mbits/s (current policy)
		Navigation message	50	bit/s
Method of position fixing	One-way ranging Passive user			

System outputs and accuracies	PPS	SPS
Horizontal position	18 m (95%)	100 m (95%)
Vertical position	28 m (95%)	157 m (95%)
Velocity	0.2 m/s per axis (95)%)	not specified
Time	180 ns (95%)	385 ns (95 %)

Acquisition time	1 to 5 minutes depending on user equipment, with stored almanac Cold start: approximately 20 minutes
Coverage	Global
Integrity	Error detection in satellites and control system, reaction time normally less than 90 minutes (some satellites may remain out of sight of a monitor station for up to 2 hours).

Time-scale for operational ("Block 2") implementation	Global 3D: 1992
Suitability for communication purposes	None; separate communication transponders on the satellites would be required. This would have a major effect on the design of GPS satellites and it is not planned.
Compatibility of time	UTC
Geodetic reference datum	WGS-84
System enhancements	Significant accuracy and integrity improvements may be obtained by operating in a differential mode, i.e. using local ground stations that monitor the satellites and broadcast range corrections.

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APPENDIX G

GLOBAL NAVIGATION SATELLITE SYSTEM

1. Global Navigation Satellite System (GLONASS)

1.1 System description

1.1.1 The GLONASS satellite navigation system currently under development by the USSR is intended for determining civil aviation aircraft position co-ordinates and airspeed. It could also be used to serve marine and fishery needs. The system will consist of twenty-four satellites (three of them in a standby mode) positioned on three orbital planes, each plane accommodating seven - eight satellites, positioned on circular orbits with the following parameters:

Period	- 11 hours, 15 minutes;
Altitude	- 19 100 km;
Inclination	- 64.8°.

1.1.2 The GLONASS system user equipment would operate in a passive mode and perform measurements on up to four satellites' navigational parameters (pseudo-range and radial pseudo-speed). A navigation message transmitted from each satellite would consist of information on satellite ephemeric position and corrections relative to the GLONASS system time-scale, as well as information concerning all satellites' condition. Based upon measurements the user three-dimensional co-ordinates and speed vector components are determined and its time-scale is referenced to that of the system.

1.1.3 The GLONASS system satellites would emit navigation signals within the frequency band 1 602.5625 MHz to 1 615.5 MHz, with individual satellite frequencies spaced by 0.5625 MHz. The satellites are identified by their navigation signal nominal carrier frequency.

1.2 Technical characteristics

Satellites	Twenty-four, including three standby satellites; circular orbits; rotation period eleven hours fifteen minutes; altitude 19 100 km; inclination towards the equatorial plane 64.8°; three orbital planes
Number of users	Unlimited
Frequency band	(1 602.5625 to 1 615.5) ± 0.5 MHz
Method of position fixing	Pseudo-range and radial pseudo-speed finding, the user in passive mode

System outputs and accuracy	Plane co-ordinates	100 m (95 per cent)
	Altitude	150 m (95 per cent)
	Speed vector components	15 cm/s (95 per cent)
	Time	1 μs
Signal detection time	Signal detection time depends largely on the user specific equipment performance. The satellites transmit information for navigational purposes during 30 seconds and satellites' condition information during 2.5 minutes.	
Coverage	Global	
Integrity	A message transmitted to the user from each satellite would contain data on troubles concerning that satellite as soon as they occur. Such information would appear in the contents of a navigation message of all satellites not later than 16 hours after the trouble occurred.	
Implementation schedule	Approximately 1989-1990 - ten - twelve satellites 1991-1995 - twenty-four satellites	
Applicability to communication	The system would not be used for retransmission of any signals or additional messages	
System upgrading	The system accuracy can be significantly increased when user operation is in a differential mode.	

User radio link performance using an isotropic antenna

Satellite signal effective isotropic radiated power:

- along the axis of the transmitting antenna	25 dBW
- within angles ± 15°	27 dBW
- direction of transmitting antenna polarization rotation	right-hand
- received signal power (P_s)	-(156-161) dBW
- radio link energetic potential (P_s/N)	(39-44) dBHz
- information data transmission rate	50 bit/s
- signal-to-noise ratio in the symbol (E_B/N_s)	(22-27) dB

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APPENDIX H

EXTRACT FROM ATTACHMENT B (GENERAL GUIDLINES ON THE ESTABLISHMENT AND PROVISION OF A MULTINATIONAL ICAO EUR AIR NAVIGATION FACILITY/SERVICE) TO THE INTRODUCTION TO THE EUR REGIONAL PLAN (DOC 7754)

Introduction

4.1 The participation of States in the provision of a multinational facility/service is based on the assumption that any State having supported and agreed to the implementation of such a facility/service and making use of it, should also shoulder its respective share of the costs involved (4.27 refers). The participating States would need to formalize the terms under which the multinational facility/service is to be provided in an agreement. A primary aim of the agreement should be to ensure that the costs involved are shared amongst the participating States in a fair and equitable manner.

4.2 This part of the guidelines is concerned with the main contractual aspects, financial, managerial and other, that should normally be considered when initiating work on a potential multinational facility/service. The basic provisions that would need to be considered for incorporation in such an agreement are outlined, including provisions concerning cost sharing and cost determination. However, the guidance does not extend to the presentation of a draft model agreement or clauses, since circumstances related to the planning, implementation and operation of individual multinational facilities/services may vary considerably.

Note.— The guidelines generally refer to "agreement" as a generic term covering one or more agreements as the case may be.

Types of agreement

4.3 An agreement covering the development, implementation, operation and maintenance of a multinational facility service could either take the form of a formal international treaty or an "administrative agreement". Both forms establish an international obligation but a treaty requires the signature of the head of state or government and will also require the ratification or approval of the national legislative assembly, which, as a rule, is a time-consuming process. An "administrative agreement", on the other hand, is at a lower level of requirement in respect of formalities and procedures than a treaty, can be signed by a minister or director of civil aviation or some other authorized person, and could be concluded by an exchange of letters or notes.

4.4 It is recommended that, whenever possible, the agreement be established in the form of an "administrative agreement" rather than a formal international treaty because this would allow the agreement to come into force with minimum delay and also permit greater flexibility in incorporating any subsequent modifications required. It is recognized, however, that in some States constitutional or legal circumstances may require the approval of the legislative assembly for financial obligations to be accepted by the State, particularly if these are of a substantial magnitude and/or extend over a period of time. Whatever form is used, the agreement(s) should be structured to provide for easy subsequent amendments as developments may require. To this end, material of detail which is more likely to require modifications, and which will not affect the basic provisions of the agreement, should be contained in annexes or appendices.

4.5 It is further recommended that whenever possible only one general agreement (treaty/"administrative agreement") be adopted covering all aspects of the facility/service concerned through all its phases. However, this may not always be possible. In certain circumstances it might be necessary or preferable to have more than one agreement (treaty/'administrative agreement') differing in scope and content. In those circumstances the aim should be to cover as many aspects as possible in the "administrative agreement" and limit the use of the treaty to those aspects for which this form of agreement is essential for the States concerned. Recognizing this, one agreement for example, might cover the activities, including prefinancing, to be undertaken by those States that accept the responsibility for bringing the facility/service up to operational status, with another agreement to be concluded between all the States (including the first group of States aforementioned), which would use or be served by the facility/service once it became operational. In such circumstances the former agreement would be important because the first group of States would have to ensure the provision of funds from their own resources to ensure the implementation of the facility/service, since no inflow of revenues from charges on users (aircraft operators) would take place until the multinational facility/service becomes operational.

4.6 Another possible approach, if required by circumstances, would be for all the participating States to conclude an agreement covering, in general terms, their commitment to participate in the provision of the multinational facility/service, and then developing a separate