

Part IV

COMMUNICATIONS, NAVIGATION AND SURVEILLANCE (CNS)

INTRODUCTION

1. This part of the Asia and Pacific (ASIA/PAC) Basic Air Navigation Plan contains elements of the existing planning system and introduces the basic planning principles, operational requirements and planning criteria related to communications, navigation and surveillance (CNS) as developed for the ASIA/PAC regions.

2. As a complement to the Statement of Basic Operational Requirements and Planning Criteria (BORPC) set out in Part I, Part IV constitutes the stable guidance material considered to be the minimum necessary for effective planning of CNS facilities and services in the ASIA/PAC regions. A detailed description/list of the facilities and/or services to be provided by States in order to fulfil the requirements of the plan is contained in the ASIA/PAC Facilities and Services Implementation Document (FASID). During the transition and pending full implementation of the future communications, navigation and surveillance/air traffic management (CNS/ATM) system, it is expected that the existing requirements will gradually be replaced by new CNS/ATM system-related requirements. Further, it is expected that some elements of CNS/ATM system will be subject to amendment, as necessary, on the basis of experience gained in their implementation.

3. The Standards, Recommended Practices and Procedures to be applied are contained in:

- a) Annex 10 — *Aeronautical Telecommunications*, Volumes I, II, III, IV and V;
- b) Annex 11 — *Air Traffic Services*; and
- c) *Regional Supplementary Procedures* (Doc 7030).

4. Background information of importance in the understanding and effective application of this part of the plan is contained in the *Report of the Third Asia/Pacific Regional Air Navigation Meeting* (Doc 9614, ASIA/PAC/3 (1993)) on Agenda Items 10, 11 and 12.

5. The elements of the material referred to above are presented in the following paragraphs with appropriate cross-references to recommendations and/or conclusions of ASIA/PAC/3 and regional planning groups.

COMMUNICATIONS

General

6. The plan and details of the operational requirements for communications are contained in Tables CNS 1A, CNS 1B, CNS 1C, CNS 1D, CNS 1E, CNS 2, CNS 3, CNS 4A and CNS 4B, and associated charts of Part IV of the FASID.

Ground-ground communications

Aeronautical fixed service (AFS)

7. The aeronautical fixed service comprises:

- a) the aeronautical fixed telecommunication network (AFTN);
- b) data communications subnetworks and associated systems supporting the ground-ground applications of the aeronautical telecommunication network (ATN),

namely the ATS message handling services (ATS MHS) and ATS inter-facility data communications (AIDC);

- c) ATS direct speech circuits; and
- d) meteorological operation circuits, networks and broadcast systems.

Aeronautical fixed telecommunication network (AFTN)

8. States should ensure that telecommunication agencies engaged in providing aeronautical circuits be impressed of the need for:

- a) high reliability terrestrial links connecting aeronautical facilities and common carrier terminals inclusive of priority restoration of service commensurate with the requirements of a safety service; and
- b) rapid restoration of circuits in the event of breakdown. [ASIA/PAC/3, Conc. 10/1]

9. States operating AFTN circuits which do not function satisfactorily 97 per cent of the time during which the circuit is scheduled to be in operation should exchange monthly circuit performance charts on the form provided in Attachment A. Where a circuit consistently achieves 97 per cent reliability, the exchange of performance charts may cease. The circuit performance charts should be exchanged directly between the correspondent stations, with copies to the administrations concerned and to the ICAO Regional Office. States should also identify the causes for inadequate circuit performance and take necessary remedial measures. [ASIA/PAC/3, Conc. 10/2]

10. States responsible for the operation of AFTN circuits which are not adequately meeting transit time requirements should record transit time statistics on the twenty-third day of each third month (January, April, July and October) of each year, in accordance with the existing practices, for the AFTN circuits and terminals under their jurisdiction which do not meet the specified transit time criteria. The data recorded should be exchanged directly between the correspondent stations, with copies to administrations concerned and to the ICAO Regional Office. [ASIA/PAC/3, Conc.10/3]

11. States operating AFTN circuits should:

- a) record AFTN statistics on the form contained in Attachment B, from 23 to 25 April and October each year;
- b) exchange the circuit loading data for each circuit with each correspondent station and provide a copy to the ICAO Regional Office; and
- c) evaluate circuit loading and take appropriate remedial action when occupancy level exceeds permissible levels specified in the *Manual on the Planning and Engineering of the Aeronautical Fixed Telecommunications Network* (Doc 8259). [ASIA/PAC/3, Conc. 10/4]

12. States concerned should take positive measures to ensure system reliability and provide adequate management and supervision of facilities to eliminate system failure, and to ensure data integrity and timely delivery of messages. [ASIA/PAC/3, Conc. 10/5]

13. The AFTN entry/exit points:

- a) between ASIA/PAC and AFI should be Brisbane and Mumbai;
- b) between ASIA/PAC and EUR should be Bangkok, Singapore and Tokyo;
- c) between ASIA/PAC and MID should be Karachi, Mumbai and Singapore;
- d) between ASIA/PAC and NAM should be Brisbane, Nadi and Tokyo; and
- e) between ASIA/PAC and CAR/SAM should be Brisbane. [APANPIRG/11, Conc. 11/6]

Technical aspects of AFTN rationalization.

14. The main trunk circuits interconnecting main AFTN communication centres should be provided by landline teletypewriter (LTT) facilities, operate at a modulation rate commensurate with operational requirements, and employ International Alphabet Number 5 (IA-5) and character-oriented data link control procedures — system category B, or bit-oriented data link control procedures as defined in Annex 10, Volume III, Part I, Chapter 8.

15. Also, the tributary circuits interconnecting

tributary AFTN communication centres with main AFTN communication centres, with other tributary AFTN communication centres, or with AFTN stations should be provided with LTT facilities where available and feasible, preferably operate at a modulation rate commensurate with

16. To support data communication requirements and to provide needed data integrity and minimal transit time, the CCITT X.25 protocol should be used between AFTN COM centres and main and tributary COM centres in the ASIA/PAC regions.

[APANPIRG/4, Conc. 4/27 and APANPIRG/7, Conc. 7/14]

17. States should consider implementing digital communication networks or circuits in a coordinated manner in order to meet current and future AFS communication requirements for data/voice communications and to facilitate the introduction of ATN.

[APANPIRG/11, Conc. 11/14]

ATN infrastructure transition and implementation

18. The ATN transition plan outlines the requirements to increase bandwidth and upgrade protocols for those trunk circuits that will support main data flow of traffic in the ASIA/PAC regions. The plan also provides target dates for implementation of boundary intermediate systems (BIS) and backbone BIS in the ASIA/PAC regions.

[APANPIRG/12, Conc. 12/14]

19. ATN development should be introduced in an evolutionary and cost-effective manner based on available ICAO SARPs and regional ATN technical and planning documents. The ATN infrastructure transition is expected to be implemented in three phases as follows:

- a) *Phase 1.* Upgrade of existing AFTN circuits where necessary to support the introduction of the ATN backbone BIS;
- b) *Phase 2.* Implementation of the ATN regional backbone BIS; and
- c) *Phase 3.* Implementation of supporting ATN BIS.

20. States should consider establishment of gateways, where required, to allow inter-operation between AFTN and ATS MHS.

ATS direct speech circuits

operational requirements, and employ IA-5 code and procedures and an appropriately controlled circuit protocol. [ASIA/PAC AFS RPG/3, Rec. 3/1]

ATS direct speech communications.

21. States concerned should assign a high priority to the establishment, in accordance with Annex 11, 3.6.1.1, of efficient direct-speech communications between ATS units serving adjacent areas in order to permit proper use of air-ground frequencies and further implementation of the air traffic control (ATC) service.

[ASIA/PAC/3, Conc. 5/21]

22. Voice switching centres should be provided at the following locations:

- | | |
|-------------|------------------|
| 1) Auckland | 2) Bangkok |
| 3) Beijing | 4) Mumbai |
| 5) Calcutta | 6) Guangzhou |
| 7) Jakarta | 8) Karachi |
| 9) Lahore | 10) Kuala Lumpur |
| 11) Chennai | 12) Nadi |
| 13) Tokyo | 14) Brisbane |

[ASIA/PAC/3, Rec. 10/15]

23. Dissemination of World Area Forecast System (WAFS) products in the ASIA/PAC regions will be accomplished by satellite broadcast.

[ASIA/PAC/3, Rec. 10/19]

ATS inter-facility data communications (AIDC) circuits

24. States should consider implementing the ATN application AIDC in order to enable the exchange of ATS messages for active flights related to flight notification, flight coordination, transfer of control surveillance data and free (unstructured) text data.

Air/ground communications

Aeronautical mobile service and aeronautical mobile satellite service

Frequency utilization list.

25. States in the ASIA/PAC regions should

coordinate, as necessary, with the ICAO Regional Office all radio frequency assignments for both national and inter-national facilities in the 190–526.50 kHz, 108–117.975 MHz, 960–1215 MHz and 117.975–137 MHz bands. The ICAO Regional Office, based on the information provided for this purpose by the States, will issue Frequency Lists Nos. 1, 2 and 3 at periodic intervals.

[ASIA/PAC/3, Conc. 11/4, 11/5 and 12/9]

HF en-route communications

26. States should be urged to coordinate on a national basis with the appropriate interested authorities, a programme directed towards achieving the elimination of the interference currently being experienced on some of the frequencies allocated to the Aeronautical Mobile (R) Service in the ASIA/PAC regions. When reviewing methods for developing such a national programme, consideration should be given to the procedures in Article S15 of the ITU Radio Regulations.

27. In the case of an unidentified interfering station, States should notify the ICAO Regional Office concerned, utilizing the procedure and report form developed by the Fifth Session of the Communications Division (1954) and updated by the Communications Divisional Meeting (1978). The Harmful Interference Report Form is provided in Attachment C. However, in the case of persistent harmful interference to an aeronautical service which may affect safety, it should be immediately reported to ICAO and to the ITU, using the prescribed format, for appropriate action. [ASIA/PAC/3, Conc. 11/6]

Air-ground elements of ATN

28. With the implementation of the air-ground applications of ATN, it is important to ensure that transit response times are kept to a minimum level so as not to affect the overall response time that it takes for traffic such as automatic dependent surveillance (ADS) reports and controller-pilot data link communications (CPDLC) messages to be delivered to their final destination. This also reflects the need to ensure that critical ground links within the ASIA/PAC regions are capable of handling this information efficiently.

29. One important factor with air-ground traffic is the generation of routing information caused by aircraft that will move between various ATN routing domains. As aircraft move through various coverage media and FIR

boundaries, the ATN routing backbone will be notified of the changing routing data for each mobile aircraft in the region. To allow this routing information to be propagated within the region will require a minimum number of backbone routers to be implemented which protect all other ATN routers from being inundated with routing information.

[ASIA/PAC ATN transition plan]

NAVIGATION

General

30. The plan and details of operational requirements for radio navigation aids are contained in Table CNS 3 and associated charts of Part IV of the FASID.

31. States should continue to provide ICAO with information on their flight inspection activities for inclusion in the *ASIA/PAC Catalogue of Flight Inspection Units* and circulation to States in the ASIA/PAC regions and to the ASIA/PAC Air Navigation Planning and Implementation Regional Group (APANPIRG). [ASIA/PAC/3, Conc. 12/8]

32. The development of the radio navigation aids plan, and its subsequent documentation in relevant air navigation plan (ANP) publications, defines the respective radio navigation aid requirements at each location without reference to discrete frequency assignments. The ICAO Regional Office will continue to maintain its frequency selection and co-ordination role, including the maintenance and promulgation of Frequency Lists Nos. 1 and 2 in a timely and periodic manner. [ASIA/PAC/3, Conc. 12/9]

Radio navigation aid requirements

33. States that have not yet done so should install VHF omnidirectional radio range (VOR) supplemented by distance measuring equipment (DME) as the primary aid for en-route navigation and, except in specified circumstances, delete any parallel requirement for a non-directional radio beacon (NDB) from the ANP. [ASIA/PAC/3, Rec. 5/22]

SURVEILLANCE

General

34. The plan and details of operational requirements for surveillance are contained in Table CNS 4A of Part IV of the FASID.

35. Surveillance systems for terminal and en-route ATC purposes should be installed, maintained and operated at international aerodromes and en-route area control centres whenever it is necessary to improve the safe and expeditious handling of air traffic and wherever the traffic density and associated complexity of operations, system delays, meteorological conditions and/or transition from oceanic to continental airspace would justify these installations.

[ASIA/PAC/3, Rec. 5/28]

36. Where different systems are used for navigation and position determination within the same controlled airspace, the ground facilities involved should be collocated and/or orientated so as to provide compatible flight paths and to ensure, as far as practicable, a fully integrated ATC pattern.

[ASIA/PAC, Rec. 7/14]

37. The ASIA/PAC regions are characterised by the use of:

- a) secondary surveillance radar (SSR) Mode A, C and, in the near future, Mode S in some terminal and high-density continental airspace;
- b) ADS in some parts of the ASIA/PAC regions; and
- c) the diminishing use of primary radar.

38. ADS is becoming available over the oceanic and continental airspace of the ASIA/PAC regions. SSR (augmented as necessary with Mode S) will continue to be used in terminal areas and in some high density airspace.

Automatic Dependent Surveillance (ADS)

Coordination of activities related

to the implementation of ADS

39. The introduction of air-ground data links, together with sufficiently accurate and reliable aircraft navigation systems, presents the opportunity to provide surveillance services in areas lacking such services in the present infrastructure, in particular oceanic areas and other areas where the current systems prove difficult, uneconomic, or even impossible, to implement. ADS is a function for use by ATS in which aircraft automatically transmit, via a data link, data derived from on-board navigation systems. As a minimum, the data should include the four-dimensional position. Additional data may be provided as appropriate. The ADS data would be used by the automated ATC system to present information to the controller. In addition to areas which are at present devoid of traffic position information other than pilot-provided position reports, ADS will find beneficial application in other areas including high-density areas, where ADS may serve as an adjunct and/or backup for SSR and thereby reduce the need for primary radar. Also, in some circumstances, it may even substitute for secondary radar in the future. As with current surveillance systems, the full benefit of ADS requires supporting complementary two-way pilot-controller data and/or voice communication (voice for at least emergency and non-routine communication).

40. States should closely cooperate in the development of procedures for the implementation of ADS in the ASIA/PAC regions and participate to the extent possible in trials and demonstrations related to the implementation of ADS.

[ASIA/PAC/3, Conc. 14/21]

Secondary surveillance radar (SSR)

Implementation of surveillance systems

41. Implementation of surveillance systems should be pursued as an enhancement to ATS where so required and the use of SSR alone, in accordance with the procedures in the *Regional Supplementary Procedures* (Doc 7030), should be considered as a cost-effective alternative to primary surveillance radar.

[ASIA/PAC/3, Rec. 14/20]

Attachment A

LANDLINE TELETYPEWRITER (LTT) CIRCUIT PERFORMANCE

Instructions for use of the form

1. The serviceability of the circuit should be given to the nearest 7½ minutes.
 2. The copies of the form should be dispatched to the other States concerned as soon as possible, but in no case later than the fourteenth day of the following month.
 3. Data should be entered only for the reception over the circuit concerned. When the circuit is "IN", insert the figure in the appropriate square. When the circuit is "OUT", insert the cause of outage according to the "outage code".
 4. The serviceability percentage can be computed by dividing the number of minutes the circuit is in operation by the total in a particular month, and multiplying by 100.
 5. The term "outage" means communications circuit failure.
 6. When the term "other" is used to indicate outages on the chart, additional information should be provided to define the cause of the outage.
-

Time	Date/Time																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
1300																																31
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2400																																23
Daily %																																Daily %

Outage legend:

Leased
circuit

Line between COM centre
and comon carrier terminal

Equipment RX
terminal COM centre

Equipment TX
terminal COM centre

Other

Attachment B

AFTN CIRCUIT LOADING STATISTICS

Instructions for use of the form

1. *Originating station*: Insert the name and four-letter location indicator of the station reporting the statistics.
2. *Correspondent station(s)*: Insert the name and four-letter location indicator of the distant end station of the circuit (in case of multipoint circuits, list all distant end stations and their four-letter location indicators).
3. *Signalling speed*: Transmission speed in Baud or bits per second.
4. *Number of channels*: List the number of channels on a direct AFTN circuit between the originating and correspondent stations indicated on the form. If there is more than one channel on a circuit, data to be indicated in the respective columns for each channel should be added separately, and an average figure should be indicated in the respective columns.
5. *Average loading*: Total the daily input/output percentage, as applicable, by the number of days sampled and enter the result as a percentage in the respective column.
6. *Date*: Date that the traffic sample was taken (dd/mm/yy).
7. *Peak hourly*: Insert data for the peak hour of each day for both received (input) and transmitted (output) in the respective columns.
8. *Total daily*: Total number of characters received and sent for each day to be entered in the respective daily input/output columns.
9. *Percent hourly/daily*: Calculate utilization sent and received, hourly and daily.
 - a) To calculate hourly percentage, divide the peak hour character count (input/output) separately by the effective circuit capacity (listed below). Multiply the result by 100. Enter this figure as the percentage in the respective column.
 - b) To calculate daily percentage, divide the total daily character count (input/output separately), by the effective circuit capacity (listed below x 24). Multiply the result by 100 and enter this figure as a daily input/output percentage in the respective columns.
 - c) The effective circuit capacities below are based on the code set used.

ITA-2 Code	
Signalling speed (Baud)	Effective characters/hour
50	24 000
75	36 000
100	48 000
150	72 000
300	144 000

IA-5 Code, Asynchronous (1 stop bit)		
Signalling speed (bits/s)	Effective characters/hour	
	Without protocol	CAT B protocol (93%)*
300	108 000	100 400
600	216 000	200 880
1 200	432 000	401 760
2 400	864 000	803 520
4 800	1 728 000	1 607 040
9 600	3 456 000	3 214 080

IA-5 Code, Synchronic		
Signalling speed (bits/s)	Effective characters/hour	
	CAT B protocol (93%)*	HDLC (97%)**
2 400	1 004 400	1 047 600
4 800	2 008 800	2 095 200
9 600	4 017 600	4 190 400

X.25 Circuits		
Signalling speed (bits/s)	Maximum number of bytes	
	Per hour	Per day
9 600	4 320 000	103 680 000
64 000	28 800 000	691 200 000

* Actual characters per hour have been derated to 93 per cent to allow for protocol overhead.

** Actual characters per hour have been derated to 97 per cent to allow for protocol overhead.

Attachment C

HARMFUL INTERFERENCE REPORT FORM

This form should be used in cases of harmful interference with aeronautical services and only in those instances where the procedure outlined in the ITU-R Radio Regulations has not produced satisfactory results. The form should only be submitted after at least the sections marked with an asterisk have been completed.

- * State or organization submitting report.....
- * 1. Frequency of channel interfered with
- * 2. Station or route interfered with.....
- * 3. Is the interference persistent?
- * 3.1 Date, time, altitude and position at which interference was observed:

Date	Time (GMT)	Altitude	Position

Note.— Report forms should not be sent unless the interference has been observed a sufficient number of times to justify setting international administrative machinery into motion, or unless it is considered to be endangering a radio navigation or safety service.

- 4. Has your administration already applied, regarding this case of interference, any part(s) (state which) of the ITU procedures laid down in Article S15 of the ITU-R Radio Regulations?
.....
- * 5. Call sign of IS (IS = interfering station) (See note below.)
- 6. Name of IS corresponding to the call sign.....
- 7. Notified frequency on which IS should operate (if known).....
- 8. (a) Approximate frequency of IS.....kHz/MHz (circle applicable abbreviation)
- (b) Strength of IS (QSA or SINPFEMO — See ICAO Doc 8400).....

- 9. Class of emission of IS
- 10. Language used by IS
- 11. Call sign of station in communication with IS.....

Note.— If the call sign referred to in 5 could not be received, or if the call sign received is not in the international series and cannot be interpreted, the report form should not be sent unless at least one of the questions under 12, 13 and 14 can be answered.

- 12. Location of the IS (accurate or approximate coordinates)
- 13. Country where interfering station is believed to be located.....
- 14. Bearing (in degrees true) of the IS (with indication of location of D/F station)

ITU DEFINITION OF HARMFUL INTERFERENCE

Harmful interference: interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with these Regulations.