KEMENTERIAN PERHUBUNGAN
DIREKTORAT JENDERAL PERHUBUNGAN UDARA

PERATURAN DIREKTUR JENDERAL PERHUBUNGAN UDARA

NOMOR : KP 103 TAHUN 2015

TENTANG

STANDAR TEKNIS DAN OPERASI (*MANUAL OF STANDARD CASR 171 - 02*)
SPESIFIKASI TEKNIS FASILITAS TELEKOMUNIKASI PENERBANGAN

DENGAN RAHMAT TUHAN YANG MAHA ESA

DIREKTUR JENDERAL PERHUBUNGAN UDARA,

Menimbang : a. bahwa dalam Peraturan Menteri Nomor 57 Tahun 2011 tentang Peraturan Keselamatan Penerbangan Sipil Bagian 171 (*Civil Aviation Safety Regulation Part 171*) tentang Penyelenggara Pelayanan Telekomunikasi Penerbangan (*Aeronautical Telecommunication Service Provider*) sebagaimana diubah terakhir dengan Peraturan Menteri Perhubungan Nomor PM 38 Tahun 2014 pada subbagian 171.112 mengenai Prosedur Pemasangan mengamanatkan spesifikasi teknis fasilitas telekomunikasi penerbangan diatur lebih lanjut dengan Peraturan Direktur Jenderal;

b. bahwa untuk melaksanakan ketentuan sebagaimana dimaksud dalam huruf a, dipandang perlu mengatur Standar Teknis dan Operasi (*Manual of Standard CASR 171-02*) Spesifikasi Teknis Fasilitas Telekomunikasi Penerbangan, dengan Peraturan Direktur Jenderal Perhubungan Udara;

Mengingat : 1. Undang-undang Nomor 1 Tahun 2009 tentang Penerbangan (Lembaran Negara Republik Indonesia Tahun 2009 Nomor 1 Tambahan Lembaran Negara Republik Indonesia Nomor 4956);

2. Peraturan Presiden Nomor 47 Tahun 2009 tentang Pembentukan Organisasi Kementerian Negara sebagaimana diubah terakhir dengan Peraturan Presiden Nomor 80 Tahun 2014;

3. Peraturan Presiden Nomor 24 Tahun 2010 tentang Kedudukan, Tugas, dan Fungsi Kementerian Negara serta Susunan Organisasi, Tugas, dan Fungsi Eselon I Kementerian Negara sebagaimana telah diubah dengan Peraturan Presiden Nomor 135 Tahun 2014;

4. Peraturan Menteri Perhubungan Nomor KM 22 Tahun 2009 tentang Peraturan Keselamatan Penerbangan Sipil Bagian 175 (*Civil Aviation Safety Regulation Part* 175) tentang Pelayanan Informasi Aeronautika (*Aeronautical Information Services*);

5. Peraturan Menteri Perhubungan Nomor KM 24 Tahun 2009 tentang Peraturan Keselamatan Penerbangan Sipil Bagian 139 (*Civil Aviation Safety Regulation Part 139*) tentang Bandar Udara (*Aerodrome*) sebagaimana diubah terakhir dengan Peraturan Menteri Perhubungan Nomor PM 47 Tahun 2013;
6. Peraturan Menteri Perhubungan Nomor 60 Tahun 2010 tentang Organisasi dan Tata Kerja Kementerian Perhubungan sebagaimana diubah terakhir dengan Peraturan Menteri Perhubungan Nomor PM 68 Tahun 2013;
7. Peraturan Menteri Perhubungan Nomor 57 Tahun 2011 tentang Peraturan Keselamatan Penerbangan Sipil Bagian 171 (*Civil Aviation Safety Regulation Part 171*) tentang Penyelenggara Pelayanan Telekomunikasi Penerbangan (*Aeronautical Telecommunication Service Provider*) sebagaimana diubah terakhir dengan Peraturan Menteri Perhubungan Nomor PM 38 Tahun 2014;
8. Peraturan Menteri Perhubungan Nomor PM 9 Tahun 2015 tentang Peraturan Keselamatan Penerbangan Sipil Bagian 174 (*Civil Aviation Safety Regulation Part* 174) tentang Pelayanan Informasi Meteorologi Penerbangan (*Aeronautical Meteorological Information Services*);
9. Peraturan Menteri Perhubungan Nomor PM 44 Tahun 2015 tentang Peraturan Keselamatan Penerbangan Sipil Bagian 173 (*Civil Aviation Safety Regulation Part* 173) tentang Perancangan Prosedur Penerbangan *(Flight Procedure Design);*

MEMUTUSKAN :

Menetapkan : PERATURAN DIREKTUR JENDERAL PERHUBUNGAN UDARA TENTANG STANDAR TEKNIS DAN OPERASI (*MANUAL OF STANDARD CASR 171-02*) SPESIFIKASI TEKNIS FASILITAS TELEKOMUNIKASI PENERBANGAN.

Pasal 1

Dalam peraturan ini yang dimaksud dengan:

1. Navigasi Penerbangan adalah proses mengarahkan gerak pesawat udara dari satu titik ke titik yang lain dengan selamat dan lancar untuk menghindari bahaya dan/atau rintangan penerbangan.

2. Fasilitas telekomunikasi penerbangan adalah fasilitas yang digunakan untuk pelayanan komunikasi penerbangan dan pelayanan radio navigasi penerbangan.

3. Kalibrasi penerbangan adalah pengujian akurasi, jangkauan atau semua parameter kinerja pelayanan atau fasilitas yang dilakukan dengan cara menggunakan peralatan uji yang terpasang di pesawat udara dengan terbang inspeksi.

4. Pemasangan fasilitas adalah proses pekerjaan yang dimulai dari pengadaan, instalasi, commissioning dan sampai dengan fasilitas dapat digunakan pada pelayanan telekomunikasi penerbangan.

5. Sistem peralatan adalah kesatuan dari beberapa bagian peralatan seperti pemancar, penerima, antenna, jaringan data dan fasilitas pengawasan.

6. Direktur Jenderal adalah Direktur Jenderal Perhubungan Udara.

7. Direktorat Jenderal adalah Direktorat Jenderal Perhubungan Udara.

Pasal 2

(1) Pemasangan fasilitas telekomunikasi penerbangan harus memperhatikan:
   a. kebutuhan operasional;
   b. perkembangan teknologi;
   c. keandalan fasilitas; dan
   d. keterpaduan sistem.

(2) Pelaksanaan kegiatan pemasangan fasilitas telekomunikasi penerbangan harus mengacu dan mempedomani item-item sebagai berikut:

   a. Pekerjaan Persiapan:
      1) Kesiapan lahan;
      2) Kesesuaian rencana penempatan peralatan dengan standar penempatan peralatan;
      3) kelayakan peralatan terpasang dan gedung sebelumnya (khusus penggantian peralatan).

   b. Pekerjaan Pengadaan Barang:
      1) Kesesuaian teknis peralatan;
      2) Kebutuhan Jaringan Komunikasi Data Peralatan untuk fasilitas yang memerlukan;
      3) Kebutuhan Integrasi atau penyambungan peralatan dengan sistem lain untuk fasilitas yang memerlukan;
      4) Kebutuhan Suku Cadang;
      5) Fitur-fitur sesuai kebutuhan teknis operasional.

c. Pekerjaan Penunjang :
   1) Kebutuhan Catu Daya (PLN, Genset, UPS, Electrical Treatment);
   2) Kebutuhan Jaringan Kelistrikan;
   3) Kebutuhan Tool Kits;
   4) Kebutuhan Test Equipment;
   5) Kebutuhan Pendingin Ruangan;
   6) Kebutuhan Penangkal Petir;
   7) Kebutuhan Grounding Peralatan;
   8) Kebutuhan *Fire Protection*;
   9) Kebutuhan Meubelair;
   10) Kebutuhan Pencahayaan ruangan dan lingkungan.

d. Pekerjaan Sipil :
   1) Kebutuhan Gedung Peralatan;
   2) Kebutuhan akses jalan untuk maintenance;
   3) Kebutuhan untuk pengamanan fasilitas.

e. Pekerjaan Instalasi :
   1) Instalasi Peralatan;
   2) Instalasi Antenna;
   3) Instalasi Jaringan Komunikasi Data;
   4) *Line up*;
   5) Ujicoba sistem.

f. Services :
   1) Training (*Factory Training / Site Training*);
   2) Factory Acceptance Test;
   3) *Instrument Flight Procedure* untuk fasilitas yang memerlukan;
   4) Minimum Vectoring Altitude untuk fasilitas yang memerlukan ;
   5) Supervisi pekerjaan;
   6) *Ground Assistance for Flight Commissioning* untuk fasilitas yang memerlukan;
   7) *Flight Commissioning* untuk fasilitas yang memerlukan;
   8) *Site Acceptance Test;*
   9) *Safety Assesment.*

g. Tambahan
   1) Garansi;
   2) Gambar kerja.

Pasal 3

Fasilitas telekomunikasi penerbangan yang akan dipasang sekurang-kurangnya harus memenuhi standar spesifikasi teknis sebagaimana terlampir pada peraturan ini.

Pasal 4

Direktur Navigasi Penerbangan melakukan pengawasan terhadap pelaksanaan peraturan ini.

Pasal 5

Peraturan ini berlaku sejak tanggal ditetapkan.

Ditetapkan di JAKARTA
Pada tanggal 19 Maret 2015

DIREKTUR JENDERAL PERHUBUNGAN UDARA

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SUPRASETYO

SALINAN Peraturan ini disampaikan kepada :
1. Menteri Perhubungan;
2. Sekretaris Jenderal, Inspektur Jenderal dan Para Kepala Badan di lingkungan Kementerian Perhubungan;
3. Para Direktur di Lingkungan Ditjen Perhubungan Udara;
4. Para Kepala Kantor Otoritas Bandar Udara di Lingkungan Ditjen Perhubungan Udara;
5. Para Kepala Bandar Udara di Lingkungan Ditjen Perhubungan Udara;
6. Kepala Balai Besar Kalibrasi Penerbangan;
7. Kepala Balai Teknik Penerbangan;
8. Direktur Utamá Perum LPPNPI.

Salinan sesuai dengan aslinya
KEPALA BAGIAN HUKUM DAN HUMAS

DIREKTORAT JENDERAL PERHUBUNGAN UDARA

HEMI PAMURAHARJO
Pembina Tk I (IV/b)
NIP. 19660508 199003 1 001

Lampiran I Peraturan Direktur Jenderal Perhubungan Udara
Nomor : KP 103 TAHUN 2015
Tanggal : 19 MARET 2015

STANDAR TEKNIS DAN OPERASI (*MANUAL OF STANDARD CASR 171-02*)

SPESIFIKASI TEKNIS FASILITAS TELEKOMUNIKASI PENERBANGAN

DAFTAR ISI

1. PENDAHULUAN

Persyaratan Umum

a. Setiap fasilitas telekomunikasi penerbangan harus memiliki catu daya utama dan cadangan guna memenuhi nilai *continuity* yang dipersyaratkan.
b. Fasilitas telekomunikasi penerbangan harus dilengkapi dengan pengawasan status dan kontrol parameter operasional peralatan yang ditempatkan pada ruang personel teknik telekomunikasi penerbangan.
c. Fasilitas radio navigasi penerbangan yang terdiri dari peralatan VOR, DME dan ILS harus dilengkapi dengan pengawasan status operasional peralatan yang ditempatkan pada unit *Aerodrome Control Tower* dan/atau *Approach Control Services*.

2. FASILITAS BANTU NAVIGASI PENERBANGAN

2.1 Non Directional Beacon (NDB)

2.1.1. Deskripsi Singkat NDB

Non Directional Beacon (NDB) adalah fasilitas navigasi penerbangan yang bekerja dengan menggunakan frekuensi rendah (low frequency) dan dipasang pada suatu lokasi tertentu di dalam atau di luar lingkungan bandar udara sesuai fungsinya.

Peralatan NDB memancarkan informasi dalam bentuk sinyal gelombang radio ke segala arah melalui antena, sinyalnya akan diterima oleh pesawat udara yang dilengkapi Automatic Direction Finder (ADF) yaitu perangkat penerima NDB yang ada di pesawat udara, sehingga penerbang dapat mengetahui posisinya (azimuth) relatif terhadap lokasi NDB tersebut.

Jenis-jenis NDB adalah :

a. Low Range
   Daerah cakupan (coverage range) antara 50 NM sampai dengan 100 NM (1 NM = 1.853 km) dengan daya pancar antara 50 watt sampai dengan 250 watt.

b. Medium Range
   Daerah cakupan antara 100 NM sampai dengan 150 NM dengan daya pancar antara 500 watt sampai dengan 1000 watt.

c. High Range
   Daerah cakupan (coverage range) antara 150 NM sampai dengan 300 NM atau lebih dengan daya pancar antara 2000 watt sampai dengan 3000 watt.

Fungsi NDB adalah sebagai berikut :

a. Homing
   Stasiun NDB yang dipasang di dalam lingkungan bandar udara dan digunakan untuk memandu penerbang dalam mengemudikan pesawat udara menuju lokasi bandar udara.

b. Enroute
   Stasiun NDB yang dipasang di luar atau di dalam lingkungan bandar udara dan digunakan untuk memberikan panduan kepada pesawat udara yang melakukan penerbangan jelajah di jalur penerbangan.

c. Holding
   Stasiun NDB yang dipasang di luar atau di dalam lingkungan bandar udara dan digunakan untuk memandu penerbang yang sedang melakukan prosedur holding yaitu manuver pesawat udara di dalam suatu ruang udara yang ditentukan ketika menunggu dalam antrian pendaratan yang diatur oleh pengatur lalu-lintas udara.

d. Locator
Stasiun NDB yang dipasang pada perpanjangan garis tengah landasan pacu guna memberikan panduan arah pendaratan kepada penerbang pada saat posisi pesawat udara berada di kawasan pendekatan untuk melakukan pendaratan.

e. Approach
Stasiun NDB yang dipasang pada perpanjangan garis tengah atau di samping landasan pacu guna memberikan panduan arah pendaratan kepada penerbang pada saat posisi pesawat udara berada di kawasan pendekatan untuk melakukan pendaratan.

Jika dua stasiun pemancar NDB digunakan untuk pendukung peralatan ILS, perbedaan frekuensi pembawa dari kedua peralatan tersebut tidak kurang dari 15 KHz dan tidak lebih dari 25 KHz.

Jika dua stasiun pemancar NDB digunakan pada tiap ujung dari sebuah landas pacu yang sama, maka pengoperasiannya harus bergantian (NDB yang tidak digunakan harus dalam keadaan mati/OFF).

2.1.2. Spesifikasi Teknis NDB

2.1.2.1. Transmitter

a. Configuration	:	Dual System with Automatic Change Over
b. Field Strength	:	≥ 70 µV/m
c. RF Power Output	:	50 to 250 Watts (NDB LR) 500 to 1000 Watts (NDB MR) 2000 to 3000 Watts (NDB HR)
d. Radiated Power Limitation	:	no harmful interference
e. Carrier Frequency Range	:	190 to 1750 KHz (190 to 535 KHz used)
f. Frequency Stability	:	± 0.01 %
g. Output Impedance	:	50 Ohms
h. Identification		
1) Identification Code	:	2 letters International Morse Code
2) Keying Speed	:	7 words per minute
3) Repetition	:	at least once every 30 seconds
4) Modulation Frequency	:	1020 Hz ± 50 Hz or 400 Hz ± 25 Hz
i. Emission Mode	:	NON/A2A or NON/A1A
j. Depth of Modulation	:	maintained near to 95 %
k. Power Supply Input	:	110 / 220 VAC (Stabilized), 50 to 60 Hz
l. Backup Power Supply	:	at least 2 hours
m. Operating Temperature	:	-10 °C to +50 °C

2.1.2.2. Antenna Tuning/Matching Unit

a. Input Impedance	:	50 Ohms
b. Frequency Range	:	190 to 1750 KHz (190 to 535 KHz used)

c. Tuning/Matching Method : Automatic, motorized adjustment
d. Temperature Range : -10 °C to +50 °C

2.1.2.3. Antenna
a. Radiation Patern : Omnidirectional
b. Polarization : Vertical
c. Input Impedance : 50 Ohms
d. Frequency Range : 190 to 1750 KHz
(190 to 535 KHz used)
e. Temperature Range : -10 °C to +50 °C

2.1.2.4. Monitoring
a. Monitor Action : indication or automatic change over
or automatic switch off
b. Radited Carrier Power : 50 % decrease (-3dB)
c. Identification Signal : failure to transmit
d. Monitor Failure : monitoring itself

2.1.2.5. Remote Monitoring
a. Identification Tone : Audible indication
b. Level of Signal : Metering indication

2.2 Distance Measuring Equipment (DME)

2.2.1. Deskripsi Singkat DME/N

Distance Measuring Equipment (DME) adalah alat bantu navigasi penerbangan yang berfungsi untuk memberikan panduan/informasi jarak bagi pesawat udara dengan stasiun DME yang dituju (slant range distance).

Dalam operasinya pesawat udara mengirim pulsa interogator yang berbentuk sinyal acak (random) kepada tr

ansponder DME di darat, kemudian transponder mengirim pulsa jawaban (replay) yang sinkron dengan pulsa interogasi.

Dengan memperhitungkan interval waktu antara pengiriman pulsa interogasi dan penerimaan pulsa jawaban (termasuk waktu tunda di transponder) di pesawat udara, maka jarak pesawat udara dengan stasiun DME dapat ditentukan.

2.2.2. Spesifikasi Teknis DME/N

2.2.2.1. Transponder System

a.	Configuration	:	Dual System with Automatic Change Over
b.	Accuracy	:	not exceed ± 370 m or 0.2 NM
c.	Carrier Frequency Range	:	960 MHz to 1215 MHz
d.	Channel Spacing	:	1 MHz
e.	Operating Channel	:	352 channels
f.	Channel Pairing	:	w/ VHF navigation facility
g.	Polarization	:	Vertical
h.	Interrogation PRF	:	≤ 30 PPS (normal tracking) ≤ 150 PPS (fast tracking)
i.	Aircraft Handling Capacity	:	100 Aircraft
j.	Power Supply Input	:	110 / 220 VAC (Stabilized), 50 to 60 Hz
k.	Backup Power Supply	:	at least 4 hours
l.	Operating Temperature	:	-10 °C to +50 °C

2.2.2.2. Transmitter

a.	Frequency Range	:	962 MHz to 1213 MHz
b.	Frequency Stability	:	± 0.002 %
c.	Pulse Shaped		
	1) Rise Time	:	≤ 3.0 µS
	2) Duration	:	3.5 µS ± 0.5 µS
	3) Decay Time	:	2.5 µS to 3.5 µS
	4) Pulse Level	:	not fall below 95 %
d.	Pulse Spectrum	:	ERP in a 0.5 MHz band centred on Frequencies 0.8 MHz above and below channel frequency shall not exceed 200 mW
e.	Pulse Pair Spacing	:	12 µS ± 0.25 µS

f. Field Strength : ≥ -89 dBW/m2
g. RF Peak Power Output : nom. 100 Watts (co. with ILS GP)
nom. 1000 Watts (co. with VOR)
h. Transmission Capability : 2700 PPS ± 90 PPS
i. Transmission Rate : ≥ 700 PPS

2.2.2.3. Receiver
a. Operating Frequency range : 1025 MHz to 1150 MHz
b. Frequency Stability : ± 0.002 %
c. Sensitivity : ≥ -103 dBW/m^2
d. Time Delay : 50 µS ± 0.5 µS
e. Reply Efficiency : ≥ 70 %
f. Dead Time : 60 µS

2.2.2.4. Identification
a. Identification Code : International Morse Code;
independent or associated
b. Rate / Frequency : 1350 PPS
c. Keying Speed : 6 words per minute
d. Repetition : at least once every 40 seconds

2.2.2.5. Antenna
a. Radiation Patern : Omnidirectional
b. Polarization : Vertical
c. Beam Width : more than 6 degrees
d. Gain : more than 10 dB
e. Input Impedance : 50 Ohms
f. Frequency Range : 962 MHz to 1213 MHz
g. Temperature Range : -10 °C to +50 °C

2.2.2.6. Monitoring
a. Monitor Action : indication or automatic change over
or automatic switch off
b. Transponder Time delay : ± 1 µS or more from nominal Value
(± 0.5 µS if with landing aid)
c. Pulse Pair Spacing : ± 1 µS or more from nominal Value
d. Transmitter Power output : 50 % decrease (-3dB)
e. Receiver Sensitivity : -6 dB or more
f. Monitor Failure : any part of monitor itself

2.2.2.7. Remote Monitoring and Control
a. Remote Monitoring
1) Operational Status : Visual indication
2) System Alert : Audible indication
b. Remote Control
1) Operation of Equipt. : On / Off, Changeover
2) Operational Parameter : Visual indication
3) Setting of Parameter : Using application software
4) System Alert : Visual and Audible indication

2.3 Very High Omnidirectional Range (VOR)

2.3.1. Deskripsi Singkat VOR

VHF Omnidirectional Range (VOR) adalah fasilitas navigasi penerbangan yang bekerja dengan menggunakan frekuensi radio dan dipasang pada suatu lokasi tertentu di dalam atau di luar lingkungan bandar udara sesuai fungsinya.

Peralatan VOR memancarkan informasi yang terdiri dari sinyal variable dan sinyal reference dengan frekuensi pembawa VHF melalui antena, display pada peralatan penerima VOR yang ada di pesawat udara menunjukkan suatu deviasi dalam derajat dari jalur penerbangan yang memungkinkan pesawat udara terbang menuju bandara dengan route (jalur penerbangan) tertentu dengan memanfaatkan stasiun VOR.

Selain itu penerbang dapat memanfaatkan stasiun VOR pada saat tinggal landas, dengan menggunakan jalur penerbangan dari VOR dan selanjutnya terbang menuju stasiun VOR yang lain. Dengan penggunaan sudut deviasi yang benar, peralatan VOR dapat digunakan untuk memandu pesawat udara menuju ke suatu bandar udara lainnya.

Posisi dan arah terbang pesawat udara setiap saat dapat diketahui oleh penerbang dengan bantuan VOR dan DME atau dengan menggunakan dua stasiun VOR.

Penerima VOR di pesawat udara mempunyai tiga indikator, yaitu :

a. Untuk menentukan azimuth, sudut searah jarum jam terhadap utara dari stasiun VOR dengan garis yang menghubungkan stasiun tersebut dengan pesawat udara.
b. Menunjukkan deviasi kepada penerbang, sehingga penerbang dapat mengetahui jalur penerbangan pesawat udara sedang dilakukan berada di sebelah kiri atau di kanan dari jalur penerbangan yang seharusnya.
c. Menunjukkan apakah arah pesawat udara menuju ke atau meninggalkan stasiun VOR.

Peralatan VOR dapat dipergunakan dalam beberapa fungsi, yaitu :

a. Homing
   Stasiun VOR yang dipasang di dalam lingkungan bandar udara dan digunakan untuk memandu penerbang dalam mengemudikan pesawat udara menuju lokasi bandar udara.
b. Enroute
   Stasiun VOR yang dipasang di luar atau di dalam lingkungan bandar udara dan digunakan untuk memberikan panduan kepada pesawat udara yang melakukan penerbangan jelajah di jalur penerbangan.
c. Holding
   Stasiun VOR yang dipasang di luar atau di dalam lingkungan bandar udara dan digunakan untuk memandu penerbang yang sedang melakukan prosedur holding yaitu manuver pesawat udara di dalam

suatu ruang udara yang ditentukan ketika menunggu dalam antrian pendaratan yang diatur oleh pengatur lalu-lintas udara.

d. Locator
Stasiun VOR yang dipasang pada perpanjangan garis tengah landasan pacu guna memberikan panduan arah pendaratan kepada penerbang pada saat posisi pesawat udara berada di kawasan pendekatan untuk melakukan pendaratan.

e. Approach
Stasiun VOR yang dipasang pada perpanjangan garis tengah atau di samping landasan pacu guna memberikan panduan arah pendaratan kepada penerbang pada saat posisi pesawat udara berada di kawasan pendekatan untuk melakukan pendaratan.

2.3.2. Spesifikasi Teknis VOR

2.3.2.1. Transmitter

a.	Configuration	:	Dual System with Automatic Change Over and antenna field detector for monitoring
b.	Carrier Frequency Range	:	111.975 MHz – 117.975 MHz
c.	Channel Spacing	:	50 KHz
d.	Frequency Tolerance	:	± 0.002%
e.	Subcarrier Frequency	:	9960 Hz
f.	Polarization	:	Horizontal
g.	Field Strength	:	90 μV/m (-107 dBW/m2)
h.	RF Power Output	:	nominal 100 Watts
i.	Power Supply Input	:	110 / 220 VAC (Stabilized), 50 to 60 Hz
j.	Backup Power Supply	:	at least 4 hours
k.	Operating Temperature	:	-10 °C to +50 °C

2.3.2.2. Modulation Signal

a. Refference Signal

1)	Radiation	:	Omnidirectional
2)	Type of Modulation	:	Amplitude Modulation (AM)
3)	Modulation Frequency	:	30 Hz
4)	Frequency Stability	:	± 1%
5)	Depth of Modulation	:	28 to 32%

b. Variable Signal

1)	Radiation	:	Varies with azimuth
2)	Type of Modulation	:	Frequency Modulation (FM)
3)	Modulation Frequency	:	9960 Hz
4)	Frequency Stability	:	± 1%
5)	FM Modulation Index	:	16±1
6)	Depth of Modulation	:	28 to 32%

c. Identification

1)	Identification Code	:	3 letters of Int'l Morse Code
2)	Modulation Frequency	:	1020 Hz ± 50 Hz
3)	Depth of Modulation	:	≤ 10% with communications ch. ≤ 20% no communications ch.

4) Keying Speed : 7 words per minute
5) Repetition : at least once every 30 seconds

d. Voice
1) Frequency Range : 300 to 3000 Hz
2) Depth of Modulation : ≤ 30%

2.3.2.3. Antenna
a. Radiation Patern : Omnidirectional
b. Polarization : Horizontal
c. Input Impedance : 50 Ohms
d. Frequency Range : 111.975 MHz – 117.975 MHz
e. Temperature Range : -10 °C to +50 °C
f. Antenna Cover : Weatherproofing

2.3.2.4. Monitoring
a. Monitor Action : indication or automatic change over or automatic switch off
b. Bearing phase : > 1.0 degree
c. Modulation Signal level : reduction of 15%
d. Monitor Failure : monitor itself

2.3.2.5. Remote Monitoring and Control
a. Remote Monitoring
1) Operational Status : Visual indication
2) System Alert : Audible indication

b. Remote Control
1) Operation of Equipment: On / Off, Changeover
2) Operational Parameter : Visual indication
3) Setting of Parameter : Using application software
4) System Alert : Visual and Audible indication

2.4 Instrument Landing System (ILS)

2.4.1. Deskripsi Singkat ILS

Instrument Landing System (ILS) adalah peralatan navigasi penerbangan yang berfungsi untuk memberikan sinyal panduan arah pendaratan (azimuth), sudut luncur (glide path) dan jarak terhadap titik pendaratan secara presisi kepada pesawat udara yang sedang melakukan pendekatan dan dilanjutkan dengan pendaratan di landasan pacu pada suatu bandar udara.

Dalam operasinya, penerima di pesawat udara terdapat Cross pointer yang dapat menunjukan posisi pesawat udara terhadap jalur yang seharusnya dilalui.

ILS terdiri dari subsistem sebagai berikut :

a. Localizer.
   Subsistem peralatan ILS yang memberikan panduan garis tengah dari landas pacu bagi pesawat udara yang akan melakukan prosedur pendaratan.
b. Glide Path.
   Subsistem peralatan ILS yang memberikan panduan sudut luncur bagi pesawat udara yang akan melakukan prosedur pendaratan.
c. Marker Beacon.
   Subsistem peralatan ILS yang memberikan panduan jarak pesawat udara yang akan melakukan prosedur pendaratan terhadap ujung landas pacu.

2.4.2. Spesifikasi Teknis Localizer Category I

2.4.2.1. Transmitter

a.	Configuration	:	Dual System with Automatic Change Over
b.	Carrier Frequency Range	:	108 to 111.975 MHz
c.	Carrier Frequency stability	:	± 0.002% for dual frequency, ± 0.005% for single frequency
d.	Carrier Freq. Separation	:	5 kHz to 14 kHz
e.	Coverage		
	1) Horizontal	:	± 35°
	2) Vertical	:	Up to 7°
f.	Field Strength	:	≥ 90 μV/m (-107 dBW/m2)
g.	Course Line Limitation	:	± 10.5 m (± 0.015 DDM)
h.	Displacement Sensitivity	:	0.00145 DDM/m (0.00044 DDM/ft)
i.	Polarization	:	Horizontal
j.	Power Supply Input	:	110 / 220 VAC (Stabilized), 50 to 60 Hz
k.	Backup Power Supply	:	at least 4 hours
l.	Operating Temperature	:	-10 °C to +50 °C

2.4.2.2. Modulation

a. Modulation Frequency	:	90 Hz ± 2.5 % 150 Hz ± 2.5%
b. Modulation percentage	:	20% + 2%
c. Sum of Modulation Depth	:	30% to 60%

2.4.2.3. Identification

a. Identification Code	:	International Morse Code consist of three letter preceeded with letter "I"
b. Type of Modulation	:	A2A
c. Modulation Frequency	:	1020 Hz + 50 Hz
d. Modulation percentage	:	Adjustable 5 to 15%
e. Keying Speed	:	7 words per minutes
f. Repetition	:	not less than 6 times per minutes

2.4.2.4. Antenna

a. Radiation Patern	:	Directional
b. Polarization	:	Horizontal
c. Input Impedance	:	50 Ohms
d. Frequency Range	:	108 to 111.975 MHz
e. Temperature Range	:	-10 °C to +50 °C

2.4.2.5. Monitoring

a. Monitor Action	:	indication or automatic change over or automatic switch off
b. Mean Course Line Shift	:	> 0.015 DDM or > 10.5 m (35 ft)
c. Power Output	:	reduction more than 80%
d. Periode of Zero Radiation	:	not exceed 10 seconds
e. Monitor Failure	:	monitor itself

2.4.2.6. Remote Monitoring and Control

a. Remote Monitoring		
1) Operational Status	:	Visual indication
2) System Alert	:	Audible indication
b. Remote Control		
1) Operation of Equipment	:	On / Off, Changeover
2) Operational Parameter	:	Visual indication
3) Setting of Parameter	:	Using application software
4) System Alert	:	Visual and Audible indication

2.4.3. Spesifikasi Teknis Spesifikasi Teknis Glide Path Category I

2.4.3.1. Transmitter

a. Configuration	:	Dual System with Automatic Change Over
b. Carrier Frequency range	:	328.6 to 335.4 MHz
c. Carrier Frequency stability	:	± 0.002% for dual frequency, ± 0.005% for single frequency
d. Carrier Freq. separation	:	4 KHz to 32 KHz
e. Glide angle	:	Adjustable 2° to 4°
f. Field Strength	:	≥ 400 µV/m (-95 dBW/m2)

g. Displacement Sensitivity : 0.0875 DDM/m
h. Polarization : Horizontal
i. Power Supply Input : 110 / 220 VAC (Stabilized), 50 to 60 Hz
j. Backup Power Supply : at least 4 hours
k. Operating Temperature : -10 °C to +50 °C

2.4.3.2. Modulation
a. Modulation Frequency : 90 Hz ± 2.5 %
50 Hz ± 2.5%
b. Modulation percentage : 40% ± 2.5%

2.4.3.3. Antenna
a. Radiation Patern : Directional
b. Polarization : Horizontal
c. Input Impedance : 50 Ohms
d. Frequency Range : 328.6 to 335.4 MHz
e. Temperature Range : -10 °C to +50 °C

2.4.3.4. Monitoring
a. Monitor Action : indication or automatic change over or automatic switch off
b. Mean Course Line Shift : > - 0.075 □ to + 0.10 □ from □
c. Power Output : reduction more than 80%
d. Periode of Zero Radiation : not exceed 10 seconds
e. Monitor Failure : monitor itself

2.4.3.5. Remote Monitoring and Control
a. Remote Monitoring
1) Operational Status : Visual indication
2) System Alert : Audible indication
b. Remote Control
1) Operation of Equipment: On / Off, Changeover
2) Operational Parameter : Visual indication
3) Setting of Parameter : Using application software
4) System Alert : Visual and Audible indication

2.4.4. Spesifikasi Teknis Spesifikasi Teknis Marker Beacon

2.4.4.1. Transmitter
a. Configuration : Dual System with Automatic Change Over
b. Carrier frequency : 75 MHz
c. Frequency stability : ±0.005%
d. Polarization : Horizontal
e. Coverage (adjustable)
1) Inner marker : 150 m ± 50 m (500 ft ± 160 ft)
2) Middle Marker : 300 m ± 100 m (1000 ft ± 325 ft)
3) Outer marker : 600 m ± 200 m (2000 ft ± 650 ft)
f. Field strength : - Limits of coverage shall be 1.5 mv/m (-82 dBW/m2)

- In addition within the coverage area shall rise to at least 3.0 mv/m (-76 dBW/m2)

g. Power Supply Input : 110 / 220 VAC (Stabilized), 50 to 60 Hz

h. Backup Power Supply : at least 4 hours

i. Operating Temperature : -10 °C to +50 °C

2.4.4.2. Modulation

a. Modulation frequency

1) Inner marker : 3000 Hz

2) Middle Marker : 1300 Hz

3) Outer Marker : 400 Hz

b. Frequency tolerance : + 2.5 %

c. Total harmonic : < 15 %

d. Depth of modulation : 95 % + 4 %

e. Audio Frequency modulation

1) Inner Marker : 6 dot/s (countinously)

2) Middle Marker : continuous series of alternate dots and dashes, the dashes keyed at the rate of 2 dashes/second and the dots at the rate of 6 dots/second

3) Outer Marker : 2 dashes/s (continuously)

f. Keying rate : within $\pm$ 15%

2.4.4.3. Antenna

a. Radiation Patern : Directional

b. Polarization : Horizontal

c. Input Impedance : 50 Ohms

d. Frequency Range : 75 MHz

e. Temperature Range : -10 °C to +50 °C

2.4.4.4. Monitor (Indication and Warning)

a. Modulation or keying : Failure

b. Power Output : Reduction to less than 50%

2.4.4.5. Remote Monitoring and Control

a. Remote Monitoring

1) Operational Status : Visual indication

2) System Alert : Audible indication

b. Remote Control

1) Operation of Equipment: On / Off, Changeover

2) Operational Parameter : Visual indication

3) Setting of Parameter : Using application software

4) System Alert : Visual and Audible indication

3. FASILITAS PENGAMATAN PENERBANGAN

3.1. Primary Surveillance Radar (PSR)

3.1.1. Deskripsi Singkat PSR

Primary Surveillance Radar adalah salah satu fasilitas navigasi penerbangan yang bekerja dengan menggunakan frekuensi radio yang digunakan untuk mendeteksi obyek dalam cakupan pancarannya. PSR dipasang pada posisi tertentu baik di dalam / di luar lingkungan Bandar Udara sesuai dengan kebutuhan.

Peralatan PSR adalah jenis *Non Coorperative Radar*, dimana tidak membutuhkan jawaban dari obyek yang berada dalam cakupan pancarannya sehingga pada pesawat terbang tidak dibutuhkan penambahan Transponder. PSR memancarkan pulsa-pulsa RF yang mengandung energi gelombang elektromagnetik dimana antena PSR mengarah. Obyek yang berada dalam cakupan pancaran PSR akan memantulkan pulsa-pulsa RF tersebut, disebut Echo. Waktu yang dibutuhkan mulai dari pulsa-pulsa RF dipancarkan oleh antena PSR sampai diterima kembali oleh antena PSR kemudian dikonversikan menjadi informasi Jarak.

Informasi yang diterima berupa : jarak (*range*) dan arah (*azimuth*).

3.1.2. Spesifikasi Teknis PSR
Adapun kriteria pedoman teknis tentang tata cara evaluasi teknis dan/atau pemasangan fasilitas telekomunikasi penerbangan adalah sebagai berikut:

3.1.2.1 Spesifikasi Teknis PSR-S Band

3.1.2.1.1 System Performance :

a. Configuration : Dual System with Dual Antenna Driver System and Automatic Changeover
b. Frequency : 2.7 - 2.9 GHz (S-Band)
c. Instrumented Range : 60 - 80 NM
d. Range Accuracy : ≤ 60 m
e. Range Resolution : Better than 230 m
f. Azimuth Accuracy : Better than 0.15 degrees rms
g. Azimuth Resolution : Better than 2.8 degrees rms
h. Improvement Factor : 55 dB
i. Technology : Solid State
j. MTBF (Critical) : >33000 hours
k. MTTR : 30 minutes
l. Monitoring : RCMS and BITE
m. Probability of Target Defect : > 90%
n. Average False Target Reports : < 20

3.1.2.1.2 Antenna System

a.	Antenna Type	:	Dual Beam
b.	Frequency Band	:	2.7 to 2.9 GHz.
c.	Antenna Gain	:	34 dB (Main Beam) 34 dB (Auxiliary Beam)
d.	Azimuth Beam Width	:	1.5 degrees or +- 0.15 degrees at -3 dB points
e.	Elevation Coverage	:	>30 degrees Cosec2 Pattern or 5.5 degrees
f.	Azimuth Sidelobes	:	-25 dB
g.	Polarization	:	Linear / Circular
h.	Tilt Adjustment/Beam Tilt	:	Adjustable between +1 to +5° (Main Beam relative to horizontal)
i.	Rotation Rate	:	7.5 to 15 RPM.
j.	Motor Drive	:	Dual motors. Hand barring and brake facilities with safety inter- locks.
k.	Data Take-off	:	14 bit high accuracy system
l.	Rotating Joint	:	Shall be have channels for Main Beam, Auxiliary Beam, Wheather Channel and the Sum, Difference and control beams of a Monopulse SSR System
m.	Wind Speed	:	Shall remain operational in wind speed up to 70 knots and survive in wind speed of up to 120 knots (not rotating)
n.	Temperature	:	-40 to 70 degrees Centigrade
o.	Colour	:	ICAO International Orange and White
p.	Antenna Tower	:	The height shall be such that the center of the primary antenna is minimum 15 M above ground level. Galvanized Steel / Anti Corotion.

3.1.2.1.3 Transmitter / Receiver

a.	Frequency Band	: 2.7 to 2.9 GHz (S-Band)
b.	Power Output	: 18 KW peak
c.	Receiver Bandwidth	: Optimum for pulse duration selected
d.	Receiver Noise Figure	: Amplifier 1.5 +/- 0.1 dB. Overall figure including protection devices such as TR Cell, Duplexer, Diplexer etc. shall not exceed 4.5 dB.
e.	Pulse Width	: Short (1 uS) and Modulated Long Pulse (75 uS)
f.	Cooling System	: Forced Air
g.	Temperature	: -10 to 70 degrees Centigrade

3.1.2.1.4 Primary Plot Extractor

a. Type	:	Adaptive Processing, such as AMTD
b. A/D Converters	:	10 bit minimum I and Q
c. Improvement Factor	:	>50 dB for fixed clutter
d. Sub Clutter Visibility	:	> 31 dB at 80% Pd for fixed clutter
e. Instrumented Range	:	60 - 80 NM
f. Temperature	:	- 10 to 70 degrees Centigrade
g. Capability	:	- Installed with PSR / MSSR separately - Installed with PSR / MSSR Combined - PSR Input Interface - Primary Plot Processing - Scondary Plot Processing - PSR/MSSR Plot Combining - PSR/MSSR False Plot Filtering
h. Format	:	Combined PSR / MSSR format to be agreed by DGAC

3.1.2.2 Spesifikasi Teknis PSR-L Band

3.1.2.2.1 System Performance

a. Konfigurasi	:	Dual System With Dual Antenna Driver System And Automatic Change Over
b. Frequency	:	1.25 - 1.35 GHz (L-Band)
c. Instrumented Range	:	80 - 120 NM
d. Range Accuracy	:	≤ 60 m
e. Range Resolution	:	Better than 230 m
f. Azimuth Accuracy	:	Better than 0.15 degrees rms
g. Azimuth Resolution	:	Better than 2.8 degrees rms
h. Improvement Factor	:	55 dB
i. Technology	:	Solid State
j. MTBF (Critical)	:	>33000 hours
k. MTTR	:	30 minutes
l. Monitoring	:	RCMS and BITE
m. Probability of Target Detect.	:	> 98%
n. Average False Target Reports	:	< 20

3.1.2.2.2 Antenna System

a. Antenna Type	:	Dual Beam
b. Frequency Band	:	1.25 to 1.35 GHz
c. Antenna Gain	:	27 dB (Main Beam) 27 dB (Auxiliary Beam)
d. Azimuth Beam Width	:	1.5° +/- 0.15° at -3 dB points
e. Elevation Coverage	:	>30° Cosec2 Pattern or 5.5°
f. Azimuth Sidelobes	:	-25 dB

g.	Polarization	:	Linear / Circular
h.	Tilt Adjustment / Beam	:	Tilt Adjustable between +1 to +5° (Main Beam relative to horizontal)
i.	Rotation Rate	:	5 to 12 RPM
j.	Motor Drive	:	Dual motors. Hand barring and brake facilities with safety interlocks
k.	Data Take-off	:	14 bit high accuracy system
l.	Rotating Joint	:	Shall be have channels for Main Beam, Auxiliary Beam, Wheather Channel and the Sum, Difference and control beams of a Monopulse SSR System
n.	Wind Speed	:	Shall remain operational in wind speed up to 70 knots and survive in wind speed of up to 120 knots (not rotating)
o.	Temperature	:	-40 to 70 degrees Centigrade
p.	Colour	:	ICAO International Orange and White
q.	Antenna Tower	:	The height shall be such that the center of the primary antenna is minimum 15 M above ground level. Galvanized Steel / Anti Corotion.

3.1.2.2.3 Transmitter / Receiver

a.	Frequency Band	:	1.25 to 1.35 GHz (L-Band)
b.	Power Output	:	100 KW peak
c.	Receiver Bandwidth	:	Optimum for pulse duration selected Amplifier 1.5 +/- 0.1 dB. Overall figure including protection devices such as TR Cell, Duplexer, Diplexer etc. shall not exceed
d.	Receiver Noise Figure	:	Amplifier 1.5 +/- 0.1 dB. Overall figure including protection devi- ces such as TR Cell, Duplexer, Diplexer etc. shall not exceed 4.5 dB.
e.	Pulse Width	:	Short (1 uS) and Modulated Long Pulse (75 uS)
f.	Cooling System	:	Forced Air
g.	Temperature	:	-10 to 70 degrees Centigrade

3.1.2.2.4 Primary Plot Extractor

a.	Type	:	Adaptive Processing, such as AMTD
b.	A/D Converters	:	10 bit minimum I and Q

c.	Improvement Factor	:	>50 dB for fixed clutter
d.	Sub Clutter Visibility	:	>31 dB at 80% Pd for fixed clutter
e.	Instrumented Range	:	80 - 100 NM
f.	Temperature	:	-10 to 70 degrees Centigrade
g.	Capability	:	- Installed with PSR / MSSR separately - Installed with PSR / MSSR Combined - PSR Input Interface - Primary Plot Processing - Secondary Plot Processing - PSR/MSSR Plot Combining - PSR/MSSR False Plot Filtering
h.	Format	:	Combined PSR / MSSR format to be agreed by DGAC

3.2. Monopulse Secondary Surveillance Radar Mode S (MSSR Mode S)

3.2.1. Deskripsi Singkat MSSR Mode S

Monopulse Secondary Surveillance Radar Mode S adalah salah satu fasilitas navigasi penerbangan yang bekerja dengan menggunakan frekuensi radio yang digunakan untuk mendeteksi pesawat terbang yang dipasang pada posisi tertentu di sekitar lingkungan Bandar Udara di dalam/di luar sesuai fungsinya.

Peralatan Secondary Radar memancarkan pulsa interogasi berupa informasi identifikasi dan ketinggian kepada transponder yang ada di pesawat terbang dan kemudian transponder mengirimkan pulsa-pulsa jawaban (Reply) yang sinkron dengan pulsa interogasi. Dengan teknik Monopulse, pulsa-pulsa jawaban tersebut dapat menentukan posisi pesawat terbang secara lebih akurat dengan pendeteksian satu pulsa jawaban. Informasi yang diterima berupa : jarak, azimuth, ketinggian, identifikasi dan keadaan darurat dikirimkan ke pemandu lalu lintas udara (ATC Controller). Penggunaan Mode S memungkinkan untuk Selective.

3.2.2. Spesifikasi Teknis MSSR Mode S

3.2.2.1. Coverage : > 250 NM

3.2.2.2. Transmitter

1) Interrogation Carrier Freq : 1030 MHz ± 0.01MHz
2) Polarization of interrogation : vertical
3) Modulation Mode S interrogation : pulse modulated
4) Modulation data pulse P_6 : phase modulation

3.2.2.3. Receiver

1) Frekuensi : 1090 MHz ± 3 MHz
2) Sensitivity : > -85 dBm
3) Interval P1 – P3 : Mode A 8 ± 0.2 microseconds
   Mode C 21± 0.2 microseconds
4) Interval P1 dan P2 : 2 ± 0.15 microseconds
5) Durasi pulsa P1, P2, dan P3 : 0.8 ± 0.1 microseconds
6) Rise time pulsa P_1, P_2, dan P_3 : 0.05 – 0.1 microseconds

3.2.2.4. Interrogation Intermode :

a. Mode A/C/S all-call : interrogation terdiri dari 3 pulsa yang ditransmisikan dan diberi simbol P_1 dan P_3 serta P_4Long. Serta P_2 sebagai pulsa control untuk sidelobe suppression.
b. Mode A/C only all-call : interrogation terdiri dari 3 pulsa yang ditransmisikan dan diberisimbol P_1 dan P_3 serta P_4 Short. Serta P_2 sebagai pulsa control untuk sidelobe suppression
   1) Interval P1 – P3 : Mode A 8 ± 0.2 microseconds
      Mode C 21± 0.2 microseconds
   2) Interval P1 dan P2 : 2 ± 0.15 microseconds
   3) Durasi pulsa P1, P2, dan P3 : 0.8 ± 0.1 microseconds
   4) Rise time pulsa P1, P2, dan P3 : 0.05 – 0.1 microseconds

5) Interval P3 – P4 : 2 ± 0.05 microseconds
6) Durasi P4 short : 0.8 ± 0.1 microseconds
7) Durasi P4 long : 1.6 ± 0.1 microseconds
8) Amplitude P_4 : within 1 dB of the amplitude of P_3

3.2.2.5. Interrogation Mode S : interrogation terdiri dari 3 pulsa yang ditransmisikan dan diberi simbol P_1, P_2, dan P_6, serta P_5 sebagai pulsa control yang ditransmisikan untuk Mode S side lobe suppression.
1) Interval P1 – P2 : Mode S 2 ± 0.05 microseconds
2) Interval leading edge P_2 – sync phase reversal P_6

3.2.2.6. Detection Requirements
1) Detection probability : >95%
2) False Detection : < 2% dari total target
3) False target Reports : < 0.1%
4) Multiple SSR Target Reports
Overall Multiple SSR target report ratio : <0.3%
Multiple SSR target report ratios :
- From reflections : < 0.2%
- From sidelobes : < 0.1%
- From splits : < 0.1%
5) Code Detection
- Mode A probability of code detection : > 98%
- Mode C probability of code detection : > 96%
6) Akurasi deteksi
- Deviasi range dan azimuth: 250 m dan 0.15 derajat untuk SSR; 100 m dan 0.06 derajat untuk MSSR

3.2.2.7. Groundstation Capacity : > 400 pesawat per scan

3.2.2.8. Quality Requirements
1) Positional Accuracy
Systematic errors :
- Slant range bias : < 100 m
- Azimuth bias (degree) : < 0.1°
- Slant range gain error : 1m/Nm
- Time stamp error : < 100 ms
Random errors (standard deviation values) :
- Slant range : < 70 m
- Azimuth (degree) : < 0.08°
Jumps :
- Overall ratio of jumps : < 0.05%
2) False code information
- Overall false codes ratio : < 0.2%
- Validated false Mode A codes : < 0.1%
- Validated false Mode C codes : < 0.1%

3.2.2.9. Availability requirements
1) Outage time availability
- Maximum outage time : ≤ 4 hours
- Cumulative outage time : ≤ 10 hours / year

2) Maintenance
   - MTBF : ≥ 40.000 hours
   - Bagian yang redundant termasuk extractor dan processing unit dengan deteksi failure otomatis harus dapat switch – over dalam waktu 2 detik dan bagian yang rusak jika dimungkinkan dapat diperbaiki dalam waktu kurang dari 24 jam.
   - Minimal terdapat 1 peralatan field monitor yang digunakan untuk mengetahui kesalah pendeteksian dan monitoring alignment secara permanen dari peralatan secondary radar.

3.3. Automatic Dependent Surveillance Broadcast (ADS-B)

3.3.1. Deskripsi Singkat ADS-B

Rekomendasi Organisasi Penerbangan Sipil Internasional (ICAO) tentang penggunaan sistem pengamatan masa depan yang berbasis satelit pengganti radar. Pesawat terbang yang diperlengkapi dengan peralatan ADS-B, pancaran sinyalnya akan diterima oleh Ground Station selanjutnya ditampilkan pada layar pengendali lalu lintas udara (ATC System) melalui sistem komunikasi data baik sistem Mode S Extended Squitter, VDL Mode 4 maupun UAT.

3.3.2. Spesifikasi Teknis ADS-B

a.	Jangkauan Deteksi	: 250 NM pada 290 FL
b.	Target Capacity	: +/- 250 target pesawat pada saat yang bersamaan
c.	Kemampuan proses	: DO 260, DO260A, DO260B
d.	Update rate	: 1 second<rate<5 seconds as Operationally required
e.	Tipe target	: Mode ES, Mode A/C, Mode S
f.	Time Synchronization	: GPS Network Time Server
g.	Receiving signal	: Extended Squitter ADS-B, Mode S 1090 MHz, GPS.
h.	Network Latency	: 95%<2 seconds of G/S output
i.	Reliability 1	: 2 autonomous groundstation including antenna, each providing data, no common point of failure
j.	Reliability 2 – MTBF	: Each groundstation including antenna to have MTBF>10.000 hrs
k.	Communication link	: completely duplicated, no common point of failure.
l.	Availability	: 99,999 %
m.	Integrity - Groundstation	: Site Monitor, GPS RAIM, monitored item by RCMS, at least : - Status Reporting; - Buffer Overflows; - Processor Overloads; - Target Overloads;

- Communications Overload;
- Communications Loss;
- Time Synchronization;
- Temperature Range;

n. Integrity – Data communication And Processing : All system up to ATM system errors < 1x10E-6
o. Data Transmission Mode : Asterix Category 21 edition : 0.23, 0.26, 1.6, 2.1 orlatest edition.
p. Antenna
   1) Frequency : 960 MHz s/d 1215 MHz
   2) Impedance : 50 Ohm
q. Grounding system : Sesuai dengan standar PUIL2000 atau PUIL terbaru
r. Recording dan playback : 30 hari atau lebih
s. Backup power supply : Redundant UPS dengan kemampuan backup tiap unit masing-masing 5 jam

3.3.3. Persyaratan Lingkungan

Mampu beroperasi dalam kondisi :

a. Operation indoor temperature : +10 to +40° C
b. Operation outdoor equipment : -10 to +70° C
c. Indoor Humidity : max. 90%, non condensing
d. Outdoor humidity : max. 95% (-10 to 39° C), max. 50% (-10 to 70°C)
e. Wind velocity : up to 130 km/h
f. Kemampuan menahan beban tambahan pada tiang antenna sampai dengan 200 Kg.
g. Ketahanan tiang antenna mampu bertahan sampai dengan 20 tahun.

3.4. Multilateration (MLAT)

3.4.1. Deskripsi Singkat

Multilateration adalah seperangkat peralatan yang dikonfigurasi untuk memperoleh informasi posisi dari sinyal transponder Secondary Surveillance Radar (SSR), MSSR Mode-S dan ADS-B baik berupa *squitter* maupun *reply* menggunakan teknik *Time Difference of Arrival* (TDOA).TDOA merupakan perbedaan waktu relatif ketika suatu sinyal dari transponder yang sama diterima oleh beberapa stasiun penerima yang berbeda.

MLAT merupakan aplikasi pengamatan yang akurat dalam menentukan posisi pancaran, sesuai dengan identitas data (octal code, aircraft address or flight identification) yang diterima oleh sistem ATM.

3.4.2. Spesifikasi Teknis

a. Pemancar :
   - Interrogation message Generation : 1030 MHz

b. Antenna penerima :
   - Frequency penerima : 1090 MHz
   - Kemampuan penerimaan : Menerima sinyal yang dipancarkan dari target (Mode A/C/S dan ADS-B) dan timestamp di setiap antenna.
   - Time Stamping : UTC time via GPS

c. Central Processor : memproses data dan menjadikannya output dari MLAT (dan ADS-B) track

d. Remote Ground station :
   - Listrik : tersedia
   - Komunikasi : tersedia
   - Remote Control : tersedia
   - Remote switching dan monitoring : tersedia

e. Automation system adaptation : tersedia

f. Persyaratan Lingkungan : tersedianya Power, jalur komunikasi data, akses menuju site, adanya lahan (serta kemungkinan untuk pengembangan).

3.5. ATC Automation

3.5.1. Deskripsi Singkat ATC Automation

ATC Automation adalah fasilitas yang digunakan oleh Air Traffic Controller (ATC) dalam pemanduan lalu lintas udara dan menjaga separasi antar pesawat. Sistem tersebut berfungsi untuk mengolah data radar, mengolah data flight plan, prediksi posisi pesawat, memberikan peringatan, memberikan informasi cuaca, merekam tindakan ATC, dan koordinasi antar unit Air Traffic Service (ATS).

ATC Automation merupakan sistem komputerisasi yang terdiri dari server dan workstation, serta antarmuka dengan peralatan komunikasi dan pengamatan penerbangan.

ATC Automation bertujuan untuk meningkatkan keselamatan penerbangan dengan menyediakan informasi penerbangan dari peralatan pengamatan penerbangan dan unit ATS lain. Informasi ditampilkan pada berbagai layar fungsional, termasuk di antaranya layar situasi ruang udara, layar data penerbangan, layar supervisor, dan layar informasi aeronautika.

3.5.2. Spesifikasi Teknis ATC Automation

3.5.2.1. Spesifikasi Hardware

1) Server (SDPS, FDPS, AGDPS, Radar Front Prcessor, ADS-B Processor, Safety Net, Recording)

a. CPU	:	CPU kelas server modern dengan kemampuan multi-core processing, multi-threading (*latest technology*).
b. Beban maksimum CPU	:	50 % dari kapasitas CPU
c. Memory	:	Memory kelas server dengan kemampuan Error Correcting Code
d. Beban maks Memory	:	50 % dari kapasitas memory
e. Harddisk	:	Redundant Array of Independent Disk (RAID) dengan kemampuan Mirroring.

2) Workstation (CWP, AWP, DBM, FDO, Operational Supervisor, Technical Supervisor, Playback, DAF)

a. CPU	:	CPU kelas workstation high end modern dengan kemampuan multi-core processing, multi-threading (latest technology)
b. Beban maksimum CPU	:	50 % dari kapasitas CPU
c. Memory	:	Memory kelas server dengan kemampuan Error Correcting Code
d. Beban maks Memory	:	50 % dari kapasitas memory
e. Harddisk	:	Redundant Array of Independent Disk (RAID) dengan kemampuan Mirroring.

3) Time Reference System
   - Jenis : Satellite derived (GPS)
   - Protokol : NTP
   - Deviasi maksimum : 100 ms
4) Console : Ergonomis
5) Peralatan Penunjang : Thermal Flight Strip Printer, Flight Plan Strip Holder, Flight Plan Strip Holder Rack, Dimmer,
6) Persyaratan lain-lain
   a. Kemampuan menampilkan track maks. 500 ms sejak track message diterima
   b. Kemampuan menampilkan alarm status <3 detik sejak deteksi kejadian
   c. Waktu untuk switch-over
      - Surveillance server : maks. 2 detik
      - Flight plan server : maks. 10 detik
      - Data recording server : maks. 2 detik

3.5.2.2. Required States and Modes

a. The system shall have the capability to operate in Operational Partition or in Simulator Partition.
b. The surveillance and Flight display consoles shall have the capability to operate in Operational Mode, Direct Radar Access Mode, Simulator Mode, and Playback Mode.
c. The servers shall have the capability to operate in Mode Active, Hot Stand-by and Maintenance Mode.

3.5.2.3. System Capability Requirement, sekurang-kurangnya memuat:

3.5.2.3.1 Man-Machine Interface

The surveillance positions will be able to provide surveillance tracks without interruption. Data will be displayed in a clear way avoiding confusion and/or misunderstanding, and taking into consideration its contents, meaning, or the importance of the data displayed.

3.5.2.3.2 Graphic Interface

3.5.2.3.2.1 Predicted Position Indicator

a. The Main Controller Display shall be able to designate a track vector and to define the predicted ahead in time (minutes) what those vectors represent.
b. The system shall have a command to designate a track for display and define a specific time ahead.
c. The graphic representation of a velocity will be displayed as an extended velocity vector and the length of the vector shall be a function of the controller selected time for predicted positions.

3.5.2.3.2.2 Functional Controls

a. The system shall have the capability to cancel or delete any input action that has been initiated, before the completion or confirmation of execution of the command.
b. The system shall have functional controls using dedicated function keys and a trackball.

3.5.2.3.2.3 Radar Coverage Diagrams and Color Assignment

a. The supervisor position shall have the capability to select colors to be applied to various display elements, in a manner not to degrade or affect the processing of operational functions.
b. Selection of color brightness and intensity shall be available as an operational function in the individual workstation.
c. The main controller position shall have capability to display coverage diagrams for each surveillance sensor and resultant coverage diagram for all ground based surveillance sensors presented in a specific color.
d. These coverage diagrams shall be customized to emulate the theoretical coverage for the heights 5,000 feet, 10,000 feet, and 20,000 feet for each azimuth. Areas with no surveillance coverage shall have a special color.

3.5.2.3.2.4 Screen Annotation

a. The surveillance workstations shall have the capability for entering up to TBD annotations for display. Each annotation will have a specific text and color.
b. The surveillance workstation shall have the capability to route the screen annotation to other surveillance workstations and to suppress displayed annotations as well.

3.5.2.3.2.5 Windows Presentation

a. The surveillance workstation shall organize all the information presented in windows to present surveillance data, flight plan data, alerts, status, commands, where each window shall be selected, resized or moved by the controller.
b. The system shall have the capability to notify any critical information shown in a minimized or inactive window.

3.5.2.3.2.5.1 Main Surveillance Window

The main surveillance window shall present the surveillance data with the capability to zoom and pan.

3.5.2.3.2.5.2 Secondary Surveillance Window

The secondary surveillance windows shall provide the same capability than the main surveillance window with independent resize, zoom and pan.

3.5.2.3.2.5.3 System Status Window

The System Status Window shall display the following information:

- Time and Date;
- Selected display range;
- Altitude filter bounds;
- SSR block code selections;
- CJS Designation;

- Presentation mode;
- Magnetic Variation;
- Label line selections.

3.5.2.3.2.5.4 General Information Window

The system shall provide the capability to display the following information on the Flight Data Display:

- Flight Plan
- MET data
- Aeronautical/Meteorological Information: Notice to Airmen (NOTAM) and Meteorological Report (METAR), and other meteorological messages (SIGMET, AIRMET, GAMET, SPECI and TAF);
- General Purpose Information;
- QNH values for aerodromes and regions.

3.5.2.3.2.5.5 Messages Windows

a. The system shall have the capability to display pending coordination messages between centers, sectors or tracks (via Datalink).
b. The system shall have the capability to register all the coordination actions even when the interface between the systems is not working.
c. The system shall have the capability to display an alert when a response to a coordination message is not received.
d. The system shall have the capability to display the coordination messages received till the operator send the answer correctly.
e. The system shall have the capability to display the history of coordination messages.

3.5.2.3.2.6 Images

The main surveillance window shall have the capability to display georeferenced images representing meteorological information as an overlay under operator control.

3.5.2.3.2.7 Surveillance Data Display Elements

a. ADS-B, ADS-C, PSR, SSR, and PSR/SSR plot presentation shall be available as a selectable function.
b. Surveillance workstations shall have the capability of manually enable or disable the presentation of plot data besides the presentation of tracked targets.
c. The track information shall indicate:
    - Aircraft position;
    - Track history information.
d. The system shall have the capability to process and display:
    - SSR code or callsign when correlated with a flight plan;

- Flight level/altitude based on Mode C or barometric corrected altitude (below the transition level) surveillance information;
- Heading and ground speed (as a speed vector);
- Alitude indicator, i.e., climb, descent, or level flight.

e. The system will have the capability to calculate and display the predicted position of any track as designated by a controller input action.

f. The surveillance position shall have the capability to process and display alphanumerically the ground speed and heading (track) of any track designated.

g. The following elements shall be available for display:
   - Map information;
   - Range rings;
   - Time;
   - Selected Surveillance Display range;
   - Selected height filter;
   - Controller jurisdiction indicator;
   - Handoff indication;
   - Range/bearing line (cursor);
   - Indication when the Air Situation Display is not being updated;
   - Selected track presentation mode/surveillance sensor;
   - Special codes;
   - STCA (Short Term Conflict Alert);
   - MSAW (Minimum Safe Altitude Warning);
   - MTCD (Medium Term Conflict Detection);
   - CLAM (Cleared Level Adherence Monitoring);
   - AIW (Area Infringing Warning);
   - RAM (Route Adherence Monitoring);
   - Track information, including:
     - o Position symbols;
     - o Track history information.
   - Label information.

h. Critical information related to the display of special codes, STCA, MSAW, MTCD, CLAM, AIW Data or information considered to be critical for the operation shall always be displayed in a clear and unambiguous manner.

3.5.2.3.2.8 Surveillance Data Position Symbols

Different symbols shall be used for indicating a PSR plot, SSR plot, PSR track, SSR track, PSR/SSR track, ADS-B Track, ADS-C Track, Multilateration Surveillance track, Flight Plan navigated track.

3.5.2.3.2.9 Track History Information

a. The surveillance workstation shall have the capability to enable or disable track history information in each position.

b. The surveillance workstation shall have a capability to select the number of track history positions, using a specific symbol.

3.5.2.3.2.10 Display Range

The Surveillance Display shall have the capability to select a specific range for each surveillance workstation.

3.5.2.3.2.11 Range Rings

The system shall have the capability to display Range rings individually selectable at each surveillance workstation as circles centered on the selected ground based surveillance sensor in monoradar mode and multiradar mode.

3.5.2.3.2.12 Quick Look

a. The system shall have a capability to display all tracks and labels through an individual quick look function.
b. The quick look function shall enable display of label track data bypassing all local filters.

3.5.2.3.3 Range Bearing Line

Each Surveillance Display shall have the capability to display a minimum of 3 range/bearing lines, displayed at the end of the line, as the following types:

- Between any two operator selectable points;
- Between any two moving targets, including a time field,
- Between a operator selectable point and a moving target, including a time field;

3.5.2.3.4 Smart Labels

The smart label will be the main way to interact with the system.

The system shall have a capability to display three types of label:

- Standard Label – with the minimal track/flight plan information.
- Extended Label – activated when the cursor pass over the label.
- Selected Label- similar to the extended label but with interaction in the fields.

3.5.2.3.4.1 Controller Jurisdiction Indicator (CJI)

a. The system shall have a capability to display an indication an indication of which sector has jurisdiction over the track in question.
b. The system shall allocate a separate jurisdiction indicator as defined in adaptation data.
c. This CJI shall be shown in conjunction with the handoff function.
d. The system shall display involved in a handoff through a distinct presentation.

3.5.2.3.4.2 Special Position Indicator (SPI)

a. The system shall display activation of SPI using a unique indication.
b. The system shall have the capability to re-position any label relative to the position symbol, manually or using an automatic algorithm.
c. The following data shall be displayed in a label, if available:
   - SSR code or call sign when correlated with a flight plan or entered manually from a surveillance workstation;
   - Mode C flight level/altitude;
   - Attitude indicator, i.e., climb, descent, or level flight;
   - Controller jurisdiction indicator;
   - Calculated ground speed, expressed in tens of knots;
   - Cleared flight level;
   - Quality Factor;
   - ADS Data:
   - Coordination Data;
   - Free text, entered manually.
d. The calculated vertical speed shall be displayed after an appropriate controller input action.

3.5.2.3.5 Filters

a. The system shall have a capability to select an upper and lower limit for the level filter, at each surveillance workstation.
b. The following conditions shall override the filters:
   - Tracks which are under the jurisdiction of this workstation;
   - Special condition tracks;
   - Tracks that are quick-looked at the display;
   - Active handoff tracks;
   - Targets that do not currently have valid Mode C data;
   - Tracks which are individually selected for display by the controller;
   - Unsuppressed tracks in MSAW, STCA, MTCD, CLAM, RAM, AIW alerts.
c. The surveillance shall have a capability to display the height filter limits selected.
d. The system shall have the capability enable/disable adapted areas within which detected tracks will not be displayed.
e. The system shall have a capability to designate specific codes or code groups to filter the track label presentation.

3.5.2.3.6 Maps

a. The system shall have a capability to select and present map data in each surveillance workstation.
b. The map presented shall have specific graphic representation for the following entities:
   - FIR/UIR borders;
   - Lateral limits of sectors;

- Terminal control areas;
- Control zones;
- Traffic information zones;
- Airways and ATS routes;
- Restricted areas.

3.5.2.3.6.1 Weather Surveillance Data

a. The system shall have the capability to display weather surveillance data from PSR radars or Meteorological radars.
b. The system shall have a capability to select the display of high intensity, both high and low intensity, or no weather, if this information is available.

3.5.2.3.6.2 Private Maps

a. The surveillance workstation shall provide the capability to define and to display private maps created on-line with different attributes of lines.
b. Presentation of each private map shall be individually selectable.

3.5.2.3.7 Flight Plan

3.5.2.3.7.1 Flight Strip Window

The system shall provide the capability to display up to TBD pages of flight strip information in this window on the ESD.

3.5.2.3.7.2 Flight Data Displays

a. The system shall provide functional controls to enter, modify, cancel and display flight plan data.
b. The system shall have the capability to insert a change in a flight plan route through graphical point selection.
c. The flight plan functions shall include:
    - flight plan data entry;
    - flight plan update data update;
    - Display of flight plan data;
    - Edition of stored/displayed information;
    - Printing of Flight Progress Strips:
    - Edition of departure clearance for inactive and pre-active flight plans;
    - Manual edition of ATS messages;
d. The system shall have the capability to edit a flight plan using a graphic tool over a specific thematic map.
e. The system shall have a capability to display a flight plan history, with all the actions and message updates received or transmitted related to that flight plan.

3.5.2.3.7.3 Flight List Presentation

The system shall have the capability to display traffic lists, based on the flight plan status, including coast and hold information.

3.5.2.3.7.4 Flight Strip Presentation

The system shall have the capability to display Electronic Flight Strip and to print Paper Flight Progress Strip.

3.5.2.3.7.4.1 Paper flight progress strip

a. The system shall have the capability to define a flight Strip format and layout in adaptation data.
b. The system shall distribute flight strips in accordance with the route system and the Strips distribution plan as defined in adaptation, and the capability to print flight strips at any time.

3.5.2.3.7.4.2 Electronic Flight Strips

a. The system shall have the capability to display electronic flight strips.
b. The system shall have the capability to allow the operator to select pre-defined flight level using smart labels.
c. The system shall display electronic flight strips associated with the flight under control or prior to control of the associated jurisdiction sector at the position associated to the sector.
d. The system shall have the capability to display at least the following sub-states for a flight plan:
    - active not controlled;
    - active controlled;
    - in transfer (donor, receptor and proposed);
    - announced;
    - holding;
    - transferred;
e. There shall be specific presentations for the following conditions:
    - correlated;
    - multicorrelation (two or more tracks having identical SSR code associated to the same flight plan);
    - non-conformance route/track position indication;
f. There shall be a unique presentation for the first display of the flight plan.

3.5.2.3.7.5 Flight Plan Data Retrieval

a. The system shall have the capability to retrieve flight Plans, repetitive flight plans, and flight plan history from the database.
b. The system shall have the capability to retrieve flight plan data available on the basis of: Flight identification, in combination with departure aerodrome, and/or EOBT/ETA (validity times).

3.5.2.3.7.6 Repetitive Flight Plan Retrieval
The Flight plan workstations shall have access to RPL data in the RPL file, and to retrieve RPL data available on the basis of: Flight identification, in combination with departure aerodrome and/or EOBT/ETA.

3.5.2.3.7.7 Flight Plan History
The system shall have a capability to display and print all messages concerning a flight plan, including associated update messages, for at least adaptable hours after termination of flight plan.

3.5.2.3.7.8 Free Text Input and Distribution
The system shall have the capability to perform "free text" input, and to be able to route this information for output to other designated workstations or any AFTN/AMHS address.

3.5.2.3.7.9 RVSM
The system shall have the capability to process and display RVSM status according with the associated flight plan, the operator input data and coordination messages as well, considering the RVSM airspace;

3.5.2.3.7.10 PBN
The system shall have the capability to process and display the PBN status associated to the flight plan according with the Amendment 1 of Doc 4444, considering the operator input data and coordination messages as well;

3.5.2.3.8 Datalink Communication

a. The system shall be linked to aircraft by a datalink service provider (DSP).
b. The system shall be capable of transmitting and receiving AFN, ADS and CPDLC messages complying with RTCA/DO258A-EUROCAE/ED-100 and AIDC messages complying with the Asia/Pacific Regional Interface Control Document for AIDC (ICD).
c. The system shall include the ACARS Convergence Function (ACF) to convert messages between the character-oriented data of ACARS and the bit-oriented data used in ADS and CPDLC.
d. The system shall provide air traffic controllers with:
    - Display of message exchanges;
    - Display of updated aircraft positions and maps;
    - Tools for measuring separation in distance or time;
    - Tools for measuring angles between aircraft flight paths;
    - Information on aircraft flight status;
    - HMI tools for composing ADS and CPDLC messages;
    - Alerts for exception conditions;
    - Conflict probe capability;

- Electronic flight prog
- ress strips, and paper strips if required;
- Presentation of emergency status;
- Other information pertinent to ATS operations.

3.5.2.3.8.1 CPDLC

a. The system shall have the capability to communicate using the protocol CPDLC
b. ("Controller- Pilot Datalink Communication").
c. The system shall be capable of processing the specified number of message exchanged with each of the aircraft.
d. Down-linked CPDLC messages shall be displayed to controllers. Tools shall be provided to allow simple and intuitive initiation of, or response to, CPDLC messages.
e. CPDLC position reports shall be used to display aircraft positions when no ADS report is available.
f. The system shall have the capability of terminating CPDLC connection with the aircraft.
g. The system shall allow transfer of CPDLC between sectors of an ATCAS without changing the data authority and with the same CPDLC link.
h. The system shall be capable of handling the message set and the standardized free text messages defined in the FOM, as well as free text.
i. The system shall allow controllers to review uplink messages prior to sending.
j. Messages shall be handled in order of priority.
k. Messages with the same priority shall be processed in the time order of receipt.
l. The controller shall be alerted to unsuccessful receipt of the required response in the specified time or receipt of Message Assurance Failure (MAF).
m. The system shall allow controllers to send any response messages linking with the reference number of the message received.
n. A CPDLC dialogue shall not be closed until an appropriate closure response for that message with same reference number is received.
o. When the closure response message is sent, the dialogue is closed and the system shall reject any further attempt to send a response message.
p. The capability of closing a CPDLC dialogue, independent of CPDLC closure message receipt, shall be provided.
q. The system shall have the capability to send the more frequent CPDLC messages through an interface using the associated track label.

r. The system shall have the capability to display aircraft data, received by ADS, in the standard or extended track label.
s. The system shall have the capability to display different shapes or symbols to differentiate that the aircraft is ADS/CPDLC capable and it is in contact with the Center.
t. The system shall have the capability to allow the operator to differentiate information of course, speed and vertical speed received automatically by ADS.
u. The system shall have the capability to uplink messages to the aircraft regarding the controller actions that the pilot need to know.
v. The system shall have the capability to display in the outbox message list all the uplink CPDLC messages that are pending for an answer from the pilot.
w. The system shall have the capability to display in a unique way the field associated to a change made by the controller till a downlink message is received from a pilot saying the change was made.
x. The system shall have the capability to display a communication failure message, when an expected downlink message is not received during a time-out (adaptable).

3.5.2.3.8.2 ADS

a. The capacity of the ADS function shall be determined from the operational policy and procedures and the airspace characteristics, including number of FANS capable aircraft, periodic reporting rate, airspace size, waypoint event report frequency, usage of event and demand contracts, and projected traffic growth.
b. The system shall be capable of initiating periodic, event and demand contracts.
c. The system shall be able to support a demand, an event and a periodic contract simultaneously with each aircraft.
d. The system shall apply validation checks to incoming data by reference to flight plan data in relation to time, altitude, direction and position.
e. The system shall be capable of processing ADS reports to display aircraft positions, tracks and altitude. Between ADS reports, aircraft positions shall be extrapolated and displayed automatically at specified intervals.
f. Air and earth reference data of ADS reports shall be provided to controllers if required. The types of ADS contract are described at ICAO 9694 and 9880 documents.
g. ADS messages shall be processed by the system in the following order:
    1) ADS emergency mode.
    2) Demand/event reports.
    3) Periodic report.

h. Within these categories, messages shall be handled in the order received.
i. The following errors shall be notified to controllers:
   - Message validation error.
   - Message sequence error detected with time stamp.
   - Time-out of ADS report in response to request.
   - Periodic and waypoint event report failure.

3.5.2.3.8.3 Notification of Error Messages

a. The system shall be capable of performing the cyclic redundancy check (CRC) on each message.
b. The system shall be capable of verifying the format and validity checks appropriate to each message.
c. Controllers shall be notified when the system detects:
   - A message error;
   - A message sequence error;
   - A duplicate message identification number;
   - Message non-delivery;
   - An expected response not received.
d. The system shall have a capability to display ADS or CPDLC emergency message received from an ADS/CPDLC equipped aircraft.

3.5.2.3.8.4 Timestamps and Timers

a. CPDLC and AIDC messages shall be timestamped.
b. By setting and/or deactivating various timer values for the messages received in response to transmitted messages, the system shall monitor whether or not aircraft responses arrive within a specified time limit. Timers are generally based on the operational requirements of each ATCAS.
c. The timers for sending messages relating to the automatic transfer of CPDLC connection and to AIDC shall be set according to bilateral agreements with adjacent ATCAS concerned.
d. A timer file shall be provided in the system for:
   1) Timeout settings for delayed response.
   2) Timing to initiate actions in ADS/CPDLC operations for:
      - Connection request (CR);
      - ADS periodic, event and demand requests;
      - Automated transfer of connection to the next ATCS;
      - Sending Next Data Authority (NDA) message;
      - Sending AFN Contact Advisory (FN_CAD): at least 30 minutes prior to FIR boundary message;
      - Sending End Service message prior to the aircraft crossing the FIR boundary (e.g. 5 minutes before);
      - Timer to trigger actions for sending AIDC messages;

- Timer for re-transmission of the message when no response is received within a specified time.

3.5.2.3.8.5 AFN Logon Functions

The AFN logon functions provide the necessary information to enable ADS and CPDLC communications between the system and aircraft avionics systems for:

• Logon;

• Forwarding logon information to the next ATCAS.

Note: Details of Datalink Initiation Capability (DLIC) functional capabilities are provided in Doc 9694 Part 2.

The required capacity for AFN logons will be determined from the operational requirements, such as estimated number of FANS aircraft at the peak hours and anticipated growth of FANS traffic.

a. The system shall be capable of accepting or rejecting AFN logon requests.
b. The system shall have the capability to correlate the AFN logon data automatically with the aircraft flight plan.
c. The controller's workstation shall be capable of displaying the following data:
   - Address and version number of the aircraft applications, if required;
   - Response from the aircraft with timestamp;
   - Status of correlation of the aircraft with its stored flight plan;
   - Indication of 'Acceptance' or 'Rejection' to the logon request from aircraft.
d. When an aircraft downlinks its supported applications and their version numbers in an FNCON message, the ATCAS system response shall indicate whether or not it supports those version numbers.
e. The system shall be capable of sending the Acceptance message or the Rejection message with reason, as appropriate.

3.5.2.3.9 Surveillance Data Processing

Ideally, surveillance systems shall incorporate all available data to provide a coherent picture that improves both the amount and utility of surveillance data to the user. The choice of the optimal mix of data sources shall be defined on the basis of operational demands, available technology, safety and cost-benefit considerations.

3.5.2.3.9.1 Air Situation establishment

a. The system shall make available a plot position presentation as a selectable function.
b. The system shall have the capability to receive, process and integrate all the messages (plots and tracks) to create and update a

dynamic Air Situation received form the following surveillance sources:

- ADS-B: Eurocontrol Asterix Protocol Standard including Categories 10, 11, 21 e 23;
- ADS-C: ACARS Protocol;
- Multilateration: Eurocontrol Asterix Protocol Standard including Categories 10, 11, 19 e 20;
- Mode S: Eurocontrol Asterix Protocol Standard including Categories 10, 11, 34 e 48;
- Adjacent Centers: Eurocontrol Asterix Protocol Standard including Categories 62, 63 e TVT2;
- Radars: Eurocontrol ASTERIX protocols including categories 1, 2, 8, 34, 48 with UAP from Raytheon, Thales, SELEX, Lockheed Martin, INDRA, INVAP, NRPL;
- Radars: EV 720, CD2, AIRCAT500, TVT2 legacy Protocols.

c. The system shall have the capability to create and update track information based on the flight plan information and controller data input (Flight Plan Navigated tracks);
d. All the messages shall be submitted to a process to validate the message format before the surveillance integration, discarding erroneous messages and logging all errors found.
e. The system shall have the capability to create a timestamp for all the messages using an UTC Time reference sent by the sensor, or using the local relative time.
f. The system shall have the capability to integrate all the meteorological information from the primary radars (cat 8 messages) to display at the surveillance display.
g. The system shall have a capability to tracking all the surveillance reports using a
h. Surveillance Multisensor Tracking, improving accuracy and smoothing of the resulting system tracks through adaptative Kalman filters.
i. The system shall have the capability to manage the status of all sensors, to determine which of the sensors are available to participate of the data fusion.
j. The system shall have the capability to manage the surveillance report aging from all the sensors, and to verify the eventual interruption of message flow.
k. The system shall have the capability to manage the surveillance track update and the track suppression for both the system track file and the local track file.
l. The system shall have the capability to evaluate in real-time the highest quality information, and use the highest quality component information to update the system tracks, establishing priorities for the sensor types as defined in adaptation. At the current stage of

development of ADS-B systems, radar is generally accepted as the best surveillance data, followed by ADS-B and then by ADS-C. Flight plan tracks have the lowest quality.

3.5.2.3.9.2 Surveillance Data Output

The system shall have the capability to forward surveillance track and flight plan information associated to the Adjacent ATCAS, using an ASTERIX interface categories 62, 63, and following a geographical filter previously defined in adaptation.

3.5.2.3.9.3 Surveillance Data Processing Capabilities

a. The SDPS shall support the updating of system tracks with a Surveillance Tracking (ST) method which uses data from multiple sensors when overlapping surveillance coverage exists. The ST capability includes a track filtering algorithm capable of processing data from different surveillances. The data will be received at irregular times and each surveillance data will have unique position error variances.
b. The SDPS shall maintain a system track and shall have the capability to display smooth system tracks which are updated based on surveillance data from multiple sensors.

3.5.2.3.9.4 Surveillance Presentation

a. The SDPS will have the capability to present surveillance data in two modes:
   - System Track Presentation Mode: A surveillance mosaic (the system mosaic) based on an integration of all surveillance sensors.
   - Local Track Presentation Mode: Any single sensor connected to the SDPS.
b. Each Surveillance Controller workstation shall individually be able to select a presentation mode, with a clear indication of the mode of presentation selected.
c. When switching from one track presentation mode to another, there shall be no noticeable disruption in the presentation of data, except that some targets may not be detected anymore and others will be repositioned.
d. When Local Track Presentation Mode has been selected, data processed at system track level shall be maintained for display and cinematic surveillance data presented shall be derived from the designated single sensor.

3.5.2.3.9.5 Surveillance Data Processing Functions

a. The system shall provide the following functions:
   - SSR reflection suppression;

- Processing and displaying of aircraft ground speeds, headings, predicted positions, SSR Mode C data, ADS Data;
- Display of position symbols (radar and ADS symbols) and specified track and label data;
- Processing and displaying of SPI and special codes;
- Provision for filtering;
- Display of coasting tracks;
- Surveillance data recording.

3.5.2.3.9.6 Direct Surveillance Access (DSA) Back-up Mode

a. The DSA server shall provide surveillance sensor data onto the DSA LAN for selection by controller surveillance workstations in the DSA Back-up mode.
b. The Direct Surveillance Access server shall process all surveillance data formats specified for the SDP.
c. The controller specified DSA surveillance information shall be available upon selection of the DSA Back-up mode.
d. Each surveillance workstation shall receive and process data from the Direct Surveillance Access server.
e. The back-up mode shall provide map selection, range selection, off-centering, and manual code/callsign association, as well as display management functions in each surveillance workstation.

3.5.2.3.9.7 Real-Time Quality Control (RTQC) of Surveillance Data

3.5.2.3.9.7.1 Automatic Test Target Monitoring

In accordance with ICAO recommendations, fixed SSR Test Transponders will be installed within the surveillance coverage for each of the SSR sources integrated to the system.

a. Test Targets shall be available for presentation in any surveillance position.
b. The system shall have the capability to monitor the geographical position of the Test Transponders. If a Test Transponders position falls out of tolerance (adaptation), the SDPS shall notify and log at the Technical and Operational Supervisor Position.

3.5.2.3.9.7.2 Status Message Monitoring

a. The system shall monitor the status messages to detect a change in the status of the surveillance sensor link or an increase in the error rate status message to declare a surveillance link down or up.

3.5.2.3.9.7.3 Surveillance Data Counts Monitoring

a. The system shall maintain a count of the various types of surveillance messages in the system, including SSR and PSR

messages. All anomalies in these controls shall be reported to the Technical and Operational Supervisor.

3.5.2.3.9.7.4 Registration Analysis

a. The system shall provide the RTQC capability for ground based radars to perform range deviation and azimuth deviation computations on targets of opportunity. The capability will be continuously active and will monitor target reports received from surveillance pairs identified in adaptation.
b. The system shall have the capability to calculate range and azimuth bias errors, and if these errors exceed adapted tolerance standards, an alert message shall be reported to the Technical and Operational Supervisor.
c. The system shall have the capability to print a report of the most recent registration analysis on request.

3.5.2.3.9.7.5 Registration Correction

The system shall provide the capability to manually update the surveillance registration corrections.

3.5.2.3.9.7.6 SSR Reflections

The system shall have the capability to suppress SSR reflections, using the following conditions:

- The plot/track report has an SSR code that is one of the adapted discrete codes;
- The range and azimuth of the report lie within one of the reporting surveillance's adaptable reflection areas;
- Another report from the same radar that has the same code (duplicate) from the same surveillance scan, and its range is less than the range of the current plot/track report minus a design parameter range delta.

3.5.2.3.9.7.7 Altitude Processing

a. The system shall have the capability to process QNH values for a minimum of TBD airports for the calculation of Transition Levels and conversion of Mode C derived data.
b. The system shall have the capability to convert Mode C derived flight levels into altitudes for all aircraft in a QNH area below the relevant Transition Level.
c. The system shall have the capability to process area QNH values for a minimum of TBD areas for the calculation of minimum usable flight levels on airways and other ATS routes.

3.5.2.3.10 Flight Plan Data Processing

3.5.2.3.10.1 Flight Data Processing Functions

a. The system shall have the capability to receive, store, process, update, and display, repetitive flight plans (RPL), flight plans, and other ATS messages.
b. The system shall have the capability to receive ATS messages from several sources, including AFTN/AMHS and adjacent centers.

3.5.2.3.10.2 Flight Data Processing Capabilities

a. The system shall include the following capabilities:
   - Flight plan routes analysis and flight trajectory and times calculation;
   - Flight plan status determination based on inputs and timed events;
   - Displaying and/or printing of flight plan data to relevant sectors;
   - Automatic and manual Secondary Surveillance (SSR) code allocation;
   - MET data processing;
   - Flight plan / track association;
   - Intersector and interunit coordination;
   - Automated updating of flight plans based on Estimated Time Over (ETO) through correlation of flight plan data and surveillance data;
   - AFTN Message processing.
b. The system shall make available fully automatic processing of the standard ICAO flight plan messages, including the coordination message as foresee in the OLDI (used only to exchange data with pre-existent ACC/APP that use this interface) and AIDC specification.
c. The system shall support the current and new flight plan format, as in the Amendment 1 to the Procedures for Air Navigation Services — Air Traffic Management, Fifteenth Edition (PANSATM, Doc 4444) for applicability on 15 November 2012.
d. The system shall generate and maintain a system flight plan which will be kept until it is terminated.
e. The system shall ensure that equipment or communication unavailability in a sector will not cause any disturbances to the data interchange between other sectors/ centers.
f. The system shall process VFR flights in the same manner as IFR flights unless otherwise specified

3.5.2.3.10.3 Flight Data Database

The system shall have the capability to establish and maintain a database of flight plans and to activate these flight plans for further processing, permitting modification, addition, and deletion of previously entered flight plans.

3.5.2.3.10.3.1 Repetitive Flight Plan (RPL) Data

a. The system shall have the capability to receive RPL data via media, download or manually entered and store them in the RPL file.
b. The system shall have a capability to transfer a RPL automatically to a flight plan database at a stipulated (adaptable) time prior to the time of entry into the area of responsibility.
c. The FDPS shall provide the operator with the capability to create, modify and delete flight plans from the RPL file.

3.5.2.3.10.3.2 AFTN/AMHS Flight Plan Data

a. The system shall have the capability to receive and process the following ATS messages received from AFTN/AMHS: FPL, DEP, ARR, RQP, ALR, RCF, RQS, AFP, SPL, CPL, DLA, CNL, EST, CHG, CDN, LAM, ACP and AIREP as foresee in the ICAO 4444 Document and include other coordination messages.
b. The system shall have a capability to enable or disable via a VSP the automatic processing of ATS messages for each message type. When it is enabled, ATS messages shall be processed for display to specific Flight Plan positions in the following conditions:

    1) Whenever the message contains an error, discrepancy or other invalid data.
    2) Whenever the flight plan contains data in field 18, except when the data are prefixed by "REG/", "SEL/", "OPR/", "ALTN/", or "EET/".

c. In the cases where a message is not identified, or contains data that are not valid, or cannot be paired with previously stored data, an "invalid" response as well as the message itself shall be displayed to the specific flight plan positions. The message shall in such cases be displayed in the format in which it was received and with an indication of the "invalid" data.
d. The system shall have the capability to check all ATS messages for:
    - Format errors;
    - Syntax errors;
    - Previous receipt of the same message;
    - Validity, with respect to whether the flight plan or flight update message will affect the area of responsibility;
    - Compatibility, with respect to conformance between aircraft type, True Airspeed (TAS), flight level/altitude, EET, departure aerodrome, route within the defined route system, and destination;

- Validity time;
- Channel sequence number.

3.5.2.3.10.3.3 Operator Flight Data Input

The system shall have the capability to display at the Surveillance Display and Flight Data display and input the following types of flight plan messages:

- FPL and CPL;
- Flight updates messages;
- Departure state transition messages;
- Fix estimate updates;
- Cleared level updates.

3.5.2.3.10.3.4 MET Data

a. The wind direction and speed, referenced as MET Data shall be able to be received through the AFTN/AMHS interface, as defined in the SICD.
b. The MET data shall be processed for multiple height layers and areas for use in trajectory and times calculation, employing the data valid for the route (area).
c. The Flight Data Display shall have the capability to display and change the MET data.

3.5.2.3.10.3.5 Input Message Processing

a. The FDPS data base shall have the capability to identify, classify, and process the message types received, as well as identify the originator (source) of the message.
b. Received CNL-messages with respect to pre-active and active flight plans shall be processed for display to the sectors concerned.
c. Flight update messages shall automatically change the parent flight, causing, if necessary, the re-processing of the flight plan.
d. The system shall have a capability to do the following actions, as required, when a flight update message is received:
    1) New calculation of flight trajectory/flight times;
    2) New analysis of flight plan route;
    3) New analysis of flight strip distribution plan;
    4) New distribution of flight data for display update.

3.5.2.3.10.4 Flight Progress Processing

a. The system shall have a capability to determine the status for each flight plan, reflecting the current state of the flight.
b. During a flight plan lifetime, the system shall have a capability to attribute a flight plan the following states and its transitions:
    - Inactive - when a new flight plan is created;

- Pre-active – VSP time before the effective realization of the flight;
- Active - corresponds to the effective realization of the flight;
- Terminated - corresponds to the period when the flight plan is ended by operator action or automatically, staying in the system only for consulting features.

3.5.2.3.10.5 Route Processing

a. The system shall have the capability to produce and maintain a continuous flight profile/trajectory for every valid flight plan received.
b. The system route system shall include:
   - The defined airspace, airways, and ATS route structure;
   - Navigational aids/significant positions and Aerodromes;
   - Sector boundaries;
   - SID/STAR procedures.
c. The route processing function shall accept input data based on:
   - Route as indicated in the flight plan or, if applicable, as subsequently indicated by an update message;
   - Entry of significant positions defining the route by significant points/positions, latitude/longitude positions.
d. The system shall have a capability to do a Route analysis/conversion automatically.
e. Trajectory estimation shall be based on route, flight planned level/altitude, available wind data, and aircraft performance characteristics.
f. The route processing function shall determine significant positions and calculate ETOs for those positions.
g. The system shall have the capability to integrate an AMAN (Arrival Management) and/or a DMAN (Departure Management) and/or SMAN (Surface Manager) tools for Tactical Local Planning.

3.5.2.3.10.6 Secondary Surveillance (SSR) Code Allocation

a. The system shall have the capability to process both manual and automatic SSR code allocation.
b. The system shall have the capability to maintain lists of codes to be used for automatic code allocation.
c. The system shall have the capability to maintain lists of codes to be retained for flights from another ATC Center.
d. The system shall have the capability to automatically allocate non-duplicated codes to flight plans for flights generated within the FIR and equipped with a 4096 SSR code transponder.
e. The system shall have the capability to assign non-duplicated adapted discrete codes an adapted non-discrete codes to designated flights as specified by controller input action.

f. The system shall have the capability to release previously assigned codes for re-allocation.

3.5.2.3.10.7 Flight Plan/Track Association Function

a. The system shall have the capability to automatically associate flight plans with the appropriate surveillance system tracks.
b. The system shall have a capability to allow the operator to initiate an association.
c. The system shall have the capability to terminate the association (also called disassociation) between a track and a flight plan either automatically or manually.
d. The system shall have the capability to do an automatic association only with discrete SSR codes.
e. The system shall have the capability to allow the operator to do a manual association with discrete and nondiscrete SSR codes and tracks without an SSR code (primary tracks).
f. The system shall allow the manual association only if the track and flight have the same CALLSIGN.
g. The system shall have the capability to monitor periodically each controlled flight for conformance with its planned route, using the associated surveillance system track's position to compute the ETO for each fix in the route, and to determine when each fix has been passed.

3.5.2.3.10.8 Sectorization

The airspace of interest is described geographically in the adaptation data in terms of nonoverlapping volumes of airspace known as geographic sectors. These volumes are polygons in the horizontal plane and have an up to TBD different levels dividing the airspace that can be controlled by a controller. This unit of airspace is usually called a controlled sector.

The system shall have the capability to declare up to TBD different levels to define the control sectors.

3.5.2.3.10.8.1 Sector Reconfiguration Function

a. The system shall have the capability to change the definition of control positions and the assignment of control sectors to positions through the consolidation input.
b. The system shall check if the new position has the capacity for all the flights affected by the requested consolidation and to automatically change the ownership to this new position.

3.5.2.3.10.9 ATFM Functions

a. The system shall have the capability to analyze the air traffic with anticipation for Air Traffic Flow Management purposes.

b. The system shall have the capability to display a graphic of flight plans associated to a predicted period of time , using a filter for a specific:
   - Airport: classified by flights in ETA or ETD;
   - Coordination point: classified for ETO;
   - Sector: classified for time of arrival in the sector;

3.5.2.3.10.10 DPS Output

a. The system shall have the capability to provide all controller workstations with an up-to date presentation of the state of all individual flights assigned to, or otherwise of significance to (i.e., to be assigned to) each workstation.
b. The system shall have the capability to transmit flight update messages to all ATC workstations and adjacent ATC centers.

3.5.2.3.10.10.1 Output of Messages to AFTN/AMHS Network

The system shall have the capability to support a protocol for communication with interactive ACCs, where adapted, and the transmission of the FPL, DEP, ARR, RQP, ALR, RCF, RQS, AFP, SPL, CPL, DLA, CNL, EST, CHG, CDN, LAM, ACP and AIREP messages.

3.5.2.3.10.10.2 Flight plan Handoff

a. The system shall have the capability to determine automatically when a surveillance track associated with a flight plan is about to cross sector or FIR boundaries, in order to transfer the flight plan from one controller to another or from one controller to another ATC system sector.
b. The system shall have the capability to allow the controller do a handoff between the involved sectors or Adjacent ATCAS involving the main phases:
   - handoff warning: it is generated at a time (adaptable) before the ETO of the coordination point to the current owner of the flight to indicate that the handoff to the next sector is due;
   - handoff initiation: the owning controller requests the hand-off function to validate and initiate the control transfer to the next sector on the flight's planned route;
   - handoff acceptation: the receiving controller can accept and conclude the control transfer processing.
c. The system shall have the capability to output flight plan data to the Adjacent ATCAS as specified in the SICD.
d. The system shall have the capability to exchange coordination messages, with the following protocols:
   - Messages ICAO 4444 standard, using the AFTN/AMHS;

- Messages AIDC as specified in the Asia-Pacific ICD, using the AFTN/AMHS;
- Messages OLDI as specified by EUROCONTROL, using dedicated links.

e. For AIDC protocol, the system shall have the capability to exchange the minimum set of messages (ABI, CPL, EST, PAC, ACP, MAC, LAM, LRM, TOC, AOC) for the Notification, Coordination and Handoff phases defined in the referenced AIDC ICD.

f. For OLDI protocol, the system shall have the capability to exchange the minimum set of messages (ABI, ACT, REV, PAC, MAC e LAM) for the Basic Procedure, Dialogue Procedure – Coordination Phase and Dialogue Procedure – Transfers Phase as defined in the referenced OLDI ICD.

g. The actual protocol used to Exchange flight plan messages with adjacent ATCAS shall be defined in adaptation data.

3.5.2.3.10.10.3 ATFM unity

a. The system shall have a capability to send coordination information, slot information, predicted and current traffic load and flight plan updates to an ATFM unity.

b. The system shall have the capability to send to the ATFM unity the go/no-go status on the major ATCAS subsystems and sensors.

3.5.2.3.11 Alerts

a. The system shall provide a window dedicated to display all the conflicts detected during the flight plan life.

b. The system shall display all the alerts detected during the flight plan route visualization.

c. The system shall display all the flights involved in a conflict.

3.5.2.3.11.1 Special Codes and Emergency Messages

a. The system shall display codes reserved for special purposes, such as A7500, A7600, A7700, using also a time-limited (VSP) audio signal, of individual activation's of special codes.

b. The system shall have a capability to display ADS or CPDLC emergency message received from an ADS/CPDLC equipped aircraft.

c. The system shall have the capability to display the last detected position of a special code squawk and the associated track history as well, till the controller acknowledges the alert at the supervisor position. The capability to print all the data associated shall be provided.

3.5.2.3.11.2 Short Term Conflict Alert (STCA)

a. The system shall have the capability to generate a Short Term Conflict Alert (STCA) with respect to tracks, taking into account the CFL and considering the PBN status information. If the system determines that a violation of vertical separation minima (adaptable) and horizontal separation minima (adaptable) is calculated within a pre-determined (adaptable) time period.
b. The system shall have the capability to define adapted areas where the STCA feature will be applicable.
c. The system shall have the capability to process tracks in respect to heading, speed, altitude/flight level, vertical speed, when available for a pre-determined (adaptable) time ahead.
d. The alert STCA generated shall include a visual and aural (time-limited) indication to the workstation(s) that are responsible for the tracks concerned, which will be extinguishable upon acknowledgment by the controller.

3.5.2.3.11.3 Minimum Safe Altitude Warning (MSAW)

a. The system shall have the capability to generate MSAW with respect to tracks providing SSR Mode C information. A minimum safe altitude warning will be generated when SSR Mode C information indicates that an aircraft:
   - In level flight is inside or within (adaptable) NM of an area where the minimum safe flight level is greater than the aircraft flight level.
   - Has a rate of descent (adaptable time) indicating that a minimum safe altitude will be penetrated.
   - Has a rate of climb (adaptable time) insufficient to obtain a minimum safe altitude.
b. The system shall have the capability to define adapted areas where the MSAW feature will be applicable.
c. The alert MSAW generated shall include a visual and aural (time-limited) indication to the workstation that has the track, which will be extinguishable upon acknowledgment by the controller.

3.5.2.3.11.4 Medium Term Conflict Detection (MTCD)

a. The system shall have the capability to generate a MTCD when a new or modified flight plan create a conflict in any point of its route with other active flight plan, taking into consideration the PBN status, airspace RVSM and the APP airspace as well.
b. The MTCD shall be generated only to the Controller and Assistant that has a sector jurisdiction over the flight plan. This alert will be displayed at the operational supervisor as well.
c. When any events or changes in the route, level or estimated time occur the system shall have the capability to recalculate the

conflict prediction automatically taking into consideration all others flight plans.

3.5.2.3.11.5 Cleared Level Adherence Monitoring (CLAM)
The system shall have the capability to display at the track label an alert when an aircraft is deviating from its Cleared Flight level by a value greater than a threshold.

3.5.2.3.11.6 Route Adherence Monitoring (RAM)
The system shall be able to monitor if a trajectory flight is in conformance with its flight route, and to alert when an aircraft is deviating from its planned route, considering the PBN status information.

3.5.2.3.11.7 Area Infringement Warning (AIW)
The system shall be able to alert in situations when an aircraft is, or is predicted to be, crossing the border of a reserved area (restricted or dangerous) on-line predefined or off-line adapted.

3.5.2.3.11.8 Conflict Probe

a. The system shall have a tool (Conflict Probe) initiated by the controller for a particular aircraft, to determine whether a proposed flight plan will come into conflict with another during a specified period.
b. The system shall compare the proposed trajectory with the current planned trajectories of other aircraft information and displays the position and time of calculated conflicts to the controller, considering the PBN status information.

3.5.2.3.11.9 Approach Funnel Deviation Alert
The Approach Funnel Deviation Alert (sometimes also known as Approach Monitoring Aid) is the Safety Net function responsible to alert in situations when an aircraft deviates from the approach funnel, either laterally or vertically.

3.5.2.3.12 Recording and Playback

a. The operational system shall include a data recording facility to record and replay data.
b. The recording function shall be able to operate concurrently with the playback function.

3.5.2.3.12.1 Recording

a. It shall be possible to record data continuously for 48 hours without operator intervention. The replacement of the non-volatile removable storage medium shall be limited to a maximum of once every 48 hours.
b. It shall be possible to record all displayed targets, weather information, maps, lists, images, filter limits, display control

settings, and all Surveillance Display operator actions performed shall be date/time stamped and recorded.

c. The system shall record all operational actions and system messages at the Surveillance Display, Flight Data Display and Electronic Flight Display and the Technical/Operational Supervisor.
d. The system shall have the capability to record online all the surveillance and flight plan data in a commercial database, in order to execute queries to generate reports.
e. The system shall record each system flight plan record whenever its flight state or holding state changes or whenever an item changes as a result of operator input or an external message.
f. The system shall record the data while still meeting its response time requirements.
g. For archival purposes, recorded data shall also be copied to a non-volatile removable storage medium for permanent storage. The recording computer may use internal hard disks as temporary storage medium.

3.5.2.3.12.2 Playback

a. The system shall have a capability to record data and playback to be used in the following activities:
   - to create the air situation display at the surveillance display with all the flight plan events associated;
   - to obtain a log of operator actions and system messages;
   - to perform data analysis and statistics;
b. The recorded information shall be capable of being played back at selected working positions without interrupting the operational system.
c. It shall be possible to playback data archived on removable storage medium loaded.
d. The system shall be capable of performing a high speed search of the recording medium in relation to time of day.
e. It shall be possible to select a specific time to the nearest minute from which the data playback is to commence.
f. The system shall be capable of replaying data that has been recorded up to 60 days prior in a slow, normal or fast mode.
g. The system shall provide an interface to synchronize the playback with the Audio Recorder.

3.5.2.3.12.3 Surveillance Display Playback

a. The system shall have the capability to change the playback mode to an interactive playback mode in which it is possible to change the Surveillance Display presentation.
b. The system shall have the capability to display recorded data at any surveillance display working position configured for playback.

3.5.2.3.12.4 Non-interactive Playback Mode

During non-interactive replay, the replayed data shall be presented in a manner that emulates the display presentation at the time of recording including the result of controller display input actions and all functions executed using all input devices.

3.5.2.3.12.5 Interactive Playback Mode

a. In the interactive mode, the selected working position receives all of the recorded data and the user can change the display of this data as if in an operational environment, without interference with the operational system.
b. A working position configured to operate in playback mode shall be able to enter interactive mode at any time during the playback.

3.5.2.3.12.6 Flight Data Display Replay

The system shall have the capability to provide a log of all previously recorded controller and assistant actions to a printer.

3.5.2.3.13 Architecture and Supervision

3.5.2.3.13.1 Functional Redundancy

Critical functions shall be dualized to provide redundancy ensuring continued full system operation in the event of single failures, such as:

- The Flight Plan Data Processing Servers;
- The Surveillance Data Processing Servers;
- The Data recording servers;
- The Control and Monitoring Servers and Displays;
- The Aeronautical and Meteorological Servers.

3.5.2.3.13.2 System Requirements

a. The system shall have the capability to ensure that the failure of any single functional unit will not cause the total failure of the system.
b. The system shall have the capability to distribute a time Reference to all positions in accordance with the mode of operation (on-line, playback or simulation).
c. The system shall have the capability to automatically restore itself to normal operation after interruptions due to power failure.
d. In case of power return after complete power outage, the ATCAS shall automatically restart and go into operation in the same configuration as before the outage.
e. The system shall have the capability to provide the following functions.
    - Monitor the status of all system elements;
    - Perform manual and automatic system reconfigurations;
    - Supply status information for display;

f. All events shall be stored on disk and classified depending on its relevance.
g. The system shall have the capability to filter and display all the events and system error reports recorded based on its type, relevance and time, as an interactive data base.
h. The system shall have the capability to switch over its critical function servers with no loss of information.
i. The system shall have the capability to restart any nodes and perform reconfiguration of all servers.
j. The system shall have the capability to display and print out the actual operational configuration and status, including the monitored external sources.
k. The system shall have the capability to use dual LAN (Local area network) and meet all functional and performance requirements with one of the dual LANs out of service.
l. The system shall have the capability to supervise and display the status of the dual LANs and perform automatic reconfiguration to the standby LAN if necessary.
m. The system shall have the capability to monitor continuously all the local and remote net nodes using the SNMP protocol.
n. The system shall monitor, using the SNMP protocol the following hardware devices status:
    - CPU load and temperature;
    - RAM memory use;
    - Disk partition use;
    - Network traffic.
o. The system shall monitor, using the SNMP protocol, the availability of UPS and generators used to supply Power to all equipments.
p. The system shall have the capability to display the status of all equipments and network in a synoptic view of the system.
q. The system shall have the capability to detect and display alerts and alarms at the Supervisor Positions, and all the critical and non critical errors generated by the system.
r. The system shall have the capability to configure the acceptable limits, frequency and Time-out values for the events of the system monitored using the SNMP protocol.
s. The system shall have the capability to operate each Supervisor position in the Technical, Operational and Read-only (only Display) defined by the login, including also others backup positions. Each mode shall have a specific authorization to execute determined commands in accordance with their role.
t. The system shall have the capability to define a regional operational supervisor responsible for a subset of sectors, used for centers with a big number of sectors.

3.5.2.3.13.3 Online Test

a. Online tests of the hardware as well as the software shall be provided to verify the operation of the computer systems.
b. The online test functions shall periodically check the subsystem and display alerts for fault situations.
c. The online test functions shall periodically verify the communication availability of all nodes in the local network and all the external interfaces.

3.5.2.3.13.4 ATCAS System Control and Reconfiguration

The system shall have the capability to execute the following action from the Supervisor Position:

- System Startups;
- Disable/Enable of automatic equipment switchover;
- Reconfigurations;
- Variable System Parameter updates.

3.5.2.3.13.5 ATCAS Sector Reconfiguration

a. The system shall have the capability to provide a graphical display of the ATCAS sector configuration.
b. The system shall have the capability to use preset sector configurations defined in the adaptation data.
c. Sector reconfigurations shall be performed at the Operational Supervisor.
d. The Operational Supervisor shall have the capability to print a consolidation report.
e. The system shall have the capability to display and print a current sector load and a predict sector load, based on a specific time ahead.

3.5.2.3.14 Aeronautical and Meteorological Information

a. The system shall have a capability to receive aeronautical and meteorological information from the AFTN/AMHS:
    - Meteorological information: MET data as defined in section 3.2.4.3.4 and METAR, according to ICAO Annex 3 and other meteorological messages, such as SIGMET, AIRMET, GAMET, SPECI and TAF, according to Annex 15;
    - Aeronautical information: NOTAM, according to ICAO Annex 15.
b. The MET data will be received every 6 hours from the AFTN/AMHS; in case of absence or a delay greater than 30 minutes (adaptable), the system shall have the capability to send a message to the Operational Supervisor and it shall use the latest data stored.
c. The system shall have the capability to receive aeronautical and meteorological information for display via a Web Browser.

d. The system shall have the capability to input and display QNH values.
e. The system shall have the capability to check the MET data for format and syntax errors.
f. The system shall have the capability to display and modify aeronautical information.
g. The system shall have the capability to display and modify the MET data.
h. The system shall have the capability to identify and classify MET data messages with respect to type of data and area of validity.
i. The system shall have the capability to compose and display a web browser window with general purpose information to be used internally by the controllers.
j. The system shall have the capability to compose free text input (no pre-defined format, up to 1800 characters) to be routed to AFTN/AMHS addresses.

3.5.2.3.15 Management, Operational and Technical Information Report Tool

a. The system shall have the capability to produce monthly statistics of end-to-end system datalink performance in daily operations. The system shall have appropriate tools for monitoring and analyzing the performance data for reporting.
b. The system shall have the capability to generate reports, using predefined queries or ones defined by the operator, such as: total number of flight plans in a sector during a specific period of time, with filters defined by the user (aircraft type, level, airway, VFR or IFR rules, ATCAS origin, and airport).
c. The system shall have a capability to generate reports with a list of all strips updates during a specific flight plan lifetime.
d. The system shall have a capability to generate reports with a list of working hours for each operator during a specific time and their respective totals consolidation, based in the logon/logoff records.
e. The system shall have a capability to generate reports with a list of sectors allocation hours, taking into account all the sector consolidation/deconsolidation.
f. The system shall have a capability to generate reports with a list of all alerts distributed per type, criticality, sector and time.
g. The system shall have a capability to execute scheduled (E.g.: annually, monthly, daily, hourly) pre-defined reports.
h. The system shall have a capability to provide commercial tools to create user-defined reports.
i. The system shall have the capability to define different Access levels for data and reports.
j. The system shall have a capability to generate graphical and textual reports and print.

3.5.2.4 System External Interface Requirements

a. The network shall conform to the protocol suite defined as part of the ATN concept.
b. For messages from controller to pilot, the ground ATN routers must choose the most suitable data link device available and route the messages to that transmitting station.
c. It is intended that the ADS and CPDLC functions shall eventually be carried by the ATN. The purpose of the ATN is to "provide data communication services and application entities insupport of the delivery of air traffic services (ATS) to aircraft; the exchange of ATS information between ATS units; and other applications such as aeronautical operational control (AOC) and aeronautical administrative communication (AAC)." [Annex 10, Vol III, 3.3].
d. It is important, therefore, that any new system should either include provisions for, or have a defined upgrade path to provide, interfacing with the ATN. ICAO Doc 9705 - Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN) is the appropriate source of interface data for the ATN.
e. At present, the ATN is under development and trials are being carried out in several ICAO Regions.

3.5.2.4.1 Datalink and Surveillance sensors interfaces

3.5.2.4.1.1 Datalink Service Provider

In the current FANS 1/A environment, ADS and CPDLC messages are passed between aircraft and the System using the ACARS data messaging system. ACARS was developed by the DSPs to pass information between the airline operating centre (AOC) and the aircraft. ADS and CPDLC required an air-ground datalink and, in the absence of the Aeronautical Telecommunication Network (ATN), the ACARS system was used. It is essential therefore to specify the appropriate interface port(s) to connect to the chosen DSP. This is typically an RS232 serial port, but the exact requirement needs to be confirmedwith the DSP.

3.5.2.4.1.2 Radar Data

Data imported from a separate radar system will take the form of track data or possibly plot data, using a standardized interface ASTERIX.

3.5.2.4.1.3 Multilateration (MLAT)

MLAT is an enabling technology that will enhance the provision of ATM in a variety of applications, from "radar-like" air traffic control purposes to enhanced situational awareness of surface movements. MLAT offers most advantages in situations where other surveillance systems (e.g. radar) are not available. It can also be combined with other surveillance systems, such as radar and ADS-B, to improve the total surveillance picture.

MLAT is dependent on the aircraft having at least a Mode A/C transponder. It can receive identity through correlation of a code with the flight plan, or the flight identification transmitted by ADS-B or Mode S transponder.

3.5.2.4.2 AFTN/AMHS

The AFTN is currently the carrier for ground-ground messaging between ATC units and carries AIDC messages in the FANS 1/A environment. The AMHS (Aeronautical Message Handling System) is the ground-ground messaging application of the ATN.

Any new system AMHS shall include at least one AFTN gateway. AIDC messages generated in AMHS structure can then be transmitted via the AFTN and incoming messages from the AFTN shall be transposed to AMHS structure.

After the ATN becomes operational and the AFTN is no longer used, the gateway can be removed.

The AMHS specification, as defined in ICAO Doc. 9705 (Document that will be consolidated with Doc. 8080) and ICAO Doc 9880, includes only two levels of service which correspond to a different level of functionality for the AMHS. They are the Basic ATS Message Handling Service and the Extended ATS Message Handling Service.

a. The system shall accept and transmit ICAO flight plan data messages via the AMHS or

   AFTN, as defined in ICAO documents Doc 4444 15ª Ed and 9705.

3.5.2.4.3 Adjacent ATCAS interface

Direct Connection between ATCAS Systems – It is necessary when a full system must be connected directly to an existing system for flight plan coordination and surveillance data sharing.

3.5.2.4.3.1 Flight Plan Coordination

a. The Flight plan data shall be exchanged with adjacent ATC centers (Others ACC). The system shall provide the capability to exchange flight plan data with these ATC centers, using OLDI or AIDC messages. The OLDI application, which is implemented in the EUR Region, consists of the exchange of messages (a subset of AIDC messages), using a dedicated OLDI protocol operating directly over X.25. This is going to evolve in the short- to mid-term towards FMTP (Flight Message Transfer Protocol), which is a specific protocol operating over TCP/IP.

b. For flight plan coordination, the interface shall be AIDC over AMHS/AFTN or the future ATN, but for compatibility with pre-existent legacy systems OLDI may be implemented over X-25 with direct links or over TCP/IP (using a X.25 to TCP/IP converter).

c. AIDC messages will be passed via the AFTN until the ATN is operational. However, AFTN/AMHS gateways shall increasingly be used to provide a transition between the AFTN and ATN. These gateways transpose AFTN messages into AMHS format and vice versa. This consists in the exchange of AIDC messages over AFTN, using the "Optional Data Field" included in the header of AFTN messages. This application is governed by the document named "Asia/Pacific Regional Interface Control Document (ICD) for ATS Interfacility Data Communications (AIDC)".

3.5.2.4.3.2 Surveillance Data Sharing

The system shall provide an interface to exchange track data with adjacent ATC centers. This can be implemented by sharing the radar sensor using ASTERIX or exchanging system surveillance data between surveillance servers using ASTERIX format cat 62, 63.

3.5.2.4.4 Defense systems interfaces

This interface will be used to surveillance data sharing, since there will be sensors used in Air Defense Systems that can be useful for Air traffic Control.

This also can be implemented by sharing the radar sensor using ASTERIX or exchanging system surveillance data between surveillance servers using ASTERIX format cat 62, 63.

3.5.2.4.5 Operator interface

3.5.2.4.5.1 Human Factors

Human factors play a major part in the success or failure of a system to meet its operational objectives. A system that is uncomfortable to use will lead to controller dissatisfaction. As controllers are an essential part of the overall system, it can only degrade the overall systemperformance.

Displays and keyboards that are poorly designed from a human factors aspect will be inefficient and may cause actual harm to the users. Bad display design can affect the eyes and bad keyboard design may result in occupational overuse syndrome (repetitive strain injury). The human factors implications of the system specification should be considered very carefully.

3.5.2.4.5.2 Displays

One or more displays are required to handle the Surveillance, Flight plan interface with ADS, CPDLC and AIDC messages. Many systems incorporate message handling in the situationdisplay.

Modern displays use LCD technology and may be as large as 600 x 600mm, with typical resolution of 2048 x 2048 pixels. Smaller displays may be more appropriate for some uses, particularly if there are 2 displays at a controller position: a second display is often used for flight datahandling. However, the arrangement of displays will largely depend on the extent to which the newsystem is to be integrated with existing systems.

While color displays offer great advantages in differentiating between different categories of data, the choice of colors for the various categories can be very contentious. It is essential that color allocation is not arbitrarily decided, but is based upon sound human factors principles. Inappropriate color choices can contribute to fatigue, confusion and errors.

Different symbols will be used for radar tracks, ADS-B tracks, ADS-C tracks and tracks generated from flight plan information. The track symbol shall be that of the source of the highest quality information. At the current stage of development of ADS-B systems, radar is generallyaccepted as the best surveillance data, followed by ADS-B and then by ADS-C. Flight plan tracks arethe lowest quality.

The status of the CPDLC connection is an important information for the controller and is best displayed in the track label.

3.5.2.4.5.3 Message Handling

Message handling for ADS, CPDLC and AIDC messages is usually achieved by some form of menu access for generating messages and by pop-up windows for replying to incoming messages. Most systems now offer access via the track label.

For CPDLC, there are two elements to generating most messages: selection of the specific message and entry of necessary data. The message selection shall be simple: there are about 180 uplink messages available. Some systems present a selection of appropriate messages – for example, by offering only height-related messages if the height field in the track label is selected. ADS contract messages are more simple and infrequently required, so that a simple menu-type operation is normally adequate. AIDC messages can usually be generated automatically to form flight plan data.

3.5.2.4.5.4 Input Devices

The controller input devices include the text input device and the pointing device.

The text input device is normally a keyboard and there are various types of keyboard

(standard, ergonomic, etc).

3.5.2.4.6 Time Reference System and Audio Recorder interface

The system contains a Time Reference System which will establish a common time source for all subsystems. In addition, outputs will exist to synchronize external systems with the common time source, such as the Audio Recorder for Playback activities.

The Time Reference System will be used to keep time synchronization in the Operational and Simulator Partition.

The TRS will be synchronized to GPS signals received by the antenna, and it will be distributed to all net nodes by ntp protocol.

a. The system shall have the capability to synchronize all subsystems to a common time source with a maximum deviation of 100 milliseconds.
b. Time reference outputs shall be provided to synchronize other clocks with the common time source, typically Audio Recorder Systems.

3.5.2.4.7 ATFM Unity Interface

a. The system shall provide an interface with a central ATFM for flight plan information and coordination.

b. An air traffic flow management (ATFM) service shall be implemented for airspace where traffic demand at times exceeds the defined ATC capacity. ATFM will be implemented on the basis of a national/regional air navigation agreement or, when appropriate, as a multilateral agreement. The ATFM service within a region or other defined area, will be developed and implemented as a centralized ATFM organization, supported by flow management positions established at each area control centre (ACC) within the region or area of applicability.
c. The responsible ATFM unit shall receive the traffic demand continuously from the responsible ATC unit, allowing the ATFM unit to monitor if this demand exceeds, or is foreseen toexceed, the capacity of a particular sector or aerodrome in order to coordinate ATFM measures.

3.5.2.4.8 AIS and MET

This interface is used for Web interfaces (HTTP) to access AIS and MET data using a Web Browser with a LAN connection. It represents a new tendency to access data information using the future ATN.

3.5.2.5 System Internal Interface Requirements
The system usually will use a LAN 100/1000 Mbps as specified in the IEEE 802.3x with protocol TCP/IP.

3.5.2.6 System internal data Requirements
Not applicable.

3.5.2.7 Adaptation requirements
3.5.2.7.1 Database Management

a. It shall be possible at the Database Management position, to print-out for visual
b. presentation maps entered into the system via the DMS, including graphic presentation.
c. The system shall have a capability to edit a database with the following data sets:

- Airways;
- Airports and Runways;
- Restricted areas;
- NAVAIDS;
- SID/STAR Procedures;
- AFTN/AMHS Directions;
- Sectors;
- Adjacent ATCAS;

- Coordination points;
- Adaptable System Parameter;
- Default values for Variable System Parameter;
- FIR/UIR borders;
- Terminal control areas;
- Control zones;
- Traffic information zones;
- Airways and ATS routes;
- Radars sensors information and protocol;
- Configuration files;
- Time Parameters;
- Alerts Parameters;
- Flight Plan parameters;
- Coordination Protocols;
- Aircraft Types and performance;
- Significant points;
- ATS routes;
- TMA Areas;
- PBN data;
- Alerts data;
- Adaptable System Parameters;
- Variable System Parameters;
- Etc.

d. The system shall verify the data validation and consistency before the generation of a set of adaptation data.
e. The system shall have a capability to download a new set of adaptation data to all positions or a group of positions without interfering with the operation.

3.5.2.8 Safety requirements

Safety assessments are described in detail in ICAO Doc 9859, Safety Management Manual. Safety nets are described in the item 3.2.5.

3.5.2.9 Security and Privacy Requirements

The system shall have the capability to control users and password and display the list of users logged at the operational supervisor and record all the actions with the responsible user information based in the logon/logoff control.

3.5.2.10 System environment requirements

a. The acoustic noise level shall be no greater then 50 dBA at 1 meter for servers and peripherals normally located in an equipment room.
b. The acoustic noise level shall be no greater than 50 dBA from the front surface of fully enclosed consoles normally located at the ATC operations room.

3.5.2.11 Computer Resource Requirements

a. The maximum load admitted in any condition for any processor shall be 50% of maximum capacity.
b. The maximum memory occupation admitted in any condition shall be 50 % of the maximum available memory.

3.5.2.12 System Quality Factors

3.5.2.13.1 System Reliability

Reliability predictions will be made for all equipment through observation or calculated using a specific standard. The system reliability will be maximized through use of redundant equipment configurations where a single failure would impact system operation. All single point failures will be identified.

3.5.2.13.2 System Maintainability

The system design will employ system fault detection and fault isolation.

a. The system shall have the capability to detect 90% of all system failures.
b. The system shall provide the mean time to repair to be less than 30 minutes.

3.5.2.13.3 System Availability

The system will provide operational availability through use of redundant/fault tolerant system architecture, system fault coverage and fault detection, and preventative and corrective maintenance.

- The system availability of the ATCAS shall exceed 99.999%.

3.5.2.14 Design and Construction constraints

a. The system shall be built using open systems technology, using an operating system likeUNIX or similar.
b. The system shall make full use of help files and hints for button options to improve the usability.

3.5.2.15 Personnel-related requirements

Not applicable.

3.5.2.16 Training-related requirements

Training must involve:

a. Controller Training;
b. System Operator Training;
c. Maintenance Training;
d. Simulator Based Training.

3.5.2.17 Logistics-related requirements

The system shall have the capability to restore the operating system software on the workstation using the network or the peripheral device required to transfer the operating system from standard distribution media.

3.5.2.18 Other requirements

3.5.2.18.1 Time Requirements

a. The system shall have a capability to display a track at a maximum time of 500 milliseconds, since the track message reception (95 percentile).
b. The system shall have a capability to display all remote status and all external alarms at the Supervisor Position within 3 seconds after the detection of the event.
c. The system shall have a capability to execute a switch-over to the stand-by server with thefollowing time requirements:
   - Surveillance Server : maximum 2 sec
   - Flight Plan Server: maximum 10 sec
   - Data recording Server: maximum 2 sec
d. The system shall have a capability to restart and become fully operational at up to ten minutes (cold start).

3.5.2.18.2 Capacity Requirements

The system shall meet the following operational capacities:

a. Size of system plane : 2048 x 2048 NM
b. Point of tangency (latitude/longitude): 1
c. Surveillance data sources : TBD simultaneous
d. Weather data sources : TBD primary surveillances
e. Maximum single surveillance data rate : 64 Kbps
f. Display update rate : continuous (based on inputs)
g. Maximum surveillance reports per second from all surveillances : TBD
h. Minimum system track display capability : TBD
i. Adjacent ACC interfaces : TBD
j. AMHS interfaces : TBD
k. AFTN interface: TBD
l. Stored flight plans (RPL's) : TBD
m. Inactive Flight Plans (stored FPL's) : TBD
n. Active flight plans (at any one time) : TBD
o. Aircraft classes : TBD
p. Wind/temperature layers (MET data) : 8
q. Wind/temperature areas (MET data) : 10
r. Maps (fully digital – labels and vectors) : TBD
s. SID/STAR Procedure: TBD
t. Hold Procedures: TBD

The datalink system capacity will be determined from:

- Traffic density at the peak hours.
- Frequency and size of messages per aircraft.
- Airspace size and number of waypoints.
- Number of FANS capable aircraft operating in the airspace.
- Anticipated growth of FANS operation.
- Number of displays.
- Number of connections for terminal systems.

3.5.2.19 System environment requirements

1) Equipment room : <50 dBA at 1 meter for servers and peripherals
2) ATC operation room : <50 dBA from front surface of fully enclosed consoles

3.5.2.20 System Quality Factors

1) System reliability : Redudant equipment configuration
2) System maintainability : Capability to detect 90% of all system failures
3) MTTR : < 30 minutes
4) Availability : > 99.999 %

3.5.2.21 Capacity Requirement

1) Size of system plane : 2048 x 2048 NM
2) Point of tangency (lat/long) : 1
3) Maximum single surveillance data rate : 64 kbps
4) Display update rate : continous (based on inputs)

3.6. ASMGCS

3.6.1 Deskripsi Singkat

Advanced Surface Movement Guidance and Control Systems (A-SMGCS) *[ICAO Doc 9830]* adalah sebuah sistem yang memberikan fungsi *routing, guidance, surveillance* dan *control* terhadap pesawat dan kendaran di darat yang terdampak agar dapat mempertahankan tingkat pergerakan dalam semua kondisi cuaca dalam *Aerodrome Visibility Operational Level* (AVOL) dengan tetap menjaga tingkat keselamatan yang disyaratkan.

Dalam penerapannya ICAO membagi level implementasi sistem ASMGCS menjadi 5 tingkatan berdasarkan tipe aerodrome. tipe aerodrome dapat dikombinasi dari kategori bandara. secara umum semakin tinggi level implementasi maka peran avionics dan otomatisasi sistem semakin besar. tabel di bawah memberikan gambaran singkat mengenai level implemetasi ASMGCS. untuk lebih lengkapnya terdapat pada Doc. 9830 ASMGCS Manual Appendix B.

Tabel 1 : Kombinasi tipe Bandara

Visibility condition	1	2	3	4
Aerodrome type	T-1:(B)(L) T-2:(B)(M) T-3:(B)(H) T-4:(S)(L) T-5:(S)(M) T-6:(S)(H) T-7:(C)(L) T-8:(C)(M) T-9:(C)(H)	T-10:(B)(L) T-11:(B)(M) T-12:(B)(H) T-13:(S)(L) T-14:(S)(M) T-15:(S)(H) T-16:(C)(L) T-17:(C)(M) T-18:(C)(H)	T-19:(B)(L) T-20:(B)(M) T-21:(B)(H) T-22:(S)(L) T-23:(S)(M) T-24:(S)(H) T-25:(C)(L) T-26:(C)(M) T-27:(C)(H)	T-28:(B)(L) T-29:(B)(M) T-30:(B)(H) T-31:(S)(L) T-32:(S)(M) T-33:(S)(H) T-34:(C)(L) T-35:(C)(M) T-36:(C)(H)

			Conflict prediction and/or detection	*Conflict analysis*	*Conflict resolution*		*Ground*				*On board*	
							*1	*2	*3	*4		
T-8: 1:(C)(M) T-12: 2:(B)(H) T-14: 2:(S)(M) T-16: 2:(C)(L) T-19: 3:(B)(L) T-20: 3:(B)(M) T-22: 3:(S)(L)	Controller		X	X	X				X			III
	Pilot/Vehicle driver		X	X[1)]	X[1)]		X					
	System	X	X	X	X	X						
T-9: 1:(C)(H) T-15: 2:(S)(H) T-17: 2:(C)(M) T-18: 2:(C)(H) T-21: 3:(B)(H) T-23: 3:(S)(M) T-24: 3:(S)(H) T-25: 3:(C)(L) T-26: 3:(C)(M) T-27: 3:(C)(H)	Controller		X	X	X							IV
	Pilot/Vehicle driver		X	X[1)]	X[1)]		X					
	System	X	X	X	X	X				X		
T-28: 4:(B)(L) T-29: 4:(B)(M) T-30: 4:(B)(H) T-31: 4:(S)(L) T-32: 4:(S)(M) T-33: 4:(S)(H) T-34: 4:(C)(L) T-35: 4:(C)(M) T-36: 4:(C)(H)	Controller		X	X	X							V
	Pilot/Vehicle driver						X				X	
	System	X	X	X	X	X				X		

*1. Painted centre line and taxiway guidance signs
*2. Fixed centre line lights
*3. Manual switched centre line lights
*4. Automatic switched centre line lights

Note 1.— Does not apply in visibility condition 3.

Tabel 2 : Kriteria penentuan level implementasi ASMGCS

Secara lebih deskriptif, penjelasan dari masing-masing level implementasi ASMGCS dapat dijelaskan sebagai berikut :

a. Implementasi Level I : pada implementasi ASMGCS level I, pengamatan sepenuhnya berada pada controller, prediksi dan deteksi konflik, analisis, dan pemecahan masalah dilakukan bersama oleh controller dan pilot. pengaturan jalur lintasan untuk pesawat dilakukan controller, dan petunjuk yang diberikan kepada pilot berupa jalur bercat yang ada di atas lintasan runway/taxiway.

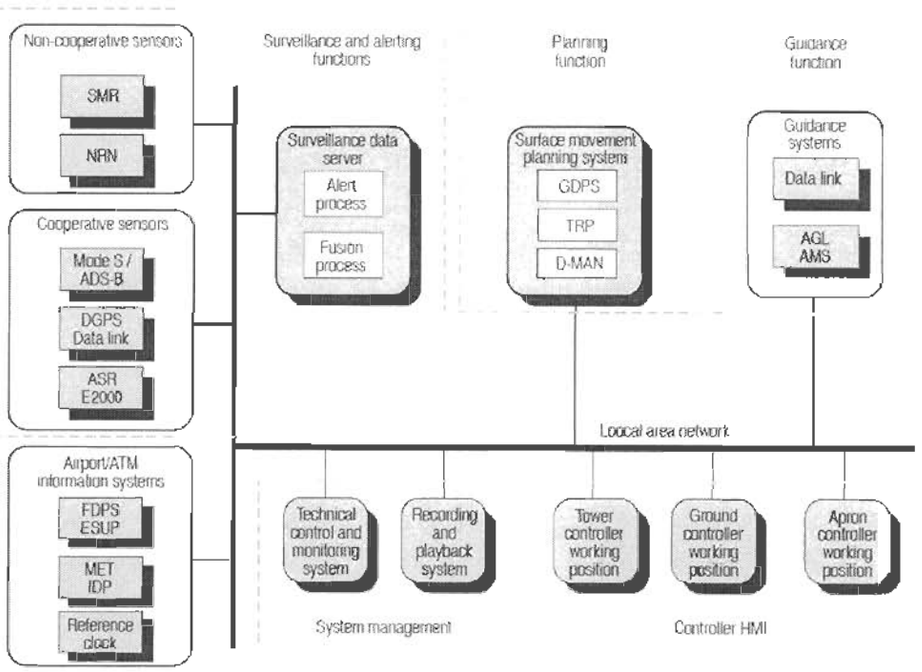
b. Implementasi Level II : Pada implementasi level II, pengamatan dilakukan oleh controller dengan dukungan oleh system. prediksi dan deteksi conflik dilakukan oleh controller, pilot dan juga system, namun analisis dan pemecahan masalah masih dilakukan oleh controller dan pilot. pengaturan jalur lintasan untuk peawat dilakukan oleh controller. petunjuk yang diberikan kepada pilot selain jalur bercat juga pelampuan jalur tengah yang selalu menyala.

c. Implementasi Level III : Pada implementasi level III, peranan system pendukung mengalami peningkatan yang signifikan. pegamatan sepenuhnya berada pada pada system. prediksi dan deteksi konflik, analisis, dan pemecahan masalah dilakukan bersama oleh system, controller dan pilot, meskipun pada keadaan jarak pandang kategori 3 pilot tidak dapat berpeam banyak. pengaturan jalur lintasan untuk pesawat dilakukan sepenuhnya oleh system dan petunjuk yang diberikan kepada pilot berupa jalur bercat serta system pelampuan yang secara manual dapat dinyalakan/dimatikan oleh controller.

d. Implementasi Level IV : Perubahan dari level IV ini adalah pelampuan jalur yang secara otomatis dapat dimatikan dan dinyalakan berdasarkan pertimbangan sistem. selebihnya sama dengan implementasi level III.

e. Implementasi Level V : Sebagai level implementasi paling tinggi, level V ASMGCS meniadakan keperluan bagi pilot untuk melakukan prediksi , deteksi, analisis dan pemecahan konflik dalam keadaan jarak pandang yang bagaimanapun juga. pengaturan jalur sepenuhnya dilakukan pleh system, dan sebagai tambahan pada system petunjuk untuk pilot adalah adanya implementasi *on board guidance system* yang tersinkronisasi dengan system penunjuk jalan dan juga pelampuan otomatis.

Secara umum arsitektur perangkat keras, jaringan dan fungsi system ASMGCS dapat digambarkan sebagai berikut :



Gambar 1 : functional architectur

Tabel 3 Equipment evolution for A-SMGCS

Aerodrome type			Visibility	Surveillance system										Routing system		Guidance system			Control system							
				Approach		Manoeuvring area				Apron									Conflict			Movement	Intrusion alerts		Protection	
	Layout	Traffic level		Visual	Instrument	Detection	Tracking	Identification	Accurate	Detection	Tracking	Identification	Accurate	Route	Route planning	Visual aids	Situation awareness	Restricted area	Detection	Alert	Resolution		Runway	Taxiway	Runway	Taxiway
1	B	L	1											ATCO	ATCO	P	C								H,C	H,C
2	B	M	1											ATCO	ATCO	P	C								H,C	H,C
3	B	H	1	R	R									ATCO	ATCO	P	C								H,C	H,C
4	S	L	1											ATCO	ATCO	P	C								H,C	H,C
5	S	M	1			SMR								ATCO	ATCO	P	C		(✓)						H,C	H,C
6	S	H	1	R	R	✓	✓							ATCO	ATCO	P	C		(✓)				(✓)	(✓)	H,C	H,C
7	C	L	1		R	SMR								ATCO	ATCO	P	C		(✓)						H,C	H,C
8	C	M	1		R	✓	✓							ATCO	Sys	M	C		(✓)				(✓)	(✓)	H,C	H,C
9	C	H	1	R	R	✓	✓							Sys	Sys	A	C		✓	✓	✓		✓	✓	H,C	H,C
10	B	L	2		R	SMR								ATCO	ATCO	P	C		(✓)			(✓)	✓	✓	H,C,G	H,C
11	B	M	2		R	SMR								ATCO	ATCO	P	C		(✓)			(✓)	✓	✓	H,C,G	H,C
12	B	H	2	R	R	✓	✓							ATCO	Sys	M	C		(✓)			(✓)	✓	✓	H,C,G	H,C
13	S	L	2		R	SMR								ATCO	ATCO	P	C		(✓)			(✓)	✓	✓	H,C,G	H,C
14	S	M	2		R	✓	✓	✓						ATCO	Sys	M	C		(✓)			(✓)	✓	✓	H,C,G	H,C
15	S	H	2	R	R	✓	✓	✓						Sys	Sys	A	C		✓	✓	✓	(✓)	✓	✓	H,C,G	H,C

3.6.2 BASIC FUNCTIONAL REQUIREMENTS

3.6.2.1 Surveillance

3.6.2.1.1 The surveillance function of an A-SMGCS should:

a) provide accurate position information on all move- ments within the movement area;

b) provide identification and labelling of authorized movements;

c) cope with moving and static aircraft and vehicles within the coverage area of the surveillance function;

d) be capable of updating data needed for the guidance and control requirements both in time and position along the route; and

e) be unaffected by operationally significant effects such as adverse weather and topographical con- ditions.

3.6.2.1.2 The operational status of all surveillance equipment should be monitored by the system, and alerts should be provided as appropriate.

3.6.2.1.3 All control authorities concerned should be provided with surveillance data in the required area of the aerodrome.

16	C	L	2		R	✓	✓	✓					ATCO	Sys	M	C		(✓)			(✓)	✓	✓	H,C,G	H,C
17	C	M	2		R	✓	✓	✓					Sys	Sys	A	C		✓	✓	✓	(✓)	✓	✓	H,C,G,S	H,C,T
18	C	H	2	R	R	✓	✓	✓					Sys	Sys	A	C		✓	✓	✓	✓	✓	✓	H,C,G,S	H,C,T
19	B	L	3		R	✓	✓	✓		✓			ATCO	Sys	M	C		(✓)	✓	✓	✓	✓	✓	H,C,G,S	H,C,T
20	B	M	3		R	✓	✓	✓		✓			ATCO	Sys	M	C		(✓)	✓	✓	✓	✓	✓	H,C,G,S	H,C,T
21	B	H	3		R	✓	✓	✓	✓	✓	✓	✓	✓	Sys	Sys	A	C		✓	✓	✓	✓	✓	✓	H,C,G,S	H,C,T
22	S	L	3		R	✓	✓	✓		✓	✓			ATCO	Sys	M	C		(✓)	✓	✓	✓	✓	✓	H,C,G,S	H,C,T
23	S	M	3		R	✓	✓	✓	✓	✓	✓	✓	✓	Sys	Sys	A	C		✓	✓	✓	✓	✓	✓	H,C,G,S	H,C,T
24	S	H	3		R	✓	✓	✓	✓	✓	✓	✓	✓	Sys	Sys	A	C		✓	✓	✓	✓	✓	✓	H,C,G,S	H,C,T
25	C	L	3		R	✓	✓	✓	✓	✓	✓	✓	✓	Sys	Sys	A	C		✓	✓	✓	✓	✓	✓	H,C,G,S	H,C,T
26	C	M	3		R	✓	✓	✓	✓	✓	✓	✓	✓	Sys	Sys	A	C		✓	✓	✓	✓	✓E	✓E	H,C,G,S	H,C,T
27	C	H	3		R	✓	✓	✓	✓	✓	✓	✓	✓	Sys	Sys	A	C		✓	✓	✓	✓	✓E	✓E	H,C,G,S	H,C,T
28-36	All	All	4		R	✓	✓	✓	✓	✓	✓	✓	✓	Sys	Sys	A,E	C,E	E	✓	✓	✓	✓E	✓E	✓E	H,C,G,S,E	H,C,T,E

Aerodrome types

Layout	B = Basic
Layout	S = Simple
Layout	C = Complex
Traffic	L = Light
Traffic	M = Medium
Traffic	H = Heavy

System Modules

R	Approach radar
SMR	Surface movement radar [1]
P	Painted centre line with/without lights [1]
M	Manually switched (block of) centre line lights [1]
A	Automatic switched centre line lights
C	Aerodrome chart and signs [1]
H	Holding position marking [1]
G	Runway guard lights [1]
S	Switched stop bar [1]
T	Traffic lights
ATCO	Air traffic controller
Sys	System
✓	New development required
(✓)	New development desirable
E	Enhanced cockpit display

Note 1.— For details see Table 2-2 of Doc 9476.

3.6.2.1.4 Within the required area of the aerodrome, surveillance should be provided up to an altitude so as to cover missed approaches and low-level helicopter operations.

3.6.2.1.5 Surveillance should be provided for aircraft on approach to each runway at such a distance that inbound aircraft can be integrated into an A-SMGCS operation so that aerodrome movements, including aircraft departures or aircraft crossing active runways, can be managed.

3.6.2.1.6 A seamless transition should be provided between the surveillance for an A-SMGCS and the surveil- lance of traffic in the vicinity of an aerodrome.

3.6.2.1.7 The A-SMGCS should detect any incursion into areas used for aircraft movement and the runway strips, and within any designated protected area as required by airport authoritics. The surveillance system should also continuously indicate the position of unauthorized aircraft, vehicles and obstacles in the above areas.

3.6.2.1.8 For aircraft and vehicles within the areas men- tioned in 2.5.1.7, the surveillance function of an A-SMGCS should continuously provide information required to detect deviations from the assigned route, with an update rate that is sufficient to ensure an adequate response of the system.

3.6.2.2 Routing

3.6.2.2.1 Either manually or automatically, the routing function of an A-SMGCS should:

a) be able to designate a route for each aircraft or vehicle within the movement area;
b) allow for a change of destination at any time;
c) allow for a change of a route;
d) be capable of meeting the needs of dense traffic at complex aerodromes; and
e) not constrain the pilot's choice of a runway exit following the landing.

3.6.2.2.2 In a semi-automatic mode, the routing func- tion should also provide the control authority with advisory information on designated routes.

Note.— In a semi-automatic mode, assignment of routes is carried out by the control authority.

3.6.2.2.3 In an automatic mode, the routing function should also:

a) assign routes; and
b) provide adequate information to enable manual intervention in the event of a failure or at the discretion of the control authority.

3.6.2.2.4 When assigning routes, an A-SMGCS should:

a) minimize taxi distances in accordance with the most efficient operational configuration;
b) be interactive with the control function to minimize crossing conflicts;
c) be responsive to operational changes (e.g. runway changes, routes closed for maintenance, and tem- porary hazards or obstacles);
d) use standardized terminology or symbology;
e) be capable of providing routes as and when required by all authorized users; and
f) provide a means of validating routes.

3.6.2.3 Guidance

The guidance function of an A-SMGCS should:

a) provide guidance necessary for any authorized movement and be available for all possible route selections;
b) provide clear indications to pilots and vehicle drivers to allow them to follow their assigned routes;
c) enable all pilots and vehicle drivers to maintain situational awareness of their positions on the assigned routes;
d) be capable of accepting a change of route at any time;
e) be capable of indicating routes and areas that are either restricted or not available for use;
f) allow monitoring of the operational status of all guidance aids; and
g) provide online monitoring with alerts where guid- ance aids are selectively switched in response to routing and control requirements.

Note.— When visibility conditions permit a safe, orderly and expeditious flow of authorized movements, the guidance function will primarily be based on standardized ground visual aids. If expeditious flow is restricted due to reduced visibility, additional equipment or systems will be required to supplement visual aids in order to maintain flow rates.

3.6.2.4 Control

3.6.2.4.1 The control function of an A-SMGCS should:

a) have a capacity sufficient for the maximum authorized movement rate (dynamic capacity);
b) have a capacity sufficient for the aerodrome plan- ning of requested movements for a period of up to one hour (static capacity);
c) detect conflicts and provide resolutions;
d) be able to provide longitudinal spacing to predeter- mined values of:
    1) speeds;
    2) relative directions;
    3) aircraft dimensions;
    4) jet blast effects;
    5) human and system response times; and
    6) deceleration performances;
e) provide alerts for incursions onto runways and activate protection devices (e.g. stop bars or alarms);
f) provide alerts for incursions onto taxiways and activate protection devices (e.g. stop bars or alarms);
g) provide alerts for incursions into critical and sensitive areas established for radionavigation aids;
h) provide alerts for incursions into emergency areas;
i) be capable of incorporating computer-aided management tools;
j) keep controllers, pilots and vehicle drivers in the decision loop;

k) control movements within a speed range so as to cover the operations in all required situations, taking into account the type of movement;

l) be capable of allowing operations to continue in all visibility conditions down to the AVOL; and

m) be capable of allocating priorities to control activities.

3.6.2.4.2 The control function of an A-SMGCS should also provide for:

a) sequencing of aircraft after landing, or of departing aircraft, to ensure minimum delay and maximum utilization of the available capacity of the aero- drome;

b) segregation of support and maintenance vehicles from operational activities as necessary;

c) spacing between aerodrome movements according to the prescribed minima, taking into account:

1) wake turbulence;

2) jet blast and propeller/rotor wash;

3) aircraft dimensions; and

4) different locations and layouts (runway, taxi- way, apron or aircraft stand);

d) separation of movements from obstacles; and

e) separation with a prescribed minimum of all aircraft from an aircraft isolated for security reasons (Annex 14 to the Convention on International Civil Aviation — Aerodromes, Volume I, Chapter 3).

3.6.2.4.3 The following short-term alerts should be provided by the A-SMGCS within enough time to enable the appropriate immediate action:

a) short-term conflict alert: whereby an alert is triggered when the predicted spacing will be below preset/predefined minima;

b) area penetration alert: whereby an alert is triggered when a movement likely to enter a critical or restricted area is detected;

c) deviation alert: whereby an alert is triggered when the computed deviation will be more than the preset/predefined maximum deviation;

d) runway incursion alert: whereby an alert is trig- gered when a movement likely to enter an active runway (runway strip) is detected; and

e) taxiway (or an inactive runway being used as a taxiway) or apron incursion alert: whereby an alert is triggered when a movement likely to enter a taxiway or apron in use, which does not belong to its assigned route, is detected.

3.6.2.4.4 Distinctive medium-term alerts should be provided well in advance to enable the appropriate remedial action to be taken with respect to:

a) conflict prediction;

b) conflict detection; and

c) conflict resolution.

3.6.2.4.5 Once a conflict has been detected, an A-SMGCS should either automatically resolve the conflict or, on request from the controller, provide the most suitable solution.

3.6.3 SUPPLEMENTARY REQUIREMENTS

3.6.3.1 Global risk factor

The introduction of an A-SMGCS should not result in an overall level of risk in excess of the probability of one fatal accident per 107 operations.

3.6.3.2 Aircraft types

An A-SMGCS should support operations involving all aircraft types and be capable of adaptation to cater for future aircraft types.

3.6.3.3 Vehicles

a. An A-SMGCS should be capable of being used by appropriately equipped vehicles operating within the movement area.
b. Any authorized vehicle intended to be used on the aerodrome in the vicinity of the manoeuvring area should be equipped to inform an A-SMGCS of its position.

3.6.3.4 Speeds and orientation

The system should be capable of supporting operations of aircraft and vehicles within the following parameters:

a. minimum and maximum speeds for aircraft on final approach, missed approach and runways;
b. minimum and maximum speeds for aircraft on taxiways;
c. minimum and maximum speeds for vehicles; and
d. any heading.

3.6.3.5 Susceptibility

The system should not be affected by:

a. radio interference, including that produced by navigation, telecommunications and radar facilities (including airborne equipment);
b. signal reflections and shadowing caused by aircraft, vehicles, buildings, snow banks or other raised obstacles (fixed or temporary) in or near the aero- drome; and
c. meteorological conditions or any state of the aerodrome resulting from adverse weather in which operations would otherwise be possible.

3.6.3.6 Reference system

3.6.3.6.1 An A-SMGCS should be referenced to the World Geodetic System-1984 (WGS-84).

3.6.3.6.2 A common reference point on aircraft and vehicles should be used in A-SMGCS.

3.6.3.7 Planning

3.6.3.7.1 In order to support the primary functions (surveillance, routing, guidance and control), the planning facilities of an A-SMGCS should provide for:

a. strategic planning which will indicate the predicted traffic situation for chosen times in excess of 20 minutes in advance;
b. pre-tactical planning which will indicate the pre- dicted traffic situation at a chosen time up to 20 minutes in advance; and
c. tactical planning which will indicate the present traffic situation.

3.6.3.7.2 Planning facilities should include methods of predicting an aerodrome capacity and indication of start-up times for traffic to meet this capacity.

Note 1.— The capacity assessment is to be based on factors such as weather conditions, serviceability of equip- ment, and closure of sections of the movement area.

Note 2.— Additional elements to be included in the capacity assessment are the operational activity needs of the movement area, such as surface inspections, friction measurement, and snow clearance.

Note 3.— The implementation of an A-SMGCS requires the designation of routes that ensure the safe and efficient movement of aircraft and vehicles. The route issued for any movement will be dependent on strategic, pre-tactical and tactical considerations that will be addressed within the overall planning function.

3.6.3.8 Recording

3.6.3.8.1 Selected data on the communications control activity and display information should be recorded for accident and incident investigation.

3.6.3.8.2 There should be a function to provide direct replay of recorded data within the operational system, as part of the requirement for immediate checking of suspect equipment and initial incident investigation.

3.6.3.9 System failures

3.6.3.9.1 Equipment that shows control data should be both fail-safe and fail-soft.

Note.— The term "fail-safe" in this context means that sufficient redundancy is provided to carry data to the display equipment to permit some components of the equip- ment to fail without any resultant loss of data displayed.

The term "fail-soft" means that the system is so designed that, even if equipment fails to the extent that loss of some data occurs, sufficient data remain on the display to enable the controller to continue operations.

3.6.3.9.2 In case of a failure of an element of an A-SMGCS, the effect should be such that the status is always in the "safe" condition.

3.6.3.9.3 All critical elements of the system should be provided with timely audio and visual indications of failure.

3.6.3.9.4 An A-SMGCS should be self-restartable. The recovery time should be a few seconds. The restart of an A-SMGCS should include the restoration of pertinent information on actual traffic and system performance.

3.6.3.10 Aerodrome considerations

An A-SMGCS should be capable of accommodating any change in the layout of the aerodrome (runways, taxiways and aprons).

3.6.3.11 Pilot considerations

Pilots should be provided with the following:

a) information on location and direction at all times;
b) continuous guidance and control during:
    1) the landing roll-out;
    2) taxiing to the parking position and from the parking position to the runway-holding pos- ition;
    3) lining up for an appointed take-off position; and
    4) the take-off roll;
c) indication of the route to be followed, including changes in direction and indication of stops;
d) guidance in parking, docking and holding areas;
e) indication of spacing from preceding aircraft, including speed adjustments;
f) indication of spacing from all aircraft, vehicles and obstacles in visibility condition 4;
g) indication of the required sequencing;
h) information to prevent the effects of jet blast and propeller/rotor wash;
i) identification of areas to be avoided;
j) information to prevent collision with other aircraft, vehicles and known obstacles;
k) information on system failures affecting safety;
l) the location of active runways;
m) alert of incursions onto runways and taxiways; and
n) the extent of critical and sensitive areas.

Note.— Most of the foregoing requirements may be satisfied by using ground visual aids.

3.6.3.12 Vehicle driver considerations

3.6.3.12.1 Vehicle drivers should be provided with the following:

a. information on location and direction at all times;
b. indication of the route to be followed;
c. guidance along the route being followed or guidance to remain within designated areas;
d. information, and control when and where appropri- ate, to prevent collision with aircraft, vehicles and known obstacles; and
e. alert of incursions into unauthorized areas.

3.6.3.12.2 In addition to 2.6.12.1, the drivers of emergency and operational vehicles should be provided with:

a. the capability to locate the site of an emergency within the displayed range of the system; and
b. information on special priority routes.

Note.— Most of the foregoing requirements may be satisfied by using ground visual aids.

3.6.3.13 Apron management considerations

The following information should be available to the apron management services:

a. information on the identity, position and progress of aircraft, including aircraft under tow;
b. information on the identity, position and progress of vehicles whose movements might conflict with aircraft movements;
c. information on the presence of obstacles or other hazards;
d. information on the operational status of system elements; and
e. information on facilities appropriate to the control to be exercised.

3.6.3.14 Automation

3.6.3.14.1 Where automation is available, the auto- mated systems should demonstrate an acceptable level of HMI efficiency.

3.6.3.14.2 The design of an A-SMGCS should make it possible to make a distinction between the following system elements and functions:

a. system assistance in the decision-making process;
b. system advice on the decisions taken; and
c. system decisions provided directly to the users.

3.6.3.14.3 Automated guidance should not be used by the system if aircraft control, conflict detection and conflict alert resolution are not available.

3.6.3.14.4 If the system integrity degrades, the system should automatically alert all users and have the capability to transfer automated functions to the controllers in a safe and easy way.

3.6.3.14.5 Without automation, it may not be possible to meet some operational requirements. Automation of functions can be applied to various parts of an A-SMGCS such as:

a. identification of aircraft and vehicles;
b. tracking and labelling of targets;
c. route assignment;
d. guidance and control;
e. runway incursion detection;
f. unauthorized intruder detection;
g. conflict prediction;
h. conflict detection;
i. conflict resolution;
j. alert indication;
k. indication of appropriate brightness setting for visual aids; and
l. stand allocation.

Note.— Automation validation processes are expected to encompass all environmental and failure conditions including a reversion to manual control.

3.6.3.15 Human-machine interface (HMI)

3.6.3.15.1 The operation of an A-SMGCS should not interfere with other ATC responsibilities.

3.6.3.15.2 The human-machine interface with an A-SMGCS should:
a. maintain a balance between the human and the machine functions;
b. permit the human to retain the power to make decisions as to those functions for which the human is responsible; and
c. provide for a balanced mix of visual, audio and tactile inputs and responses.

3.6.3.15.3 Input devices for the controllers should be functionally simple — involving the controllers in a mini- mum number of input actions.

3.6.3.15.4 It should be possible to view displays and indicators in all ambient light levels typical of an aerodrome control tower environment.

3.6.3.15.5 Account should be taken of the ability of the flight crew and vehicle drivers to respond to the guidance and control indications of the system.

3.6.3.15.6 The system should provide pilots and vehicle drivers with essential routing, guidance and control data in a standardized form that at all times is conspicuous, legible, comprehensible and credible. Guidance should be implemented in such a way as to minimize the pilots'/ vehicle drivers' head down time, while maximizing the use of visual cues.

3.6.3.15.7 For control staff, the system should have interfaces that allow them to manage the routing, guidance and control functions in a safe and efficient manner.

3.6.3.16 Interfaces

3.6.3.16.1 In order for all parties concerned to fully benefit from an A-SMGCS, the system should be capable of interfacing with the following:

a. air traffic management (ATM), including:
   1) arrival and departure management;
   2) arrival and departure coordination;
   3) optimized start-up sequence and times;
   4) optimized push-back sequence and times; and
   5) integrated initial flight plan processing system, central flow management unit, etc.;
b. aerodrome management systems;
c. existing and future ATS systems;
d. meteorological systems;
e. visual aids;
f. existing and future avionics;
g. aerodrome handling systems;
h. aircraft operators;
i. emergency authorities;
j. police/security authorities; and
k. other customers or users.

3.6.3.16.2 The data interchange between systems should be made in a standardized format.

3.6.3.16.3 An A-SMGCS should enable controllers, pilots and vehicle drivers to interface and function efficiently. These operators should also be capable of interfacing with other systems.

3.6.4 SYSTEM REQUIREMENTS

3.6.4.1 Accuracy

3.6.4.1.1 In specifying the positional accuracy par- ameters for an A-SMGCS, the requirements for the primary functions and their interdependencies should be considered.

3.6.4.1.2 For the surveillance function, the allowable error in the reported position should be consistent with the requirements set by the guidance and control functions.

3.6.4.1.3 For the guidance function, the allowable positional errors should be similar for visual and electronic taxi guidance. However, in visibility conditions where electronic guidance is required in specifying the allowable errors, taxiway widths and aircraft main gear wheel tracks should be considered.

3.6.4.2 Update rate

Where appropriate, the update rate of an A-SMGCS module should be adequate for the required operational performance.

3.6.4.3 Integrity

3.6.4.3.1 The system design should preclude failures that result in erroneous data for operationally significant time periods.

3.6.4.3.2 The system should have the ability to provide continuous validation of data and timely alerts to the user when the system must not be used for the intended oper- ation. The validity of data should be assessed by the system in accordance with the assigned priority given to these data.

3.6.4.3.3 Validation of operationally significant data should be timely and consistent with human perception and/or response time.

3.6.4.4 Availability and continuity

3.6.4.4.1 The availability of an A-SMGCS should be sufficient to support the safe, orderly and expeditious flow of traffic on the movement area of an aerodrome down to its AVOL.

3.6.4.4.2 An A-SMGCS should provide a continuous service for all areas determined by the competent auth- orities. Any unscheduled break in operations should be sufficiently short or rare so as not to affect the safety of aircraft using the system.

3.6.4.4.3 Monitoring of the performance of an A-SMGCS should be provided so that operationally significant failures are detected and remedial action is initiated to restore the service or provide a reduced level of service.

3.6.4.4.4 Automatic positive indication of the status of the system or any operationally significant failure should be given to any aircraft, vehicle or control facility that may be affected.

3.6.4.5 Reliability

3.6.4.5.1 An A-SMGCS should be designed with an appropriate level of redundancy and fault tolerance in accordance with the safety requirements. A self-checking system with failure alerts should be included in the system design.

3.6.4.5.2 A failure of equipment should not cause:

a. a reduction in safety (fail-soft); and

b. the loss of basic functions.

3.6.4.5.3 The system should allow for a reversion to adequate back-up procedures if failures in excess of the operationally significant period occur. Operationally significant failures in the system should be clearly indicated to the control authority and any affected user.

3.6.5 PERFORMANCE REQUIREMENTS

3.6.5.1 SYSTEM REQUIREMENTS

3.6.5.1.1 Prior to the implementation of an A-SMGCS, the system performance and functional requirements should be demonstrated in order to ensure that the design specifi- cations or requirements have been met.

3.6.5.1.2 The A-SMGCS target level of safety (TLS) should be 1 × 10-8 collisions per operation involving aircraft on the ground.

3.6.5.1.3 The function risk has been estimated as:

a) guidance: 3 × 10-9 per operation;

b) surveillance: 3 × 10-9 per operation;

c) control: 3 × 10-9 per operation; and

d) routing: 1 × 10-9 per operation.

3.6.5.1.4 The A-SMGCS should cover at least the movement area of the aerodrome as well as aircraft on approach to each runway at such a distance that inbound aircraft can be integrated into the A-SMGCS operations.

3.6.5.1.5 The A-SMGCS should be able to handle all aircraft and vehicles that are on the movement area at any time.

3.6.5.1.6 The determination of the maximum number of aircraft on the manoeuvring area should be based on the assumed peak traffic at the aerodrome. The A-SMGCS capacity should be sufficient to cater for increased capacity, and it should be reviewed on a regular basis to ensure that it is sufficient.

3.6.5.1.7 The A-SMGCS should accommodate all air- craft and vehicle speeds that will be used within the cover- age area with sufficient accuracy.

3.6.5.1.8 The A-SMGCS should be able to accommodate the following speeds determined to within ± 2 km/h (1 kt):

a) 0 to 93 km/h (50 kt) for aircraft on straight taxiways;

b) 0 to 36 km/h (20 kt) for aircraft on taxiway curves;

c) 0 to 150 km/h (80 kt) for aircraft on runway exits;

d) 0 to 460 km/h (250 kt) for aircraft on final approach, missed approach and runways;

e) 0 to 150 km/h (80 kt) for vehicles on the movement area; and

f) 0 to 20 km/h (10 kt) for aircraft and vehicles on stands and stand taxilanes.

3.6.5.1.9 For all aircraft and vehicles moving at speeds within the ranges described above, the A-SMGCS should be able to perform the surveillance and guidance functions in accordance with, and without degradation of, the control and routing functions. This is particularly relevant to the switching of visual aids and human-related functions.

3.6.5.1.10 The A-SMGCS should determine the direc- tion of movement in terms of the magnetic heading of each participating aircraft and vehicle to within ± 1°.

3.6.5.2 SURVEILLANCE REQUIREMENTS

Note.— It is expected that more than one type of surveillance sensor will be needed to meet the surveillance requirements.

3.6.5.2.1 The surveillance function should be capable of detecting aircraft, vehicles and obstacles. Methods should be employed to reduce adverse effects such as signal reflections and shadowing to a minimum.

3.6.5.2.2 A reference point on aircraft and vehicles is required to enable the A-SMGCS to determine their positions. Although this requirement applies to the surveillance function, it is used predominantly in the control and guidance functions.

3.6.5.2.3 The actual position of an aircraft, vehicle or obstacle on the surface should be determined within a radius of 7.5 m. Where airborne traffic participates in the A-SMGCS, the level of an aircraft when airborne should be determined to within ±10 m.

3.6.5.2.4 The position and identification data of aircraft and vehicles should be updated at least once per second.

3.6.5.2.5 The latency and validation of surveillance position data for aircraft and vehicles should not exceed 1 second. The latency and validation of identification data for aircraft and vehicles should not exceed 3 seconds.

3.6.5.3 ROUTING REQUIREMENTS

3.6.5.3.1 The requirements listed in Table 4-1 should be used in the design of the routing function.

3.6.5.3.2 The time taken to process an initial route should not exceed 10 seconds. Reprocessing to account for tactical changes once the aircraft or vehicle is in motion should not exceed 1 second.

3.6.5.3.3 In the processing of optimized routes, the length of taxi distances should be computed to a resolution better than 10 m, and timing to a resolution better than 1 second.

3.6.5.4 GUIDANCE REQUIREMENTS

3.6.5.4.1 The overall response time of initiation of the guidance to verification that the correct route or infor- mation has been provided should not exceed 2 seconds.

3.6.5.4.2 The reversion time should be a maximum of 0.5 second.

3.6.5.5 CONTROL REQUIREMENTS

3.6.5.5.1 The probability of detection of an alert (PDA) situation should be greater than 99.9 per cent. The probability of false alert (PFA) should be less than 103.

3.6.5.5.2 The response time of any control function should be less than 0.5 second.

3.6.5.5.3 Longitudinal spacing (see Figure 3-2) should be based on the following typical numerical values:

a) Va = 55 km/h (30 kt);

b) Vb = 55 km/h (30 kt);

Table 4 : Routing maximum failure rate requirements

Visibility condition	Requirement (Failures per hour)
1	1.5E-03
2	1.5E-04
3	3.0E-06
4	1.5E-06

c) Aa = 1 to 2 m/s2 (depending on aircraft weight, friction coefficient, etc.);

d) Ab = 1 to 2 m/s2 (depending on aircraft weight, friction coefficient, etc.);

e) Pir = 1 s;

f) Cor = 1 s;

g) Syr = 2 s; and

h) Sar = 1 s.

3.6.5.5.4 On the basis of calculations using the above data, it can be concluded that:

a) a design taxi speed of 55 km/h (30 kt) is practicable;

b) a longitudinal spacing (St) of approximately 200 m, with aircraft taxiing in trail, will be required to achieve the minima specified below; and

c) a minimum spacing when the aircraft have stopped (Ss + Lj) of approximately 60 to 15 m can be provided by the system, with the lower figure applying to holding positions.

3.7. ATFM (CDM, AMAN, DMAN)

A-CDM (Airport Collaborative Decision Making) is "the concept which aims at improving Air Traffic Flow and Capacity Management (ATFCM) at airports by reducing delays, improving the predictability of events and optimising the utilisation of resources

A-CDM assumes the existence of airport operations optimisation systems eg. DMAN, SMAN. These systems interact with the different stakeholders relevant for the flight, here called A-CDM Partners. The A-CDM Partners provide their best estimation of when the aircraft will be ready to start movement from the gate to departure. All these estimations require access to the most updated information, therefore providing Common Situational Awareness, eg. information regarding the estimation of the arrival of the aircraft.

This results in a Collaborative Decision Making process that ensures optimised pre-departure planning which better satisfies A-CDM Partners needs while improving the airport resources utilisation, such as the runway or the gates.

DMAN is a planning system to improve departure flows at an airport by calculating the Target Take Off Time (TTOT) and Target Start-up Approval Time (TSAT) for each flight, taking multiple constraints and preferences into account

4. FASILITAS KOMUNIKASI PENERBANGAN

4.1 VHF Air Ground Tower Set

4.1.1 Deskripsi Singkat

VHF Air Ground Tower Set adalah fasilitas komunikasi penerbangan yang digunakan untuk komunikasi antar pesawat di udara dengan petugas pengendali lalu lintas penerbangan di darat untuk keperluan pengaturan lalu lintas penerbangan di suatu bandar udara yang pengaturanya dilakukan dengan pengamatan secara visual.

VHF Air Ground Tower Set merupakan sebuah kesatuan sistem peralatan komunikasi penerbangan di menara pengawas lalu lintas penerbangan yang terdiri dari beberapa sistem, yaitu :

a. VHF Transmitter dan Receiver

   Merupakan peralatan yang berfungsi untuk memancarkan dan menerima gelombang elektromagnetik yang terdiri dari pemancar dan penerima utama (*main*); dan pemancar dan penerima cadangan (*standby*). Dalam pengoperasiannya pemancar dan penerima utama (*main*); dan pemancar dan penerima cadangan (*standby*) dihubungkan dengan pemindah otomatis (*Automatic change over switch*) yang dapat memindahkannya secara otomatis sesuai dengan keperluan operasional.

b. Recorder

   Merupakan peralatan yang berfungsi untuk merekam seluruh percakapan (komunikasi suara) yang terjadi antara petugas pengatur lalu lintas penerbangan dengan pilot pesawat udara melalui peralatan VHF – A/G atau percakapan dengan unit ATS lain dalam rangka koordinasi pengendalian lalu lintas penerbangan.

c. Console Desk

   Merupakan Meja kerja bagi petugas pengendali lalu lintas udara yang dilengkapi dengan berbagai peralatan sehingga petugas dapat melakukan control, monitor, dan koordinasi sesuai dengan kebutuhan operasional. Meja kerja juga dilengkapi dengan peralatan yang sesuai dengan kebutuhan agar pelayanan pengendalian lalu lintas udara dapat terlaksana.

d. Meteo System

Merupakan peralatan yang berfungsi untuk mendapatkan informasi meteorology di sekitar tempat pemandu lalu lintas penerbangan berada, sebagai data pembanding dari data informasi meteorologi yang bersumber dari badan yang bertanggung jawab di bidang Meteorologi, Klimatologi dan Geofisika.

4.1.2 Spesifikasi Teknis

a. VHF Transmitter dan Receiver

1)	Bidang Frekuensi	:	118 – 137 Mhz Synthesizer
2)	Chanel Spacing	:	25 kHz/8.33 kHz
3)	Frekuensi stability	:	< 1ppm/<0.3 ppm
4)	Supplay voltage	:	AC : 88-265VAC 50/60Hz DC : 21-31.5 VDC
5)	Housing	:	19" rack standard

b. Pemancar

1)	Catu Daya	:	AC : 88-265VAC 50/60Hz DC : 21-31.5 VDC
2)	Daya Pancar	:	≤ 25 Watt adjusted
3)	Out put impedance	:	50 Ohm
4)	Mis Match yang diperbolehkan	:	> 2 : 1 at full power, no damage with open circuit.
5)	Emisions (active mode)	:	Spurious:<-93dBc Harmonic:<-83dBc
6)	Audio Frekuensi	:	Response: 350 to 2500Hz (8.33kHz) 300 to 3400 Hz (25kHz) Input ; -30to+10dBm Distortion:<3%@90%mod.depth Noise ;>45dB@80%mod.depth

c. Penerima

1)	Input impedance	:	50 Ohm
2)	Sensitivity	:	AM<-107dBm @ 1kHz mod. and

10 dB S/N:D8PSK < -102 dBm.

3) Blocking : > -7 dBm @ 500 kHz

4) Low Frequency : Response: 350to2500Hz(8.33kHz)
300to3400 Hz (25kHz)
Output : -30 to +10 dBm
Distortion:<5%@90% mod.depth
Noise : >45dB@80%mod.depth.

d. Antenna

1) Impedansi : 50 Ohm

2) Jenis : Omni Directional

3) Range : 118 – 137 Mhz

e. Recorder

1) Housing : 19" /4U IPC carrier with 8 expansion slot, built in TFT screen dan keyboard / touchpad in drawer.

2) Operation Conditions : + 5° C to + 40° C in opeation
-20° C to +60 ° C in Storage
10% - 80 % air humidity

3) Periheral : TFT Sccreen dan keyboard mouse, 10/100/1000 Mbit
Ethernet interface,18.000 hours (160GB SATA hardisk), 512 RAM memory.

4) Chanel capacity : 8 to 120 chanels minimum.

5) Analog : 8 potential free inputs per card
Impedance > 20 k or 600 (selectable for each chanel) : input voltage range 18 mV – 220 mV.
VOX atau Continuous recording, on – hook/off-hook recording or COR (selectable per chanel)
Adjustable prologue dan epilogue.

6)	Frequency range	:	300 – 3400 Hz according to ITU
7)	Time synchronization	:	NTP via LAN or connection of an external time source (DCF77, GPS) via RS232
8)	Bufffer size	:	1800 channel hours base on 160 GB HDD
9)	Access LAN	:	TCP/IP, Workstation PC
10)	Drive	:	DVD-RAM 9,4 GB drive w/a capacity 1.200 ch hours. Pararell, sequential or master/ slave operation
11)	Playback	:	Without interrupting recording function.
12)	Media	:	DVD cartridge 4. GB
13)	Audio Output	:	Loudspeaker and headphone connection
14)	Time announcer	:	Interna RTC
15)	Audio Data		Data compressing PCM 64 Kbit/s, Digital Silence Enconding (DSE) hanya dapat diaktifasi untuk recording dan playback.(secrete data) dan dapat di export to windows standard audio.
16)	Recording	:	Adjustable overwrite protection, Time to live Function.
17)	Password protection	:	Hierarchical access control and user right for different users.

f. Console Desk

1) Jam digital dengan dua penunjukan waktu, UTC dan local time
2) Hand microphone (dilengkapi dengan PTT)
3) Head set dengan PTT.
4) Footswitch PTT di console desk (optional)
5) Audio control panel dapat diintegrasi dengan pralatan VHF Tower Set.

6) Lampu meja operator.

7) Flight Strip Holder sebanyak 20 buah.

8) Strip holder terdiri dari 2 (dua) kolom dimana kolom pertama dapat dipenuhi untuk informasi penerbangan yang aktif dan kolom kedua untuk informasi penerbangan yang masih dalam rencana (standby)

g. Peralatan Meteo System

Wind Direction and Speed display

1)	Wind Speed Accuracy	:	±0.25 mph to 23 mph ±1% from 24 to 160 mph
2)	Wind Speed Range	:	0 to 160 mph
3)	Wind Speed Resolution	:	1 mph
4)	Wind Direction Resolution	:	2 degrees
5)	Wind Direction Range	:	0 to 360 degrees
6)	Wind Direction Accuracy	:	±4 degrees

Temperatur

1)	Accuracy`	:	±0.9°F from +14° to 185°F (±0.5°C from -10° to 85°C) ±3.6°F from -67° to 257°F (±2.0°C from -55° to 125°C)
2)	Resolution	:	0.01°F

Relative Humidity

1)	Type	:	Capacitance
2)	Accuracy	:	±3% (or better) from 10 to 90% RH at 68°F
3)	Temperature Effect	:	less than <±1.5% RH from 14°F to 140°F
4)	Stability	:	±2% RH over 2 years
5)	Reporting Resolution	:	1% RH
6)	Range	:	0 to 100%

Barometric Pressure

1)	Accuracy	:	±0.03 in.Hg over ran level, with temperature between 182°F (0° - 85°C)
2)	Range	:	27 to 33.96 in.Hg
3)	Resolution	:	0.01 in.Hg

4.2 VHF Air Ground APP (Approach Control)

4.2.1 Deskripsi Singkat

VHF Air Ground APP (Approach Control) adalah fasilitas komunikasi penerbangan yang digunakan untuk komunikasi antar pesawat di udara dengan petugas pengendali lalu lintas penerbangan di darat untuk keperluan pengendalian lalu lintas penerbangan di ruang udara suatu bandar udara.

VHF Air Ground APP (Approach Control) merupakan sebuah kesatuan sistem peralatan komunikasi penerbangan yang terdiri dari beberapa sistem, yaitu :

a. VHF Transmitter dan Receiver

   Merupakan peralatan yang berfungsi untuk memancarkan dan menerima gelombang elektromagnetik yang terdiri dari pemancar dan penerima utama (*main*); dan pemancar dan penerima cadangan (*standby*). Dalam pengoperasiannya pemancar dan penerima utama (*main*); dan pemancar dan penerima cadangan (*standby*) dihubungkan dengan pemindah otomatis (*Automatic change over switch*) yang dapat memindahkannya secara otomatis sesuai dengan keperluan operasional.

b. Recorder

   Merupakan peralatan yang berfungsi untuk merekam seluruh percakapan (komunikasi suara) yang terjadi antara petugas pengatur lalu lintas penerbangan dengan pilot pesawat udara melalui peralatan VHF – A/G atau percakapan dengan unit ATS lain dalam rangka koordinasi pengendalian lalu lintas penerbangan.

c. Console Desk

   Merupakan Meja kerja bagi petugas pengendali lalu lintas udara yang dilengkapi dengan berbagai peralatan sehingga petugas dapat melakukan control, monitor, dan koordinasi sesuai dengan kebutuhan operasional. Meja kerja juga dilengkapi dengan peralatan yang sesuai dengan kebutuhan agar pelayanan pengendalian lalu lintas udara dapat terlaksana.

4.2.2 Spesifikasi Teknis

a. VHF Transmitter dan Receiver secara umum

1)	Bidang Frekuensi	:	118 – 137 Mhz
2)	Jumlah Kanal	:	Single channel/Synthesizer
3)	Penyimpangan Frekuensi	:	$< 5 \times 10^{-6}$
4)	Spasi Kanal (switchable)	:	25Khz / 8.33 Khz
5)	Housing	:	19" standard module carrier

b. PEMANCAR

1)	Catu Daya	:	220 VAC ± 10 % / 50 Hz Atau 24 VDC ± 10 %
2)	Daya Pancar	:	≤ 50 Watt
3)	Mis Match yang diperbolehkan	:	> 2 : 1 at full power, no damage with open circuit
4)	Emisi Spurious	:	- 90 dBc
5)	Emisi Harmonic	:	- 80 dBc
6)	Kedalaman Modulasi	:	60 % - 90 %
7)	Cacat Modulasi	:	< 5 %
8)	Masukan Modulasi	:	Audio 300 – 2500 Hz
9)	MasukanDynamic microphone	:	2.5 V_{RMS} - 200 Ω ± 20%, atau yang sesuai sistem
10)	Impedansi Antenna	:	50 Ohm

c. Penerima

1)	Kepekaan / Sensitivity	:	≤ 3 μV
2)	Penolakan Frekuensi Bayangan	:	≥ 80 dB
3)	Penolakan signal IF	:	> 100 dB
4)	Penekanan signal Intermodulasi	:	≥ 80 dB

5)	Squelch setting	:	8 dB – 14 dB
6)	Adjacent channel selectivity	:	> 70 dB pada 25 Khz
7)	A G C	:	< 3 dB
8)	Total harmonic Distortion	:	< 5 % pada 90 % Mod
9)	Impedansi Saluran audio	:	600 Ohm
10)	RF input	:	50 Ω

d. Antenna

1)	Impedansi	:	50 Ohm
2)	Jenis Antenna	:	Omni Directional
3)	Bidang Frekuensi	:	118 – 137 Mhz

e. Recorder

1)	Housing	:	19" standard module carrier
2)	Operation conditions	:	temperature -0° to +50° C
3)	CPU/Bus system	:	humidity : up to 95 % at 40° C. Passive back blare with high performance plug-in CPU
4)	Operating system	:	Microsoft windows
5)	Peripherics	:	SVGA monitor, SVGA card with 16 Mb memory, keyboard PS/2 mouse, memory 256 Mb, HDD 40 Gb ethernet card 10/100 Mbps, CD-ROM floppy Disk 3.5"
6)	Channel capacity	:	8 expandable up to 128 channels
7)	Analog Interface	:	8 input channel perboard, high impedance (> 20 K ohm) matching or 600 ohm, DC isolated, terminating input range 18 mV – 2.2 rms, continuous recording, VOX, or COR control adjustable aplique and proloque
8)	Frequency range	:	300 – 3400 Hz according to ITU
9)	Time synchronization	:	Internal RTC (standard), RS 232 GPS (optional)

10)	Buffer size	:	Approx 3.500 channels hours, base on 40 Gb HDD
11)	Acces via LAN	:	TCP/IP, workstation PC
12)	Drives	:	tape cassete drive or DVD drive (single/double)
13)	Media	:	Casette 8 – 80 GB or DVD cartridge 4.7 GB
14)	Audio output	:	Built in loudspeaker headphone jack
15)	Search	:	Menu controlled search operations for date/time, channel number and call number
16)	Time announcer	:	Including application time announcer
17)	Audio data	:	Over write / erase protection programmable
18)	Password protection	:	Windows password
19)	Alarm	:	Three level alarm via loudspeaker

f. Peralatan Meteo System

Wind Direction and Speed display

1)	Wind Speed Accuracy	:	±0.25 mph to 23 mph ±1% from 24 to 160 mph
2)	Wind Speed Range	:	0 to 160 mph
3)	Wind Speed Resolution	:	1 mph
4)	Wind Direction Resolution	:	2 degrees
5)	Wind Direction Range	:	0 to 360 degrees
6)	Wind Direction Accuracy	:	±4 degrees

Temperatur

1)	Accuracy	:	±0.9°F from +14° to 185°F (±0.5°C from -10° to 85°C) ±3.6°F from -67° to 257°F (±2.0°C from -55° to 125°C)

2)	Resolution	:	0.01°F
Relative Humidity			
1)	Type	:	Capacitance
2)	Accuracy	:	±3% (or better) from 10 to 90% RH at 68°F
3)	Temperature Effect	:	less than <±1.5% RH from 14°F to 140°F
4)	Stability	:	±2% RH over 2 years
5)	Reporting Resolution	:	1% RH
6)	Range	:	0 to 100%
Barometric Pressure			
1)	Accuracy	:	±0.03 in.Hg over ran level, with temperature between 182°F (0° - 85°C)
2)	Range	:	27 to 33.96 in.Hg
3)	Resolution	:	0.01 in.Hg

g. Console Desk

Dengan Kelengkapan Sebagai Berikut :

- Jam digital dengan dua penunjukkan UTC dan local time
- Hand Held Microphone (dilengkapi dengan saklar PTT)
- Head Set dengan Microphone (dilengkapi dengan PTT).
- Footswitch PTT di console desk (optional)
- Speakers yang dapat di adjust sesuai kebutuhan
- Auto – switch headsed / speakers
- Radio selector Panel dan Change over (Remote Control Unit / RCU)
- Lampu meja operator
- Flight Information Strip Holder (dilengkapi strip holder 20 buah)
- Cassing tempat back up VHF A/G Transceiver
- Strip holder terdiri dari 2 baris, baris pertama untuk informasi penerbangan yang aktif dalam pengontrolan dan baris kedua untuk informasi penerbangan yang masih dalam rencana (standby).
- Intercom system (minimal 6 saluran)

4.3 VHF Air Ground Portable

4.3.1 Deskripsi Singkat

VHF Air Ground Portable adalah fasilitas komunikasi penerbangan yang digunakan untuk komunikasi antar pesawat di udara dengan petugas pengendali lalu lintas penerbangan di darat untuk keperluan pengendalian lalu lintas penerbangan di ruang udara suatu bandar udara yang pengaturanya dilakukan dengan pengamatan secara visual.

VHF Air Ground Portable merupakan peralatan komunikasi penerbangan yang hanya terdiri dari satu sistem transmitter dan receiver yang berfungsi untuk memancarkan dan menerima gelombang elektromagnetik.

VHF Air Ground Portable memiliki spesifikasi teknis sebagai berikut :

4.3.2 Spesifikasi Teknis

a. VHF Transmitter dan Receiver secara umum

1)	Bidang Frekuensi	:	118.000 – 136.975 Mhz
2)	Jumlah Kanal	:	Multichannel
3)	Spasi Kanal (switchable)	:	25Khz / 8.33 Khz
4)	Temperatur operasi	:	mampu beroperasi dengan baik hingga pada temperature 55 ^{0}C
5)	Temperatur penyimpanan	:	≤ + 55 ^{0}C
6)	Sensitivity	:	< 1.5 μV at 6 dB (S+N) / N ≥ 5 watt pada 4 Ω
7)	Output Audio	:	Built in dengan unit transceiver tidak jadi satu dengan microphone)
8)	Selectivity	:	> 5 watt carrier, 16 watt PEP
9)	Loudspeaker	:	VSWR ≤ 3 : 1
10)	Output Transmit	:	1 – 10 mV Symetrical
11)	Antena mismatching	:	AM
12)	Microphone	:	Receive current < 70 mA
13)	Type of modulation	:	Transmitt current < 2.5 A
14)	Penggunaan power	:	220 VAC ± 10 % /50 Hz
15)	Power supply/charger		12 VDC ± 10 %

4.4 HF Air Ground

4.4.1 Deskripsi Singkat

HF Air Ground merupakan peralatan komunikasi penerbangan yang digunakan untuk komunikasi radio darat – udara yang digunakan untuk pertukaran berita dalam bentuk suara, antara :

a. petugas komunikasi di stasiun FSS (Flight Service Station) dengan penerbang di pesawat udara yang terbang di jalur penerbangan domestic (Regional Domestic Air Route Area);
b. petugas komunikasi di stasiun FSS (Flight Service Station) dengan penerbang di pesawat udara yang terbang di jalur penerbangan Internasional (Major World Air Route Area).

dalam rangka pelayanan pertukaran informasi penerbangan.

Peralatan HF Air Ground terdiri dari peralatan Transmitter HF dengan kelengkapannya, Receiver HF dengan kelengkapannya serta Console Desk dan kelengkapannya yang dipasang di Gedung Operasi.

4.4.2 Spesifikasi Teknis

a. Meja operator (Control Desk)
    1) Flight Information Strip
    2) Peta Route Udara
    3) Jam digital dengan 2 (dua) penunjukkan UTC dan local time
    4) Transmitter remote control panel
    5) Receiver remote control panel
    6) Panel pemilih peralatan main/standby
    7) Panel Audio
    8) Unit Selective Calling (Selcall) dengan code A – S
    9) Microphone Meja + Headset
    10) Intercom 12 Saluran
    11) Foot Switch
b. Main Distribution Frame (MDF) untuk gedung pemancar, gedung penerima dan gedung operasi.
c. HF Transmitter

1)	Power	:	≤1 kW untuk RDARA
			≥ 1 kW untuk MWARA
2)	kelengkapan	:	Exciter
		:	Power Amplifier 1 kW
		:	Heavy duty regulated power supply
		:	Rack cabinet
3)	Transmitter rack dengan kelengkapan	:	Transmitter change over switch
		:	Remote control unit
		:	Interface cabling dan connector
		:	Dummy load 50 Ω, > 1 k W
4)	Antenna transmitter dengan kelengkapan	:	HF – Antenna
		:	Mast lighting kit
		:	Coaxial cable dan konektor

d. HF Receiver

1)	kelengkapan	:	Receiver Multi Coupler 1 input 6 output
		:	High Pass Filter
		:	Receiver rack
			wiring system
			power supply
2)	Antenna receiver dengan kelengkapan		Antenna
			Mast lighting kit
			Coaxial cable dan konektor

e. Buku Petunjuk (Manual Books)

f. UPS (Uninterupe Power Supply

1)	Power UPS Transmitter	5 kVA
2)	Power UPS Receiver	3 kVA
3)	Power UPS Console Desk	1 kVA

4.5 ATIS (Aeronatical Terminal Information System)

4.5.1 Deskripsi Singkat

ATIS adalah peralatan yang dapat digunakan untuk memberikan layanan informasi aeronautika termasuk pesan meteorologi yang di pancarkan secara Broadcast (siaran/ terus menerus) di wilayah udara bandara sesuai dengan ketentuannya, untuk menunjang keselamatan, keteraturan dan efesiensi navigasi penerbangan.

peralatan ATIS secara system terdiri dalam 2 bagian utama, yaitu :

a. Peralatan ATIS server yang berfungsi mengelola data/informasi meteorologi sekitar bandara dan runway in used baik yang datang dari peralatan meteo system maupun data entry dari ATC, data dirubah menjadi voice (suara) dan dipancarkan, yang bekerja secara kontinyu dan otomatis.
b. Peralatan VHF Transmitter yang berfungsi memancarkan output ATIS secara omni.

4.5.2 Spesifikasi Teknis

a. ATIS secara umum
   1) Kanal Frekuensi : 118 – 137 Mhz
   2) Jumlah Kanal : Single channel/Synthesizer
   3) Spasi Kanal (switchable) : 25Khz / 8.33 Khz
   4) Penyimpangan Frekuensi : $< 5 \times 10^{-6}$

b. Transmitter
   1) Catu Daya : 220 VAC ± 10 % / 50 Hz atau 24 VDC ± 10 %
   2) Daya Pancar : > 5 watt carrier, 16 watt PEP
   3) Emisi Spurious : - 90 dBc
   4) Emisi Harmonic : - 80 dBc
   5) Kedalaman Modulasi : 60 % - 90 %
   6) Cacat Modulasi : < 5 %
   7) Masukan Modulasi : Audio 300 – 2500 Hz
   8) Masukan untuk Dynamic microphone : 2.5 V_{RMS} - 200 Ω ± 20 %, atau yang sesuai system

9)	Impedansi Antenna	:	50 Ohm

c. Server

1)	C P U	:	Pentium IV 2,6 GHz, atau lebih baik
2)	Tipe	:	Industrial PC-19" Rack Mount
3)	Data Masukkan	:	Menggunakan LAN, Komunikasi Serial / Keyboard entry
4)	Sistem Operating	:	Unix 32 bit, Linux, Windows atau lainnya
5)	Antarmuka yang dipakai	:	Windows Graphical
6)	Antarmuka ATIS Digital	:	Acars ATS Protocol

d. User Terminal & Supervisory Control

1)	C P U	:	Pentium IV 2,6 GHz, atau lebih baik
2)	Tipe	:	Desktop
3)	Disk	:	40 GB atau lebih tinggi
4)	Sistem Operasi	:	Berbasis Windows

4.6 Integrated AIS (Integrated Aeronautical Information Service)

4.6.1 Deskripsi Singkat

Integrated AIS (*Integrated Aeronautical Information Service*) adalah peralatan yang digunakan digunakan untuk memberikan layanan informasi yang saling terintegrasi antara AIS Message, Meteo Message dan ATS Message untuk keselamatan, keteraturan dan efesiensi navigasi penerbangan.

Perangkat peralatan tersebut secara system dibagi dalam tiga bagian utama (unit) yaitu:

a. Server AIS, yang berfungsi sebagai penyimpan berita-berita keselamatan penerbangan;
b. Workstation, yang berfungsi untuk mengolah berita-berita penerbangan;
c. Manageable switch, yang digunakan sebagai pengatur jaringan dan akan di instalasi di Bandara setempat.

4.6.2 Spesifikasi Teknis

Hardware

a. Server IAIS
    1) Server Data Base
        - Rack Server dengan High Performance
        - Processor minimal Intel Xeon Dual-Core
        - Redundant Power Suplay
        - Memory minimal 1 GB
        - SAS Raid Controller
        - Dual Embedded Gigabit Network Adapter
        - Raid 5
        - Keyboard
        - Optical Mouse
        - Monitor LCD 15" TFT
    2) Server Communication
        - Industrial PC
        - PC Host Card

b. External Tape Backup

SCSI Tape, High Performance

c. Work Station

1)	Processor	:	Minimal Intel Pentium IV atau lebih baik
2)	Memory	:	Minimal 1 GB atau lebih baik
3)	Hard Disk	:	Minimal 80 GB atau lebih baik
4)	Printer	:	Laserjet
5)	Monitor	:	LCD 15" TFT
6)	Ethernet	:	10/100 Network Adapter
7)	Accecories	:	DVD-ROM

d. Managable Switch

Web smart switch 24 port 10/100/1000 TX + 2 SFP combo port

e. Ethernet Adapter

1)	Standard	:	IEEE 802.3 10BASE-T, IEEE 802.3U 100BASE-TX, IEEE802.3z 1000BASE-SX
2)	Auto negotation		
3)	1 port network - Ethernet 10Base – T/100Base – TX/1000Base-T – RJ-45		
4)	Bus	:	Type 32/ 64-bit PCI
5)	Driver	:	Windows 98SE /NT /ME /2000 /XP, LINUX, QNX

f. Unit Line Switching Serial / Automatic Change Over Unit + Signal Selector

1)	Port Serial	:	4 port RS-232 dengan konektor RJ 45
2)	Automatic Selection A/B		
3)	Manual/ Force Selector A/B		
4)	Alarm Audible		

g. Multiport (Serial Expander) / Modul Asynchronous Communication

1)	Port Serial	:	4 port RS-232 dengan konektor Rj-45

2) Speed Serial Port : 50 – 115 Kbps

3) Kontrol Sinyal : TXD, RXD, CTS, RTS, DCD, DTR, DSR, GND.

4) Expandable (daisy chaining)

h. Master Clock

Using GPS reference

i. Remote Monitoring dan Maintenance

Software

a. Operating System

Linux Enterprise Advance Platform + Cluster Suite atau setara

b. Feature System

1) GPS Master Clock Synchronizing
2) Remote Monitoring dan Perawatan
3) Graphical user Interface
4) Automatic Failure Detection dan Recorvery
5) Fully Shared Strorage Subsystem
6) Comprehensive Data Integrity
7) Practical Access Database
8) Efficient Strorage Data Management, RAID
9) Configurable, Multilevel Pasword
10) High Performance Redundant database
11) System Status Information, network, Resources
12) System Diagnostics
13) Interface ke AMSS/AFTN

c. STATISTICS

1) Nomor masuk dan keluar message dan Karakter
2) Nomor Notam-Notam, ATS Message
3) Nomor Metco Message

d. AFTN MESSAGE HANDLING

1) Fully Compliance to Annex 10
2) Automatic header (Header dan Ending) Generation
3) Automatic Sorting dan Filtering message
4) Sequence Number Check
5) Automatic Service Message Generation

6) Format AFTN untuk Format database Converter, Vice Versa Automatic Message Checking, koreksi dan rejected message management

7) Mengirim dan Menerima Message AFTN

8) Printing Automatic untuk message masuk dan keluar (configurable)

9) Retrievable AFTN mail boxes (keluar dan masuk) dan monitoring

e. MODULE ATS MESSAGE

1) Mendukung Type message : ALR, RCF, FPL, RPL, DLA, CHG, CNL. DEP, ARR, CPL, EST, CDN, ACP, LAM, RQP, RQS.

2) Waktu Automatic dan Origin Filling

3) Online field Checking Capability

4) ATS free text message template / composer

5) Supplementary Flight Plan Message, Request Supplementary Flight Plan Message

6) Checking Automatic dan warning generation of Active Flight

7) Active Flight List Sorting

8) Message Retrieve (keluar dan masuk) dengan various filter

9) Automatic field template insertion untuk retrieved message Automatic filling dari field database

10) Aircraft type, aerodrome, route

11) Automaticfilling address dan data ATS message (DES, DLA, CNL, CHG, ARR), based di related FPL

12) Online monitoring pada Inbound, Outbound dan Overflights

13) Configurable Time Window

14) Various filtering dan sorting criteria

15) Retriveable of traffic message history

f. ROBEX (regional OPMET Bulletin Exchange)

1) Configure

2) Automatic sending bulletin at specified time period

g. MODULE NOTAM

1) Automatic processing of NOTAM Message, Supported NOTAM type : NOTAM, SNOWTAM, ASHTAM, BIRDTAM, MULTIPART NOTAM

2) New NOTAM template, Delete, Edit, Retrieve-Incoming, Outgoing NOTAM, View Based on selected criteria & filter

3) Active Sorted NOTAM LIST

4) Warning for expired NOTAM

5) Template for request NOTAM (RQN) dan NOTAM check list (RQL) to other notam office

6) AutomaticNOTAM series number & Alocation

7) Request NOTAM handling from other station

8) NOTAM response template

9) NOTAM distribution list Automatic processing to NOTAM check list

10) Generation of NOTAM check list & Summary

11) Page Information Display Distribution, 20 Pages

h. INTEGRATED SELF BRIEFING

AIS, Meteo dan ATS Messages

i. PREFLIGHT INFORMATION BULLETIN

1) Generating bulletin based on type : - Area Bulletin
- Route type bulletin
- Acrodrome type bulletin

2) Based on FPL, RPL, NOTAM

3) Store, Edit, Print, Retrieve

j. POSTFLIGHT INFORMATION BULLETIN

Edit, Store, print & Retrieve

k. MODULE METEO

1) Generating (template) & processing meteorogical Message : - METAR, SPECI, SIGMET, AIRMET, SYNOP, WINTEM, TAFOR, ROFOR, ARFOR, AIREP, WARNING, SYNOP, WINSHEAR WARNING, ADVISORY VULCANO, VULCANIC Report
- Automatic Online field checking

2) Sorted Active meteo List

3) Requested Meteo RQM, Flight Schedule AIS, Flight Accident ATS

4) Retrieval dengan berbagai kriteria dan filter

5) METAR Bulletin

4.7 AMSC (Automatic Message Switching Center)

4.7.1 Deskripsi Singkat

AMSC (Automatic Message Switching Center) adalah peralatan yang bekerja secara otomatis mendistribusikan berita-berita penerbangan, yang dikendalikan oleh komputer dalam satu kesatuan lokal, yang dilengkapi dengan peralatan terminal.

Peralatan AMSC digunakan untuk penerimaan, pengolahan dan pendistribusian berita AFTN dari bandara lain dan unit-unit pelayanan keselamatan penerbangan seperti unit Aerodrome Control (ADC), unit Briefing office (BOF) dan Unit Meteorologi. Perangkat tersebut nantinya akan dipergunakan untuk mendukung operasional bandara dalam rangka pelayanan keselamatan penerbangan

Peralatan AMSC dari spesifikasi secara umum harus memenuhi syarat sebagai berikut:

a. Secara otomatis menyimpan dan menyalurkan berita-berita penerbangan, yaitu berita yang diterima akan diberi inisialisasi nomor untuk kemudian disimpan dalam perangkat data storage, setelah berita tersebut dibaca untuk selanjutnya diteruskan ke alamat tujuan dengan inisialisasi/nomor berita yang disalurkan;
b. Pengecekan format berita yang diterima, yaitu sistem harus secara otomatis melaksanakan pengecekan berita yang diterima sesuai dengan rekomendasi ICAO Annex 10 volume II;
c. Pengontrolan nomor berita, yaitu setiap berita yang diterima maupun yang dikirim secara otomatis diberi nomor yang berurutan untuk masing-masing saluran yang terhubung ke sistem;
d. Prioritas pengiriman berita, yaitu setiap pengiriman berita oleh sistem harus berdasarkan urutan prioritas dari prioritas yang tertinggi (SS) hingga prioritas yang terendah (GG);
e. Referensi berita yang disimpan, yaitu berdasarkan berita yang diterima dan berita yang telah dikirim, bukan berdasarkan berita yang masih dalam proses (antrian). Setiap berita akan mempunyai 2 (dua) nomor urut, yaitu nomor urut ke sistem sesuai dengan nomor urut berita yang diterima dan nomor urut berita yang dikirim;

f. Pemroses group address, harus dapat diolah secara stripping address. Stripping Address adalah pengiriman berita/message dengan beberapa address yang didistribusikan ke masing-masing alamat sesuai dengan salurannya tanpa diikuti dengan address yang lain yang tidak sesuai dengan alamat dimaksud;

g. Monitor saluran, yaitu suatu sistem yang mutlak harus dapat memonitor kondisi setiap saluran dan secara otomatis dapat menghentikan pengiriman berita dalam hal terjadi gangguan pada saluran (open line), dan akan mengirimkan kembali berita dimaksud dengan nomor yang berikutnya dengan segera setelah saluran tersebut normal kembali;

h. Dual system, yaitu sistem redundansi, terdiri dari On-line system dan Hot Stand By system yang dimaksudkan untuk menjamin keandalan komunikasi berita yang tinggi. Apabila terjadi adanya gangguan pada sistem yang on-line, maka secara otomatis dapat secara otomatis melakukan switch-over/berpindah ke sistem yang hot stand By tanpa adanya gangguan/hambatan baik dari segi hardware maupun software dan dalam penyaluran berita.

4.7.2 Spesifikasi Teknis

4.7.2.1. Persyaratan operasional diperlukan untuk memberikan gambaran tentang spesifikasi dari beberapa subsistem peralatan yang akan dipakai, dan membentuk/membangun peralatan AMSC. Perangkat lunak yang dibangun harus dapat melayani, menerima, mengolah, menyimpan, menyalurkan dan mengirim berita penerbangan secara otomatis sesuai dengan prosedur ICAO pada jaringan AFTN sebagaimana ditentukan dalam ICAO Annex 10 Volume II (Aeronautical Telecommunications).

4.7.2.2. Peralatan AMSC yang dimaksud harus mempunyai kemampuan dalam beberapa fungsi, yaitu :

a. "Store and forward" berita-berita AFTN secara otomatis.
b. Menerima dan mengirim berita AFTN secara bersamaan dari semua saluran / kanal yang tersedia.

c. Menampilkan dan mengirimkan secara otomatis semua berita-berita AFTN, baik berita yang memiliki "Single address maupun multi address".
d. Membuat dan mengolah statistik harian/berkala (incoming dan outgoing message) dalam bentuk tampilan dan cetakan.
e. Melaksanakan traffic insurance (check message, message sequential numbering, test message dan lain-lain).
f. Melakukan dan melaksanakan short term message file untuk jangka waktu paling kurang satu hari atau semua berita yang disalurkan / dikirim melalui AMSC.
g. Melakukan dan melaksanakan "long term message file" dengan menggunakan media penyimpanan seperti "Magnetic disk atau lainnya" yang berisi seluruh informasi yang diperlukan sehingga akan memudahkan manakala diperlukan untuk mencari dan menarik kembali (retrieve) berita yang telah pernah dikirim/disalurkan oleh AMSC, serta mencatat semua keterangan tentang berita-berita yang diterima dan dikirim.
h. Melakukan pencarian dan menarik kembali (retrieve), serta melakukan pengiriman ulang berita dengan memakai nomor urut berita (message sequential number).
i. Melakukan pengolahan sistem yaitu dapat dengan mudah memeriksa dan merubah parameter saluran dan atau jaringan dan lain-lain dari layar monitor.
j. Memberikan laporan/indikator bila mana terjadi gangguan dalam sistem jaringan dan lalu lintas.

4.7.3 Karakteristik Sistem

4.7.3.1. Jenis Jaringan Peralatan / sistem yang dimaksud harus mampu melayani lalu lintas berita penerbangan dengan memakai jenis jaringan, yaitu :

a. Full Duplex
b. Half Duplex
c. Simplex, Receive Only
d. Simplex, Send Only

4.7.3.2. Code Character yang digunakan adalah :

a. ITA - 2 (International Telegraph Alphabet No. 2) - Baudaut Code.

b. IA - 5 (International Alphabet No. 5) – (ASCII) American Standard Code Information Interchange.

c. Format WMO.

d. Aeronautical X.25

Sistem komputer ini harus mampu menerima dan mengirimkan berita-berita AFTN dengan memakai kedua jenis karakter tersebut (ITA-2 dan IA-5) pada setiap saluran/kanal yang tersedia. Pemilihan jenis karakter ini ditentukan dengan merubah parameter dari layar monitor.

4.7.3.3. Code Conversion (Konversi Kode)

Code Conversion (Konversi Kode) antara suatu sirkit masukan (incoming) dan keluaran (outgoing) dilakukan sistem secara otomatis untuk setiap penggunaan ITA-2 atau IA-5 bagi setiap saluran. Komunikasi antara sistem hanya menggunakan karakter cetak (Printing Character) yang tidak akan hilang atau diubah selama proses konversi. Konversi karakter dapat dilakukan dengan :

a. Basis satu ke satu (one to one basis);

b. Antara dua karakter alphabet dilakukan dengan menggunakan tabel-tabel konversi character tertentu (sesuai dengan ICAO dokumen Annex 10 Volume II).

4.7.3.4. Kecepatan Komunikasi (Communication Speed)

a. Peralatan AMSC harus dapat disetting dan mampu melayani kecepatan komunikasi yang bervariasi dari 50 Bps sampai dengan 19200 Bps atau lebih.

b. Untuk komunikasi lokal/intern kecepatan komunikasi akan disesuaikan dengan jenis workstation/peralatan yang dipakai; diutamakan yang menggunakan interface RS 232.

c. Untuk komunikasi outstation/remote station akan disesuaikan dengan media dan peralatan yang dipakai.

4.7.3.5. Tegangan DC jaringan komunikasi (Communication Voltage)

Untuk tegangan DC yang dipergunakan dalam jaringan komunikasi harus dapat disesuaikan dengan tegangan yang dipakai jaringan PT. TELKOM, yaitu sekitar 40 Volt sampai dengan 60 Volt atau jaringan lain yang memiliki tegangan yang berbeda.

4.7.4. Format Berita Dengan Standar AFTN

4.7.4.1. Perangkat AMSC yang dimaksud di dalam dokumen ini diharuskan mempunyai kemampuan untuk mengatasi perubahan format secara otomatis tanpa merusak / merubah berita dimanapun di dalam jaringan.

Format berita teletypewriter standar AFTN yang dimaksud adalah format yang ada dalam dokumen ICAO Annex 10 Volume II sampai dengan amandemen terakhir terdiri dari Standard berita memakai ITA – 2 dan Standard berita memakai IA – 5.

Format berita dimaksud terdiri atas : Heading (Kepala berita), Address (Alamat tujuan berita), Origin (Pengirim Berita), Text (Isi Berita), End of Message (EOM).

4.7.4.2. Penyimpangan Format dari Standard AFTN

Untuk keperluan keamanan berita, sistem dapat memberikan toleransi yang cukup besar terhadap penyimpangan format dari standard AFTN untuk berita yang diterima oleh AFTN.

Jika penyimpangan yang ternyata lebih besar dari pada toleransi maksimum yang tersedia, maka sistem ini hanya mencari Start of Message (SOM) / EOM kembali dari saluran tersebut.

a. Penyimpangan format yang dapat ditolerir (Pre – SOM)

1) Karakter-karakter palsu (Spurious Characters)

Karakter-karakter yang muncul antara suatu EOM dan SOM berita berikutnya, dapat diatur sampai jumlah maksimum yang dapat ditentukan, untuk diabaikan. Parameter ini ditentukan pada saat sistem melakukan start-up.

2) Kemungkinan kerancuan (Garbled Messages)

Ketika batas karakter palsu terlampaui, karakter-karakter berikutnya akan dikirim ke Reject Intercept secara lengkap sampai ada EOM atau SOM berikutnya. Hal ini untuk menjaga kemungkinan diabaikannya berita penting yang rancu (garbled), karena gangguan luar.

b. Heading

1) Start of Message (SOM) Suatu SOM akan dikenali, jika urut-urutan karakter berikut terbaca, baik dalam status huruf (letter case) maupun status angka (figure case), yaitu ZCZC, ZCZ,CZC dan ZC.

2) Channel Identity Identitas kanal haruslah terdiri dari 3 (tiga) karakter berurut tanpa spasi dalam status huruf (letter case). Ia haruslah merupakan identitas kanal yang diletakkan pada kanal penerimaan. Identitas kanal tersebut dapat terpisah oleh satu atau beberapa spasi setelah SOM. Tidak dikenalinya identitas kanal tidak akan menyebabkan berita diabaikan. Suatu kesalahan identitas kanal akan dikirim ke Reject Intercept berupa service.

3) Nomor urut kanal (Channel sequence number)

Nomor urut berita pada suatu kanal haruslah terdiri dari 3 atau 4 programmable karakter berurut tanpa spasi dalam status angka (figure case) yang didahului dengan satu atau lebih figure case. Ia haruslah terletak langsung setelah identitas kanal. Ketiadaan atau ketidaklengkapan nomor urut ini, tidak akan menyebabkan berita diabaikan.

4) End of Heading (EOH)

Pasangan 5 (lima) spasi dan 1 (satu) letter shift menunjukkan akhir dari heading dan harus terletak dalam satu bagian dari 42 (empat puluh dua) karakter yang dapat dicetak setelah SOM. Kegagalan mendeteksi EOH akan menyebabkan sistim mengalihkan berita ke Reject Intercept.

4.7.4.3. Address (Alamat)

a. Priority Indicator (Indikator Prioritas) Suatu Priority Indicator haruslah terdapat langsung setelah EOH yang dapat didahului oleh kombinasi Carriage Return (CR) dan Line Feed (LF), terdiri dari satu atau dua karakter dalam status huruf (letter case). Setidaknya satu dari dua karakter tersebut, haruslah merupakan karakter yang menunjukkan prioritas. Sistem akan menentukan prioritas tertinggi dari karakter-karakter prioritas yang dikenali. Jika tingkat prioritas tidak dapat ditentukan, maka sistem akan memberi prioritas FF. Adanya satu atau beberapa spasi antara EOH dengan Priority Indicator tidak akan menyebabkan berita tersebut diabaikan.

b. Addresses Indicator (Indikator alamat-alamat) Address haruslah setidaknya terdiri dari satu Addresss Indicator yang terletak langsung setelah Priority Indicator. Setiap Addresses yang ada haruslah setidak-tidaknya didahului oleh 1 (satu) spasi dan terdiri dari 8 (delapan) karakter berurutan tanpa spasi, dalam status huruf (letter case). Adanya kesalahan karakter (tidak termasuk Letter Shift), maka sistem akan mengirim SVC ke stasiun kanal berita tersebut serta salinan / copy ke Reject Intercept.

c. End of Address (Akhir dari alamat) Pasangan (CR) (LF) atau (LF) (CR) menunjukkan akhir dari Address dan harus terletak dalam salah satu dari 3 (tiga) baris / line address yang dapat dicetak setelah Priority Indicator. Untuk baris / line kedua dan ketiga tidak perlu diikuti prioritas lagi. Tidak terdeteksinya End of Address akan menyebabkan sistem mengalihkan berita ke Reject Intercept Position.

d. Text

Sistem ini tidak perlu mengevaluasi text, kecuali jika diketemukan "cancellation signal" yang akan menbuang seluruh karakter yang diterima. Panjang text maksimum adalah 1800 karakter.

e. End of Message (Akhir Berita)

Empat karakter "N" berurut tanpa spasi, baik dalam status huruf (letter case) maupun status angka (figure case) merupakan sinyal EOM. Suatu EOM haruslah ada dalam salah satu bagian dari jumlah maksimum karakter yang dapat dicetak, termasuk SOM. Apabila pada akhir berita / message tidak diketemukan karakter NNNN tersebut, maka sistem harus menambahkan : NNNN.

4.7.5. Penanganan Berita yang berstandard AFTN

4.7.5.1. Umum

Sistem menangani berita-berita yang berkaitan dengan indikator-indikator yang parameternya ditentukan ketika sistem melakukan start-up seperti :

a. Priority Indicator
b. Address Indicator
c. Message Diversion Indicator
d. Cancellation Indicator

4.7.5.2. Penanganan Prioritas

Prioritas suatu berita diberikan oleh stasiun pengirim dengan suatu Priority Indicator yang diletakkan pada awal suatu alamat / address. Sistem ini mengenal 5 (lima) Priority Indicator yang menunjukkan 3 (tiga) derajat / tingkatan prioritas, yaitu :

a. SS Message
b. DD Message
c. FF Message
d. GG Message
e. KK Message

Berita / message dengan tingkat prioritas yang lebih tinggi akan dikirim mendahului semua berita yang lain dengan tingkat prioritas yang lebih rendah. Sebagai contoh berita dengan prioritas SS akan segera dikirim dengan segera ke tempat tujuan, sekalipun beberapa berita dengan prioritas DD, FF atau yang lebih rendah prioritasnya sudah antri terlebih dahulu pada saluran tujuan berita tersebut.

Sebaliknya berita dengan prioritas yang KK atau GG baru akan dikirim, jika tidak ada berita dengan prioritas yang lebih tinggi (SS atau DD maupun FF) yang mengantri/ belum terkirim.

Jika terdapat dua atau lebih berita yang dengan prioritas yang sama, maka urutan pengiriman berita tersebut ditentukan oleh urutan masuknya berita tersebut ke sistem. Berita yang lebih dahulu masuk ke sistem akan dikirim lebih dahulu. Berita tanpa priority indicator atau priority indicator tidak dikenali oleh sistem akan diproses/diolah dengan prioritas FF.

Catatan :

Khusus untuk berita dengan prioritas SS, ketika sistem menerima berita tersebut, maka sistem secara otomatis akan mengirim suatu tanda/signal (acknowledgement) yang akan dikirim balik ke statsiun asal berita dan membuat salinannya (copy) ke Reject Intercept sesuai dengan Annex10 volume II paragraph 4.4.12.1.6.1.

Khusus karakter channel (CH) pada posisi Priority Indicator menunjukkan bahwa berita tersebut adalah Check, yang tidak mempunyai Address Indicator.Suatu berita Priority Indicator yang hanya terdiri dari 1 (satu) karakter akan diproses secara normal selama karakter tersebut adalah salah satu karakter yang menyatakan prioritas yang dikenalinya oleh sistem.

4.7.5.3. Analisa AFTN Routing Indicator

Analisa AFTN Routing dilaksanakan pada Routing Indicator yang terletak sampai baris ketiga setelah Heading (dapat merupakan Full Address). 8

(delapan) karakter yang membentuk Address mempunyai arti sebagi berikut :

a. Huruf pertama menyatakan Routing Area.
b. Huruf pertama dan kedua sekaligus menyatakan negara tujuan.
c. Huruf ketiga dan keempat menyatakan kota atau bandar udara di negara tujuan yang disebut sebelumnya.
d. Huruf kelima, keenam dan ketujuh menyatakan perusahaan/instansi kemana berita tersebut.
e. Huruf kedelapan menyatakan departemen / divisi atau bagian di lingkungan perusahaan / instansi yang disebut sebelumnya. Penentuan rute berita yang didasarkan atas analisa jumlah huruf minimum pada setiap Address Indicator. Berita yang tidak dikenali routingnya akan dikirim ke Reject Intercept Position dengan diberi notasi/catatan alasan penolakan sistem.

4.7.5.4. Predetermined Distribution

Semua berita berformat AFTN yang dikirim ke sistem akan di analisa ada tidaknya Predetermined Address Indicator pada baris address. Jika diketemukan adanya Predeterrmined Address Indicator yang benar, maka sistem akan mencari daftar distribusi yang sesuai dan mengirimkannya sesuai dengan masing-masing address/alamat yang ada dalam daftar. Predetermined Address Indicator terdiri dari 3 (tiga) bagian yang masing-masing terdiri dari 2 (dua) karakter cetak : **CLZZAAAA**

a. CL adalah Location Indicator sesuai dengan ketentuan ICAO.

b. ZZ aedalah Predetermined Designator, menunjukkan bahwa address ini menyebutkan suatu Predetermined Address.

c. AAAA adalah karakter referensi bagi daftar distribusi tertentu yang ada dalam daftar sistem.

4.7.5.5. AFTN Message Diversion (Route Alternatif)

Sistem ini mampu mengalihkan route untuk sampai pada tujuan berita melalui Supervisory Command dengan mode-mode operasi sebagai berikut:

a. Alihkan semua lalau lintas message / berita dari route normal ke route alternatif.
b. Alihkan semua lalu lintas message / berita dengan prioritas tertentu dari route normal ke route alternatif.
c. Alihkan semua lalu lintas message / berita dari route normal ke penyimpanan sementara.
d. Alihkan lalu lintas message / berita dengan prioritas tertentu dari route ke penyimpanan sementara.

4.7.5.6. Message Cancellation

Sistem akan mengabaikan Incoming Message (berita masuk) yang mempunyai sinyal pembatalan (Cancellation Signal), dimanapun setelah Heading. Sinyal pembatalan ini haruslah terdiri dari 2 (dua) kelompok, yang terdiri dari 3 (tiga) karakter, yaitu QTA berurut tanpa spasi dan langsung diikuti oleh Ending. Contoh : (LS) (CR) (CR) (LF) QTA (SP) QTA (SP) QTA (SP) QTA (CR) (CR) ... (LF) Ending

Catatan :

Sistem akan mengabaikan semua karakter non cetak yang ada antara QTA dan Ending sesuai dengan rekomendasi ICAO Annex 10 Volume II paragraph 4.4.10.12.

4.7.5.7. Message Interruption Dalam kondisi normal, outgoing message (berita keluar) akan ditransmisikan / dikirimkan secara otomatis tanpa interupsi. Ada kondisi yang mungkin timbul yang menyebabkan interupsi diperlukan, yaitu: Kemungkinkan kanal outgoing / saluran keluar mengalami gangguan, dengan terdeteksinya kondisi "open line" pada kanal incoming yang sama.

4.7.5.8. Message / Berita Abnormal Parameter kondisi continous mark dapat di set pada nilai berapapun dan di introduksikan pada saat sistem melakukan start up. Kapanpun ketidaknormalan berita diketemukan, suatu error indicator akan ditampakkan pada berita. Kemampuan sistem mendeteksi adanya ketidaknormalan dihasilkan dari pengiriman suatu service message yang berisi fault code secara otomatis. Jika selama penerimaan

suatu berita ditemukan SOM baru atau ketika sirkit berada dalam suatu kondisi continous mark melebihi waktu yang telah ditentukan (lamanya ditentukan pada saat sistem melakukan Start Up), sistem akan menghentikan berita dengan suatu forced ending sequence sebagai berikut :

(LS) (CR) (CR) (LF)

CHECK (LF)

TEXT (LF)

NEW ENDING ADDED ABCDEFGH (FS) (LS) (CR) (CR)

(CR) (LF)

Diikuti "ENDING"

Incoming message ini, dengan demikian menjadi lengkap dan disalurkan melalui route normal.

Catatan :

Huruf "ABCDEFGH" yang ada dalam suatu forced ending menunjukkan identifikasi sistem dan terdiri dari 8 (delapan) karakter huruf. Ketika terjadi 2 (dua) SOM berurutan diterima (tanpa diselingi EOM), maka message / berita yang sedang masuk dihentikan penerimaannya dengan ZCZC diikuti oleh suatu "forced ending sequence".

4.7.6. Traffic Protection

Untuk meningkatkan kontrol kontinuitas berita yang didasarkan pada nomor urut pada kanal (Channel Sequence Number), sistem mengontrol kondisi setiap saluran telegraph yang terhubung dan menyediakan sejumlah proteksi untuk menjamin kesiapan saluran untuk mentransmisikan berita. Sistem ini menyediakan Proteksi-proteksi berikut ini :

4.7.6.1. Message Protection

4.7.6.2. Circuit Protection