Working Draft

Satellite Voice Guidance Material (SVGM)

Version 0.7

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International Civil Aviation Organization

Inter-Regional SATCOM Voice Task Force (IR-SVTF)

Revision History

Date	Description of changes	Version
13-Jul-10	Initial working draft	
26-Jan-11	Added Joint working relationship with ICAO SATCOM Voice TF, added version control.	0.1
27-Jan-11	Added material from IRSVTF/1 meeting. First TF baseline. no track changes.	0.2
31-Mar-11	Added inputs since IRSVTF/1 meeting (See comment matrix for specific changes)	0.3
1-Jun-11	Added inputs from review on v0.3 (See comment matrix for specific changes)	0.4
22-Jul-11	Added inputs from IRSVTF Web1 review and actions on v0.4 (See comment matrix for specific changes)	0.5
23-Aug-11	Added inputs from IRSVTF Web2 review and actions on v0.5 (See comment matrix for specific changes)	0.6
4-Sep-11	Added inputs from IRSVTF Web3 review and actions on v0.6 (See comment matrix for specific changes)	0.7

Editor's note 1. — Editor's notes may appear throughout the document, however, refer to the master comment matrix, which includes open comments that may not have been resolved in this "working draft" version. Comments and contributory material should be submitted to "Elkhan NAHMADOV" enahmadov@paris.icao.int, "Catherine DALY" cdaly@paris.icao.int, and "Tom KRAFT" tom.kraft@faa.gov.

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FOREWORD.

1. Historical background

1.1 The *Satellite Communications (SATCOM) Voice Guidance Material* (SVGM) is the result of a task force established at the request from the ICAO Air Navigation Commission (ANC) made during its 4th Meeting of the 183rd Session held on 21 January 2010..

1.2 Over the oceanic and remote continental areas, aeronautical communications have historically been conducted with high frequency (HF) radios due to the advantage of being able to transmit and receive air/ground communications for thousands of miles. Most competent authorities hence required two independent HF sets on-board.

1.3 In the early 1980s, civil aviation recognized the increasing limitations of the present communications, navigation, and surveillance (CNS) systems for air traffic management (ATM) and the need to make improvements to overcome them and meet the future needs. Thus the Council of ICAO established the Special Committee on future air navigation systems (FANS) to study new concepts and new technologies and to recommend a system that would overcome the present and foreseen problems. The Committee made an extensive study of existing systems and the applications of new technologies. It concluded that the limitations of the existing systems are intrinsic to the systems themselves and were so restrictive that the problems could not be overcome on a global scale except by the exploitation of satellite technology. Thus a new concept of air navigation based on satellite technology was developed and consequently endorsed by the Tenth Air Navigation Conference in September 1991

1.4 In 1995, the initial future air navigation system (FANS 1/A) provided an integrated airborne CNS package. In addition to required navigation performance (RNP) and global navigation satellite system (GNSS) capabilities, FANS 1/A includes controller pilot data link communications (CPDLC) and automatic dependent surveillance – contract (ADS-C) capabilities using SATCOM, VHF, and HF data links. CPDLC and ADS-C were seen as the normal or preferred means of ATS communications. However, voice communications would continue to be required in situations where data link was not suitable. At the same time, these aircraft became equipped with SATCOM voice capability.

1.5 In June 2001, the 37th Meeting of the NAT SPG (12-14 June 2001) agreed that a study would be initiated to assess the viability of using satellite voice communications for waypoint position reporting as an initial step. The study was accompanied by the NAT trials that had been successful and demonstrated that while there were costs associated with implementation and use, SATCOM voice could be an effective and reliable long range communication system to support ATS voice communications.

1.6 In 2003, the 39th NAT SPG Meeting (17-19 June 2003) agreed that the NAT SUPPs needed to be amended to clearly state the conditions under which SATCOM voice could be used. In 2008, the 44th Meeting of the NAT SPG (17-20 June 2008) agreed that the authorization to use SATCOM voice for all ATS communications would permit reduction in risk of communications failure, improve safety of operations, and alleviate HF congestion. However, guidance material would be needed to address a number of issues related to call setup times, security and system performance and capacity. It was further concluded that any decision regarding MEL relief of one HF radio was subject to approval by the appropriate authority.

1.7 Some State authorities have granted some operators time-limited MEL dispatch relief of one HF radio whereby the aircraft may be dispatched for a limited period (5 or 10 days) with only a single operational HF radio system and a single operational SATCOM voice system. Operators are now seeking

permanent MEL dispatch relief of one HF radio by demonstrating that either the Iridium or Inmarsat SATCOM voice system meets the long range communication system (LRCS) requirements.

1.8 In 2010, the ICAO ANC having reviewed the progress of the NAT SPG SATCOM voice studies, requested that an ICAO inter-regional task force would be established to develop a globally applicable guidance material *Satellite Voice Guidance Material* (SVGM) in support of the global implementation of aeronautical mobile satellite (route) communications systems (AMS(R)S).

1.9 This edition of the Satellite Voice Guidance Material (SVGM) provides for a comprehensive update of various regional and State guidance material to use SATCOM voice for ATS communications. This includes the incorporation of performance-based specifications and associated guidance on data collection, monitoring, and analysis. This guidance material may facilitate the appropriate authority in establishing its policies on MEL for some dispatch relief. However, it assumes that sufficient HF voice infrastructure must remain in service and that the aircraft must be equipped with at least one operational HF voice system.

2. Scope and purpose

2.1 The SVGM provides guidance and information concerning SATCOM voice communications for aeronautical use and is intended to facilitate the uniform application of Standards and Recommended Practices contained in Annex 2 — *Rules of the Air* and in Annex 11 — *Air Traffic Services*, the provisions in the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444) and, when necessary, the *Regional Supplementary Procedures* (Doc 7030).

2.2 This guidance material is intended to maximize operational benefits in SATCOM voice operations by promoting ~~seamless and~~ *[pli1]* interoperable SATCOM voice operations throughout the world. This edition limits itself to current and near term operations. Future editions are expected to incorporate guidance that applies to the planned expansion of SATCOM voice capability in the high-density continental areas.

2.3 The following principles were adhered to in the development of this guidance material:

a) build on the ICAO required communication performance (RCP) framework to provide States with flexibility to apply different standards for different uses, without implication to seamless operations and providing that the safety objectives are satisfied;

b) provide a basis for States in determining acceptability of any implementation within an ATS facility, a radio facility or aircraft equipage, taking into account routine and emergency use, the provision of ATS using SATCOM voice communications, procedures for the radio operator, controller and flight crew, performance specifications and qualification;

c) note that in-flight use of portable SATCOM phones for ATS communications is not allowed, according to many existing State operating regulations;

d) do not specifically address MEL matters, but serve to facilitate State authorities or Regional Safety Oversight Organizations (RSOOs) in establishing policies in such matters; and

e) do not address the use of SATCOM voice in isolation (i.e., HF voice capability remains available on board and in the ground infrastructure).

2.4 While directed primarily at air traffic services personnel and flight crews, the following personnel should be familiar with various aspects of its contents: regulators, airspace planners, aircraft operators, dispatchers, communication service providers and radio operators, training organizations,

central monitoring and reporting agencies, automation specialists at centers and radio facilities, and aircraft manufacturers and equipment suppliers.

2.5 The guidance material will support the following activities:

a) the States' roles and responsibilities in relation to the following:

1) safety regulatory oversight of air navigation services;

2) operational approval, flight crew training and qualification;

3) airworthiness certification of aircraft SATCOM voice systems.

b) the development of agreements and/or contractual arrangements between air traffic service providers and aircraft operators and their respective communication service providers;

c) development of operational procedures; and

d) operational monitoring, analysis, and exchange of operational data among regions, States, RSOOs and communication service providers.

2.6 Guidance material and information concerning SATCOM data communications is not within the scope of this guidance material and can be found in the Global Operational Data Link Document (GOLD).

3. Status

3.1 This guidance document may contain material that may eventually become Standards and Recommended Practices (SARPs), or PANS provisions when it has reached the maturity and stability necessary for adoption or approval. It may also comprise material prepared as an amplification of the basic provisions ~~principles~~ in the corresponding SARPs, and developed ~~designed~~ particularly to assist the user in the application of the SARPs and PANS.

4. Implementation

4.1 The implementation of procedures is the responsibility of Contracting States; they are applied in actual operations only after, and in so far as, States have enforced them. However, with a view to facilitating their processing towards implementation by States, this ~~complementary~~ guidance *[pli2]* material has been prepared in language which will permit direct use by air traffic services personnel and others associated with the provision of air traffic services to international air navigation.

5. Promulgation of information

5.1 Information relating to the establishment and withdrawal of and changes to facilities, services and procedures affecting aircraft operations should be notified and take effect in accordance with Annex 15 — Aeronautical Information Services.

6. References

6.1 The following references are cited in this document:

a) ICAO Annex 1 — *Personnel Licensing*;

b) ICAO Annex 2 — *Rules of the Air*;

c) ICAO Annex 4 — *Aeronautical Charts*;

d) ICAO Annex 6 — *Operation of Aircraft – Part I — International Commercial Air Transport — Aeroplanes*;

e) ICAO Annex 10 — *Aeronautical Telecommunications – Volume II — Communication Procedures* including those with PANS status;

f) ICAO Annex 10 — *Aeronautical Telecommunications – Volume III — Communication Systems*;

g) ICAO Annex 11 — *Air Traffic Services*;

h) ICAO Annex 15 — *Aeronautical Information Services;*

i) *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, ICAO Doc 4444);

j) *Regional Supplementary Procedures* (Regional SUPPs, ICAO Doc 7030);

k) *Procedures for Air Navigation Services — ICAO Abbreviations and Codes* (PANS-ABC, ICAO Doc 8400);

l) *Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services* (ICAO Doc 8585);

m) *Aircraft Type Designators* (ICAO Doc 8643);

n) *Manual on Airspace Planning Methodology for the Determination of Separation Minima* (ICAO Doc 9689);

o) *Performance-based Navigation Manual* (PBN) (ICAO Doc 9613);

p) *Manual on Required Communication Performance* (RCP) (ICAO Doc 9869);

q) *Manual on the Aeronautical Mobile Satellite (Route) Service* (ICAO Doc 9925).

7. Changes to the document

This document is maintained as a regional document in coordination with ~~all~~ *[pli3]* ICAO planning and implementation regional groups (PIRGs) providing SATCOM voice services within their region. Each participating PIRG establishes a mechanism for submitting and ~~administering~~ change proposals.

Change proposals (CPs) can be submitted by any stakeholder participating in SATCOM voice operations. The stakeholder should submit a Change Proposal to their ICAO regional office. The ICAO regional office will coordinate the change proposal within its own region, other regions, and ICAO HQ, to determine the acceptability of the change proposal. Once the ICAO regional office has completed coordination and the participating PIRGs accept the change proposal, the change is concluded by each of the PIRGs.

8. Amendments to the SVGM

Amendment	Source(s)	Subject(s)	Approved applicable
1st Edition (2012~~1~~ *[pli4]*)	Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/23~~2~~ – 2012~~1~~) North Atlantic Systems Planning Group (NAT SPG/48 – 2012)	*Satellite Voice Guidance Material* (SVGM)	Applicable within participating Regions on 15 September ~~July~~ 2012.

Chapter 1. Definitions

Editor's note 2. — To be administratively updated just prior to completion. Terms generally will only be included if used in the document.

When the following terms are used in the present document they have the following meanings. Where the term has "(ICAO)" annotated, the term has already been defined as such in SARPs and/or PANS.

Term

ACC. The symbol used to designate area control centre. (ICAO)

ACP. The symbol used to designate actual communication performance.

ACTP. The symbol used to designate actual communication technical performance.

Aeronautical fixed telecommunication network (AFTN). A worldwide system of aeronautical fixed circuits provided, as part of the aeronautical fixed service, for the exchange of messages and/or digital data between aeronautical fixed stations having the same or compatible communications characteristics. (ICAO)

Aeronautical Information Publication (AIP). A publication issued by or with the authority of a State and containing aeronautical information of a lasting character essential to air navigation. (ICAO)

Aeronautical mobile satellite (route) service (AMS(R)S). Includes both voice and data, The use of AMS(R)S for voice communications is commonly referred to as SATCOM voice. This convention is maintained throughout this Document.

Aeronautical mobile service (RR S1.32). A mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may participate; emergency position-indicating radio beacon stations may also participate in this service on designated distress and emergency frequencies. (ICAO)

Aeronautical operational control (AOC). Communication required for the exercise of authority over the initiation, continuation, diversion or termination of flight for safety, regularity and efficiency reasons. (ICAO)

Aeronautical station (RR S1.81). A land station in the aeronautical mobile service. In certain instances, an aeronautical station may be located, for example, on board ship or on a platform at sea. (ICAO)

Note.— Aeronautical station is commonly referred to as a radio facility.

AFTN. The symbol used to designate aeronautical fixed telecommunication network. (ICAO)

AIDC. The symbol used to designate ATS interfacility data communications. (ICAO)

Term

AIP. The symbol used to designate Aeronautical Information Publication. (ICAO)

Air navigation service provider (ANSP). An organization responsible for the provision of air traffic services.

Air traffic services provider (ATSP). An organization responsible for the provision of air traffic services.

Air traffic control (ATC) service. A service provided for the purpose of:

a) preventing collisions:

1) between aircraft, and

2) on the manoeuvring area between aircraft and obstructions; and

b) expediting and maintaining an orderly flow of air traffic. (ICAO)

Air traffic management (ATM). The dynamic, integrated management of air traffic and airspace including air traffic services, airspace management and air traffic flow management — safely, economically and efficiently — through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions. (ICAO)

Air traffic service (ATS). A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service). (ICAO)

Air traffic services unit (ATSU). A generic term meaning variously, air traffic control unit, flight information centre or air traffic services reporting office. (ICAO)

Aircraft active flight plan. (See flight plan).

Aircraft address. A unique combination of 24 bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance. (ICAO)

Aircraft identification. A group of letters, figures or a combination thereof which is either identical to, or the coded equivalent of, the aircraft call sign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground air traffic services communications. (ICAO)

Note 1.— The aircraft identification does not exceed 7 characters and is either the aircraft registration or the ICAO designator for the aircraft operating agency followed by the flight identification.

Note 2. ICAO designators for aircraft operating agencies are contained in ICAO Doc 8585.

Aircraft registration. A group of letters, figures or a combination thereof which is assigned by the State of Registry to identify the aircraft.

Note. Also referred to as registration marking.

Term

Aircraft system availability (A_{AIR}). The required probability of available capability on an aircraft with an average flight of 6 hours.

Note.— The actual aircraft system availability is computed assuming that the service is available in the relevant airspace.

AIREP. The symbol used to designate an air-report. (ICAO)

Air-report. A report from an aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting. (ICAO)

AMS(R)S. The symbol used to designate aeronautical mobile satellite (route) service. (ICAO)

ANSP. The symbol used to designate air navigation service provider. (ICAO)

AOC. The symbol used to designate aeronautical operational control. (ICAO)

Appropriate ATS authority. The relevant authority designated by the State responsible for providing air traffic services in the airspace concerned. (ICAO)

Appropriate authority.

a) Regarding flight over the high seas: The relevant authority of the State of Registry.

b) Regarding flight other than over the high seas: The relevant authority of the State having sovereignty over the territory being overflown. (ICAO)

Area control centre (ACC). A unit established to provide air traffic control service to controlled flights in control areas under its jurisdiction. (ICAO)

ATC. The symbol used to designate air traffic control. (ICAO)

ATC waypoint. A waypoint contained in Item 15 of the ICAO flight plan, or as amended by ATC.

Note.— A waypoint inserted by the flight crew for purposes of conducting flight operations such as points of no return are not ATC waypoints.

ATM. The symbol used to designate air traffic management. (ICAO)

ATS interfacility data communication (AIDC). Automated data exchange between air traffic services units, particularly in regard to co-ordination and transfer of flights. (ICAO)

ATSP. The symbol used to designate air traffic service provider.

ATS. The symbol used to designate air traffic service. (ICAO)

ATSU. The symbol used to designate ATS unit. (ICAO, sort of)

Term

C for RCTP. The proportion of intervention messages and responses that can be delivered within the specified RCTP time for intervention.

Note.— For voice communications, continuity would take into consideration any dropped calls.

C for RCTP$_{AS}$. The proportion of intervention messages and responses that can be delivered within the specified RCTP$_{AS}$ time for intervention.

C for RCTP$_{AS/AIR}$. The proportion of intervention messages and responses that can be delivered within the specified RCTP$_{AS/AIR}$ time for intervention.

Note.— For voice communications, continuity would take into consideration any dropped calls.

C for RCTP$_{ATSU}$. The proportion of intervention messages and responses that can be delivered within the specified RCTP$_{ATSU}$ time for intervention.

C for RCTP$_{CSP}$. The proportion of intervention messages and responses that can be delivered within the specified RCTP$_{CSP}$ time for intervention.

C for operational performance. The proportion of intervention messages and responses that can be delivered within the specified operational performance time for intervention.

Note.— For voice communications, continuity would take into consideration any dropped calls.

Call performance. The operational portion of the transaction time to prepare the operational response, and includes the recognition of the instruction, and message composition during an interactive call between the Radio Operator and Flight Crew, e.g. flight crew/HMI for intervention transactions.

Note.— For voice communications, the call begins when the aircraft indicates an incoming call to the flight crew and ends when the callers operationally completes the call. The call includes any tasks for the radio operator to send the message to the ATSU.

Call sign. The designator used in air-ground communications to identify the aircraft and is equivalent to the encoded aircraft identification.

CNS. The symbol used to designate communications, navigation and surveillance. (ICAO)

CNS/ATM. The symbol used to designate communications, navigation and surveillance/air traffic management. (ICAO[pli5])

COM. The symbol used to designate communications, (ICAO)

Communication service provider (CSP). Any public or private entity providing communication services for general air traffic.

Term

Communication services. Aeronautical fixed and mobile services to enable ground-to-ground and/or air-to-ground communications for safety and regularity of flight.

Compulsory reporting point. An ATC waypoint for which a position report is required by the aircraft.

Control area (CTA). A controlled airspace extending upwards from a specified limit above the earth. (ICAO)

CSP. The symbol used to designate communication service provider.

CTA. The symbol used to designate control area. (ICAO)

Current flight plan. (See flight plan).

EMERG. The symbol used to designate emergency. (ICAO)

ETD. The symbol used to designate estimated time of departure or estimating departure. (ICAO)

FANS 1/A. The symbol used to designate the initial future air navigation system, as defined by RTCA DO-258A/EUROCAE ED-100A, or previous standards that defined the FANS 1/A capability.

Note.— FANS 1/A generally means that the data link system on an aircraft, the ATSU ground system, and communication service provision comply with the standard. In certain cases, specific reference is made to a particular type of FANS 1/A aircraft as follows:

a) FANS 1/A+ means that the aircraft completely complies with Revision A of the standard, which includes message latency timer; and

b) FANS 1/A ADS-C means that the aircraft complies with AFN and ADS-C applications, but does not include the CPDLC application.

FANS. The symbol used to designate future air navigation system.

FDPS. The symbol used to designate flight data processing system. (ICAO)

FIR. The symbol used to designate flight information region. (ICAO)

Filed flight plan. (See flight plan).

Flight identification. A group of numbers, which is usually associated with an ICAO designator for an aircraft operating agency, to identify the aircraft in Item 7 of the flight plan.

Flight information region (FIR). An airspace of defined dimensions within which flight information service and alerting service are provided. (ICAO)

Term

Flight level (FL). A surface of constant atmospheric pressure which is related to a specific pressure datum, 1 013.2 hectopascals (hPa), and is separated from other such surfaces by specific pressure intervals. (ICAO)

Note 1.— A pressure type altimeter calibrated in accordance with the Standard Atmosphere:

a) when set to a QNH altimeter setting, will indicate altitude;

b) when set to QFE altimeter setting, will indicate height above the QFE reference datum;

c) when set to a pressure of 1 013.2 hPa, may be used to indicate flight levels.

Note 2.— The terms "height" and "altitude", used in Note 1 above, indicate altimetric rather than geometric heights and altitudes.

Flight plan. Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft. (ICAO)

A flight plan can take several forms, such as:

Current flight plan (CPL). The flight plan, including changes, if any, brought about by subsequent clearances. (ICAO)

Note 1.— When the word "message" is used as a suffix to this term, it denotes the content and format of the current flight plan data sent from one unit to another.

Filed flight plan (FPL). The flight plan as filed with an ATS unit by the pilot or a designated representative, without any subsequent changes. (ICAO)

Note 2.— When the word "message" is used as a suffix to this term, it denotes the content and format of the filed flight plan data as transmitted.

Aircraft active flight plan. The flight plan used by the flight crew. The sequence of legs and associated constraints that define the expected 3D or 4D trajectory of the aircraft from takeoff to landing. (RTCA/EUROCAE)

GEO. The symbol used to designate geosynchronous earth orbit.

HF. The symbol used to designate high frequency (3-30 Mhz). (ICAO)

ICD. The symbol used to designate interface control document.

LEO. The symbol used to designate low earth orbit.

Master minimum equipment list (MMEL). A master list appropriate to an aircraft type which determines those instruments, items of equipment or functions installed on board that, while maintaining the intended level of safety, may temporarily be inoperative at commencement of the flight.

Term

Maximum accumulated unplanned outage time (min/yr). Measured by accumulating ***only*** the duration times for unplanned outages greater than the unplanned outage duration limit during any 12-month period. The accumulation is performed separately for each relevant operational airspace or FIR.

Maximum number of unplanned outages. Measured separately for each relevant operational airspace or Flight Information Region (FIR) over any 12-month period.

MEL. The symbol used to designate minimum equipment list. (ICAO)

MEO. The symbol used to designate medium earth orbit.

MET. The symbol used to designate meteorological or meteorology. (ICAO)

Minimum equipment list (MEL). A list which provides for the operation of aircraft, subject to specified conditions, with particular equipment inoperative, prepared by an operator in conformity with, or more restrictive than, the MMEL established for the aircraft type. (ICAO)

Monitored performance. The monitored combination of the time it takes to organize, prepare, dial and perform an interactive call plus the technical performance of the ground and air equipment.

Note.— For voice communications, monitored performance comprises $RCTP_{AS/AIR}$*, queue/connect performance and call performance.*

NOTAM. A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. (ICAO)

Operational communication transaction. The process a human uses to initiate the transmission of an instruction, clearance, flight information, and/or request, and is completed when that human is confident that the transaction is complete. (GOLD)

Operational performance. The portion of the transaction time (used for intervention) that does not include the times for message composition or recognition of the operational response.

Note.— For voice communications, operational performance comprises RCTP, queue/connect performance and call performance.

PANS-ATM. The symbol used to designate Procedures for Air Navigation Services — Air Traffic Management (ICAO Doc 4444). (ICAO)

Preemption. The immediate and automatic seizure of resources allocated to a lower-priority call.

Priority level. An indication of call precedence for ground-to-air or air-to-ground calls. Priority level may be used to establish preemption.

Term

Queue/connect performance. The operational portion of the transaction time to organize and place the call either via a manual or automated dialing sequence depending on equipment at the RO facility.

Note.— For voice communications, queue/connect performance begins when the message from the ATSU via the network is sent to the queue and ends when the last digit of the dialing sequence is finished.

Radio facility. A term commonly used to refer to an aeronautical station.

Required communication performance (RCP). A statement of the performance requirements for operational communication in support of specific ATM functions.

Required communication technical performance (RCTP). The portion of the (intervention) transaction time that does not include the human times for message composition, operational response, and recognition of the operational response.

Note.— For voice communications, RCTP comprises $RTCP_{ATSU}$, $RCTP_{AS}$, $RCTP_{AS/AIR}$ *and* $RCTP_{CSP}$.

RCP. The symbol used to designate required communication performance.

RCP availability (A). The required probability that an operational communication transaction can be initiated when needed.

Note.— For voice communications, this translates to any failure prohibiting the call to be initiated to include congestion (much like the analogy of a terrestrial mobile phone network). However this definition does not apply to a busy condition whereby the entity being called is already on the phone and does not have a way to put the existing call on hold or if able to, rejects the additional incoming call.

RCP continuity (C). The required probability that an operational communication transaction can be completed within the communication transaction time, either ET or TT 95%, given that the service was available at the start of the transaction.

Note.— For voice communications, this translates into 5 out of 100 calls not being able to conclude their voice transactions within the allotted time or the call could be disconnected for any reason, including aircraft maneuvers, switching satellites or any loss of service while on the call.

RCP expiration time (ET). The maximum time for the completion of the operational communication transaction after which the initiator is required to revert to an alternative procedure.

Term

RCP integrity (I). The required probability that an operational communication transaction is completed with no undetected errors.

Note 1.— Whilst RCP integrity is defined in terms of the "goodness" of the communication capability, it is specified in terms of the likelihood of occurrence of malfunction on a per flight hour basis, e.g. 10-5, consistent with RNAV/RNP specifications.

Note 2.— For voice communications, this translates to the ability to conduct the voice transaction with enough intelligibility to understand the verbal request. Additionally, this could also manifest in the crew executing an incorrect instruction because it was misunderstood. (It may not be clear at the time of this submittal, what type of error rate would reflect this condition, or if the read-back would mitigate or compound this).

RCP nominal time (TT 95%). The maximum nominal time within which 95% of operational communication transactions are required to be completed.

RCP specification. A specification (e.g. RCP 240) that provides the values assigned to RCP parameters for communication transaction time, continuity, availability and integrity, and allocations to ATSP, aircraft, CSP and operator.

RCTP. The symbol used to designate required communication technical performance.

$RCTP_{AS}$. The summed critical transit times for an ATC intervention message and a response message allocated to the Aero Station.

Note.— For voice communications, $RCTP_{AS}$ includes two concurrent processes:

a) the aircraft and aeronautical station technically disconnect the call; which is assumed. Operationally, the call is disconnected when the flight crew and radio operator complete the call; and

b) the aeronautical station sends the response to the to the ATSU via the ground-ground network; the performance is denoted by $RCTP_{AS}$.

$RCTP_{AS/AIR}$. The technical time for the air-ground network and associated components to initiate a call.

Note.— For voice communications, $RCTP_{AS/AIR}$ begins when the last digit of the dialing sequence is finished and ends when the aircraft indicates an incoming call to the flight crew.

$RCTP_{ATSU}$. The summed critical transit times for an ATC intervention message and a response message, allocated to the ATSU system.

$RCTP_{CSP}$. The summed critical transit times for an ATC intervention message and a response message, allocated to the CSP system.

Required communication performance (RCP). A statement of the performance requirements for operational communication in support of specific ATM functions. (ICAO)

Term

Required communication technical performance (RCTP). The portion of the (intervention) transaction time that does not include the human times for message composition, operational response, and recognition of the operational response.

Required navigation performance (RNP). A statement of the navigation performance necessary for operation within a defined airspace. (ICAO)

Note.— Navigation performance and requirements are defined for a particular RNP type and/or application.

Responder performance criteria. The operational portion of the transaction time to prepare the operational response, and includes the recognition of the instruction, and message composition, e.g. flight crew/HMI for intervention transactions.

RGS. The symbol used to designate radio ground station.

RNAV. The symbol used to designate area navigation.

RNP. The symbol used to designate required navigation performance.

SARPs. The symbol used to designate Standards and Recommended Practices. (ICAO)

Satellite communication service provider. Typically provides the inter-working unit of the terrestrial sub-system which connects the satellite ground earth station, or Gateway, and the terrestrial network in support of AMS(R)S. Commonly referred to as SSP (see SSP definition).

Satellite network operations provider. Typically provides the satellite sub-system which includes the satellite(s) and may or may not include the ground earth stations or Gateway. Commonly referred to as SSP (see SSP definition)

Satellite service provider (SSP). An entity or group of entities that provide, via satellite, aeronautical fixed services and/or aeronautical mobile services at least from the signal in space to/from aircraft, to the attachment point of the ground earth station (GES) to the ground communication services network.

SATCOM. The symbol used to designate satellite communication. (ICAO)

SELCAL. The symbol used to designate selective calling system. (ICAO)

Service availability (A_{CSP}). The required probability that the communication service is available to all users in a specific airspace when desired.

SSP. The symbol used to designate satellite service provider.

Terrestrial Network Service Provider. Typically provides the aviation centric terrestrial sub-system which provides connectivity to the end-users, such as ATS providers, airlines and flight departments. Commonly referred to as CSP (see CSP Definition).

Term

Unplanned outage duration limit (minutes). Time after the unplanned outage begins at which there is an operational impact. Measured from when an unplanned outage begins to when the ATSU receives notification that the service has been restored.

Unplanned outage notification delay (min). Notification to the ATSU of an unplanned outage. Measured from when the unplanned outage begins to when the ATSU receives notification.

VHF. The symbol used to designate very high frequency (30-300 Mhz). (ICAO)

Chapter 2. Overview of satellite voice communications

2.1 General

2.2 Aeronautical Satellite Communication Systems ~~Industry~~[pli6] Overview

2.2.1 Satellite communication systems are defined by three different altitude orbits; low earth orbit (LEO), medium earth orbit (MEO) and geosynchronous earth orbit (GEO). The altitude of the orbit determines the area illuminated by the satellite. The higher the orbit the weaker the signal is from the satellite, but it has a much larger footprint. Propagation loss is overcome by increased complexity of the antenna systems along with higher transmitter power. Conversely, a LEO satellite's footprint is much smaller requiring a higher number of satellites to provide coverage, but the antennas used are much simpler along with reduced RF power requirement on the subscriber end. Also, the lifetime of a LEO satellite is less due to drag caused by the close proximity of earth.

2.2.2 Today there are three satellite systems servicing the aeronautical market. Inmarsat and MTSAT are GEO and Iridium is a LEO satellite system. These satellite systems use AMS(R)S L-band frequencies reserved for aeronautical safety services. Inmarsat is currently replacing their older generation I-3 satellites with new technology I-4 satellites providing advanced services. That project is nearly complete. The end of life for Inmarsat I-3's is 2018. Iridium satellites current system was launched in the late 1990's and became operational in early 2000. The original life expectancy of Iridium's satellites was calculated to be seven plus years. Iridium is planning to design, build and launch their next generation satellite system call "Iridium Next" by the end of 2017. A recent study of their current system indicates that the original satellite system should last through 2017.

2.3 Iridium

2.3.1 Iridium uses a constellation of 66 satellites at an altitude of 780 km (450 miles) in six orbital planes, with eleven satellites in each orbital plane, providing global coverage. Additionally there are a number of spare satellites to replace any in-orbit failures. At that altitude each satellite covers a circular area of 4700 km (2900 miles) and is in-view to a location on the ground for approximately 9 minutes. Using a small amount of overlap in coverage between each satellite, the Iridium network hands-off the call to the next satellite coming into view to the ground location. This is similar to a GSM cellular telephone system where the subscriber moves from one cell site to another except that the satellite is the moving vehicle. The speed of the aircraft appears almost stationary compared to the speed the satellite moves.

2.3.2 Iridium uses a combination of both frequency and time multiplexing along with 48 spot beams developed by the phased array antenna from each satellite. The frequency band used by subscribers are within L-band AMS(R)S 1616 MHz to 1626.5 MHz block. Iridium transmits and receives on this single block by multiplexing time slots to control the direction of the signal. This L-band connection from the satellite to the mobile subscriber is cross-linked via inter-satellite connectivity using Ka-band frequencies. Each satellite connects to the satellite in front, behind and to each side on Ka-band. This inter-satellite Ka-band connection is routed within the satellite constellation to the ground station gateway in Tempe Arizona. Connectivity in Tempe is also on the Ka-band. Iridium's reliability is affected by rain fade on Ka-band to the Tempe gateway. A second ground earth station is being considered.

2.4 Inmarsat

2.4.1 The Inmarsat network of satellites is in geosynchronous orbit directly above the earth equator at an altitude of 35,786 km (22,236 miles). At that altitude above earth, each satellite's spot beam covers approximately 120 degrees of the earth at the equator and to approximately 82 degrees North and 82 degrees South latitude. The orbital period of each satellite is exactly the same as the rotation period of earth so each satellite appears to remain in the same position.

2.4.2 There are three new I-4 and four older I-3 satellites providing aviation services, including PSTN voice. L-band frequencies allocated for aviation AMS(R)S are split between a transmit block and a receive block with a guard band in between.. This allows the subscriber unit using a frequency duplexer to receive and transmit simultaneously. Inmarsat's primary transmit frequency allocation is adjacent to Iridium's allocation used for both transmit and receive; this can cause interference to the secondary Iridium receive allocation when the aircraft operator desires both satellite services.

2.4.3 Swift Broadband users of Inmarsat I-4 satellites have available Voice over Internet Protocol (VoIP) capability. The ground user network interface doesn't exist as yet but should evolve in time. Iridium's Next satellite system has indicated the possible availability of these VoIP services.

2.5 MTSAT

2.5.1 MTSAT is a GEO satellite system. The specification is equivalent to that of I-3 except for the footprint which is limited to the Asia and the Pacific Ocean. MTSAT is interoperable with I-3 so that the subscriber unit can seamlessly carry out the handover between MTSAT and I-3 (and legacy communication module of I-4). End of Life (the EOL) of MTSAT-1R is expected to occur during Japanese Fiscal Year 2014. A comprehensive study for next generation satellite was conducted in 2010 by JCAB. JCAB decided not to replace MTSAT-1R, but to continue to provide AMSS through MTSAT-2 after the termination of MTSAT-1R AMSS payload. The calculation of remaining fuel showed that MTSAT-2 has an outlook of four year expansion of its EOL from 2015. JCAB believes that MTSAT System by single satellite will still meet the requirements of Communication Service mainly due to the high redundancy of ground system.

2.6 Public Switched Telephone Networks and Dialing Systems Used

2.6.1 Current offerings by both Inmarsat and Iridium for voice communication services use the Public Switched Telephone Network (PSTN) or leased telephone lines from the appropriate gateway to the ground party. In instances where the reliability of the ground telephone network is poor consideration should be given for a satellite link to the ground party. The telephone number country codes for both satellite systems are provided by the ITU and are designated as Global Mobile Satellite Systems (GMSS). Inmarsat uses a Single Network Access Code (SNAC) and switches the call automatically to the correct Inmarsat earth station where the aircraft is logged into. Iridium employs telephone number ITU sub-blocks and optionally a US-based telephone number. The various options available can have significant cost incurred to the ground calling party due to various tariffs applying.

Chapter 3. Administrative provisions related to satellite voice operations

3.1 ATSP and aero radio service provision

3.1.1 When providing SATCOM voice services, ANSPs and aero radio facilities should provide these services consistent with voice communication procedures, regardless of the technology used.

3.1.2 System validation

3.1.2.1 Provide updated aircraft SATCOM telephone lists to ANSP.

3.1.2.2 Provide a reliability and availability factor of at least 99.9%.

3.1.2.3 Provide security provisions in accordance with SVTF findings (ie - CLI/PIN).

3.1.2.4 Provide service outage/return to service reports.

3.1.2.5 The ATSP call priority level should be established at level 2 as defined by **Table 3-1**~~Table 3-1~~.

3.1.2.6 Provide acceptable timely call establishment and connectivity per specifications provided at **Appendix A**.

3.1.3 Aeronautical information, notifications, and interfacility agreements

3.1.3.1 The ATSP should notify operators of SATCOM voice services using the AIP or NOTAM. Notification includes:

a) Procedures for publishing contact information, that is associated with current airspace boundaries, e.g. specific SATCOM voice numbers for applicable facilities; and

b) Requirements for use, e.g., criteria for when to contact the ATC facility or aero radio; and

c) Flight plan form and submission requirements.

3.1.4 Requirements, privileges and obligations of communication service provider (CSP)

3.1.4.1 Requirements for CSP

3.1.4.1.1 The CSP should ensure that the SATCOM voice service meets the performance criteria, in **Appendix A**. (i.e. RCP 400 with a safety objective of 10^{-3} per flight hour).

3.1.4.1.2 For those situations when a CSP cannot continue to provide SATCOM voice communications, it should inform the involved ATSPs and operators and/or, if appropriate, the providers of Aeronautical Information Services, in accordance with coordination procedures established in writing.

3.1.4.1.3 The CSP shall be under safety oversight either by:

a) an air traffic service provider (ATSP) or a commercial air operator, when contracted by at least one of them; or

b) directly by the competent aviation authority established by the State on a national or regional basis, when allowed or prescribed by applicable law.

3.1.4.1.4 In the case of provision of additional SATCOM services, e.g. as those which may be required by NextGen or SESAR, for which a safety objective more severe than 10E-3 is postulated, an authorized service provider should demonstrate to the competent authority the compliance with the applicable requirements.

3.1.4.2 Contracted COM services

3.1.4.2.1 The principle of certification and subsequent continued surveillance (or "oversight") of aviation operators is established in two Annexes to the Chicago Convention: Annex 6 Part I for Commercial Air Transport operators and 14 for aerodrome operators.

3.1.4.2.2 Annex 11 (Air Traffic Services) does not necessarily require certification of the air traffic service provider (ATSP) but requires States to establish a State Safety Programme (SSP) further described in Attachment D therein, which clarifies that States shall establish effective mechanisms to inspect and audit ATSPs in order to ensure effective safety oversight. In other words the requirement for States to oversee safety exists even in the absence of certification or approval of a certain type of aviation operators or service providers.

3.1.4.2.3 Chapter 2 (i.e. Administrative provisions for the international telecommunication service) of Volume II of Annex 10 also contains standards for the "supervision" of the COM service by a responsible authority designated by the State. Note 2 to par. 2.27.4 of Annex 11 clarifies that, when COM services are directly provided by an ATSP, their oversight is through the SSP and the Safety Management System (SMS) established by the ATSP. Same Note clarifies that if COM services are contracted to an entity other than the ATSP, the SMS requirement still applies, but only to those services with direct operational implications (e.g. communications used for ATS purposes).

3.1.4.2.4 In any case therefore, an aviation organization (commercial air transport operator, aerodrome operator, ATSP) shall be, according to specific ICAO standards, under safety oversight by the competent aviation authority. Organizations under safety oversight should take responsibility for the safe, regular and efficient conduct of operations, including for the services provided by any contractors. For instance, this latter ICAO provision is transposed in the EU by so called "EU-OPS" in respect of commercial air transport operators and by so called "common requirements " for ATSPs.

3.1.4.2.5 In this possible business model (e.g. an ATSP or air operator contracting COM services from a different organisation), depicted in Figure 3.X below, the contracting organization does not only take responsibility to demonstrate to the competent authority that proper mechanisms exist to oversee the contracted CSP, but also inevitably attracts on itself some liability also for the contracted COM service.

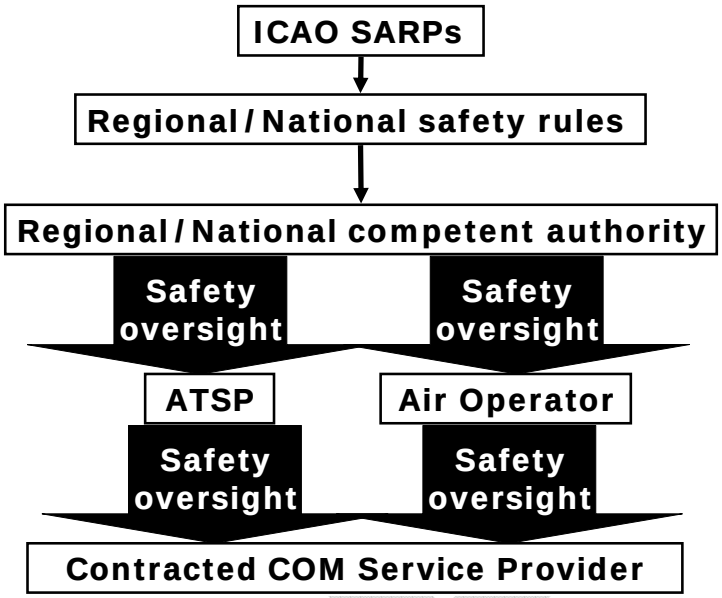


Figure 3-1. Radio operator contracted by organizations (e.g. ATSP or commercial air operator) under oversight by a competent authority

3.1.4.3 Direct certification of the CSP

3.1.4.3.1 Present wording of paragraph 2.4.1 in Volume II of Annex 10, leaves open the possibility of direct oversight by the competent authority of the communication service provider (CSP). This possibility, in fact applied e.g. in the European Union (EU), where CSPs "unbundled" from ATSPs can be certified , is illustrated in Figure 3.Y.

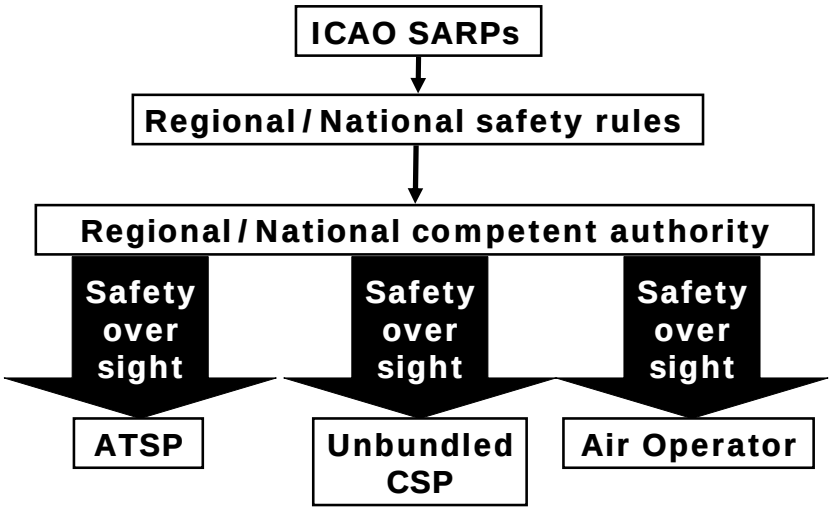


Figure 3-2. Unbundled communication service provider (CSP) directly under oversight by a competent authority

3.1.4.3.2 Even in this case agreements for the quality of the COM service (e.g. Service Level Agreements) and other contractual arrangements can be established between the ATSP (or the air operator) and the CSP, but the contracting entity takes no responsibility for safety oversight of the CSP. Such a responsibility, and therefore the corresponding liability, is transferred to the competent authority.

3.1.4.4 Privileges and obligations of authorized CSPs

3.1.4.4.1 Law applicable in the States should establish which organizations are eligible to be authorized as SATCOM CSPs (either directly by law or through a process of acceptance or certification or approval by a competent authority). For instance, in the EU, the Regulations of the "single European sky " and the EASA Basic Regulation require SATCOM and all other mobile or fixed aeronautical COM services, to be under the managerial responsibility of a certified CSP (bundled or unbundled). In the USA the FAA, as ATS provider, is authorized to contract third parties providing communication services.

3.1.4.4.2 Law adopted on a regional or national level should specify the privileges and obligations of the authorized CSPs.

3.1.4.4.3 Typical privileges may include, but are not limited to:

a) offer SATCOM services within the limits of the authorization;

b) sign declarations or statements of conformity or of verification ;

c) operate and maintain the SATCOM system;

d) release to service new or repaired constituents of the system;

e) restore the service after any outage;

f) manage any change, including development of associated risk assessments and possibly direct approval of minor changes.

3.1.4.4.4 Typical obligations may include, but are not limited to:

a) work according to the terms of authorization, contract, certification or approval and possibly to accepted manuals or procedures;

b) verify the system or constituents prior to signing any declaration, statement or release to service;

c) maintain records;

d) establish an internal scheme for occurrence reporting and analysis, including reporting to other involved stakeholders (e.g. manufacturers of avionics) and competent authority;

e) impose requirements on contractors and verify their actual implementation.

3.1.5 Radio facility considerations

3.1.5.1 To provide SATCOM voice radio services at a full operational level, the radio facility should be able to accept or place a SATCOM voice call given the necessary infrastructure to handle the expected SATCOM voice traffic demand and in accordance with prescribed performance specifications. Additionally, radio facility providers must ensure that adequate resources are available in the event that SATCOM voice services are disrupted.

3.1.5.2 When supporting satellite voice communications, radio facilities should establish procedures that:

a) Enable operators to register SATCOM voice capabilities and means to contact the aircraft. (only applies to MEL relief)

b) Ensure ANSPs and radio operators receive the relevant information needed to establish two-way communications with the aircraft.

c) Maintain, on a 28-day update cycle, INMARSAT's and Iridium's master aircraft phone number list as new SATCOM radio facilities become operational.

d) Ensure users are notified when service conditions change, i.e., service outages, degraded performance, restoration of service.

e) Establish procedures with operators to verify correct SATCOM voice number in the event of a SATCOM voice number change to a specific airframe with less than 24 hour notice.

3.1.5.3 When supporting satellite voice communications, radio facilities should provide automation support that allow the radio operator to provide SATCOM voice services for the intended operations in accordance with performance specifications provided in **Appendix A**. The automation support should include capabilities that allow the radio operator to:

a) Place and receive SATCOM telephone calls to either the INMARSAT or Iridium access points.

b) Obtain the correct authorization Personal Identification Number (PIN) for both INMARSAT and Iridium networks to place authorized ATC calls.

c) Answer and route incoming SATCOM voice calls to the appropriate SATCOM/radio operator.

d) Auto-dial capability to enable faster call setup times.

e) Accept a new call from a flight crew as a participant of an existing SATCOM voice communication already in progress, e.g., the new caller should be able to hear the transmission already in progress and standby for an opportunity to intervene. (This is an example of "Conference", …)

f) To exchange air traffic control information with ATC.

g) Provide for the ability to prioritize, preempt and establish precedence on outgoing calls.

3.1.6 Satellite voice service

3.1.6.1 The following criteria apply to the voice satellite service:

a) The ground earth station should be capable of preventing unauthorized calls to aircraft;

b) The SATCOM voice system should provide Caller ID with PIN security information for display to the receiving party.

Note.— This guidance material supports both Iridium and INMARSAT communications. INMARSAT systems typically support several levels of SATCOM voice communications. Iridium systems are typically single channel or dual channel voice systems dedicated for flight deck communications. Iridium based systems will require additional infrastructure in the Ground Earth Station to implement the necessary priority services needed for ATC voice communications.

3.1.6.2 The priority level column of **Table 3-1**~~**Table 3-1**~~ shows the order of precedence in setting up and receiving a satellite voice call. Preemption is the immediate and automatic seizure of resources allocated to a lower-priority call. Trade-offs of flight safety requirements versus passenger satisfaction should not be a consideration.

a) Technological limits of PSTNs and AMS(R)S may require CSPs and SSPs to use indications of priority levels different than those indicated in figure 3-3. When a SATCOM voice call is transmitted to and from an aircraft, the priority indicated to flight crews will conform with Annex 10, Volume II and the levels indicated in Figure 3-3.

b) Satellite voice calls should be prioritized consistent with figure 3-3. If the equipment differentiates between levels the priority should be Level 1 / EMG, Level 2 / HGH, and Level 3 / LOW, and Level 4 PUB. The satellite voice equipment should configure the cockpit default priority to level 2 / HGH. Level 4 / PUB calls should not be routed to the flight deck.

c) The flight crew must have the capability to set the priority level for all calls. The satellite voice equipment must provide the flight crew the means to preempt any call at any time. The equipment must provide the means for automatic preemption of all cabin communications.

d) If a satellite voice channel is in use and the ground earth station wants to send a higher-priority call, the satellite voice equipment should clear the lower-priority channel. If all available channels are in use, the equipment should preempt the channel supporting the lowest priority channel in favor of the higher-priority call.

Table 3-1. Priority levels for SATCOM voice calls

Priority level	Application category	SATCOM voice call examples
1 / EMG Emergency (highest) Safety of Flight	Distress and Urgency	Rapid Descent, Urgent Sidestep for Weather
2 / HGH Operational High (second highest) Safety of Flight	Flight Safety	Altitude Request
3 / LOW Operational Low (third highest) Safety of Flight	Regularity of Flight, Meteorological, Administrative	Air Traffic Information Service, Redispatch, Maintenance
4 / PUB Nonoperational (lowest) Nonsafety	Public Correspondence	Public Phone Calls

3.1.7 Monitoring system operations

3.1.7.1 The ATSP and its CSP(s) should retain records for at least 30 days to allow for accident/incident investigation purposes. The ATSP and CSPs should make these records available for air safety investigative purposes on demand. These recordings should allow replaying of the situation and identifying the SATCOM voice communications between the radio operator/controller and the flight crew.

3.2 Operator eligibility

3.2.1 Operational authorization to use satellite voice communications

3.2.1.1 Pilots holding an instrument rating (and where necessary a type rating) have the privilege to fly an aircraft under Instrument Flight Rules (IFR): e.g. en-route following a series of VOR (VHF Omni-Range) stations in the domain of navigation or using on-board radio equipment to liaise with Air Traffic Control in the domain of communication. Granting to pilots privileges linked to possess of a valid licence and proper ratings, is the normal way used by States to “authorize” aviation operations, without requiring additional administrative processes. However the meaning of “authorization”, although this word is widely used in Annex 6, is not defined.

3.2.1.2 Attachment E to Annex 6 Part I clarifies that an “approval” is an active response by the competent aviation authority established by State(s) to a matter submitted for its review, constituting a finding or determination of compliance with the applicable standards. An approval will be evidenced by

the signature by the approving official, the issuance of a document or certificate, or some other formal action (e.g. a letter). Same Attachment explains that an "acceptance" does not necessarily require an active response by the authority to a matter submitted for its review. In other words this is a form of "silent approval", unless the authority specifically rejects all or a portion of the matter under review, usually after some defined period of time after submission.

3.2.1.3 Hence in this guidance material the word "authorization" refers to a privilege granted by the applicable rules to persons holding the required licences or certificates and enjoying the related privileges (no additional administrative process). The word "approval" indicates an administrative procedure based on an application and an explicit written reply by the competent authority. The word "acceptance" means that a certified organisation (e.g. a commercial air operator) submits a document (e.g. a change to the operations manual) to the competent authority and, if the latter does not object within a given time, the change is in fact accepted.

3.2.1.4 Authorizations and approvals may be applied also to general aviation. On the contrary, since in most ICAO Contracting States an Air Operator Certificate (AOC) is not required for general aviation, the "acceptance" process does not apply to this segment of aviation.

3.2.1.5 From the point of view of air operators, the authorization (i.e. no additional administrative procedures) is normally preferred in comparison to the approval (i.e. written application followed by written reply by the authority).

3.2.1.6 The general principle of granting to properly rated pilots the authorization to use on board radio equipment, as part of their privileges, is however implicitly based on several underlying assumptions, such as:

a) the aircraft, including its avionics, has an airworthiness approval covering the type of envisaged IFR operations (e.g. long range) and a radio licence;

b) the complexity of using radio equipment, including SATCOM, does not present particular challenges;

c) the concept and systems upon which the operation will be carried out are mature enough (= not "new"), which is the case of SATCOM voice;

d) the risk associated with improper operation (including for third parties in the air or on the ground) is tolerable, which is the case for SATCOM voice since the transmission, if unclear can be repeated, and for which, a totally independent long rang communication system (i.e. HF) exists;

e) availability and continuity of SATCOM voice is ensured, under responsibility of a Service Provider as explained in previous paragraph 3.1.4;

f) appropriate standards for quality and management are established;

g) accuracy and integrity of the address data base is ensured;

h) appropriate training and checking standards and procedures for using SATCOM equipment exist and are implemented mainly for pilots; and

i) provision of information (e.g. MMEL and training requirements) from holders of Type Certificates (TC) to air operators, throughout the life cycle of the aircraft is ensured.

3.2.1.7 Should one or more of the requirements listed above not be substantiated, then the competent authority at national or regional level, should assess whether rules and procedures for an

explicit approval are necessary. Historically this has been the case in several instances in the navigation domain, but it has almost never been considered necessary in the communication domain.

3.2.2 Radio equipment to be carried on board

3.2.2.1 Competent authorities also establish the minimum number of long range radio equipment to be carried on board. For instance, in the European Union (EU) the competent regional authority (i.e. EASA) has proposed that, at the level of legally binding rules (Opinion 04/2011 of 01 June 2011) for aircraft operators, aeroplanes shall be equipped with the radio communication equipment required by the applicable airspace requirements. Radio communication equipment shall include at least two independent radio communication systems necessary under normal operating conditions to communicate with an appropriate ground station from any point on the route, including diversions. This means that in principle one set of SATCOM and one set HF could be approved in regions where both services are available for routine communications.

3.2.2.2 The possible acceptance of one set of SATCOM and one set of HF on long range routes, is further clarified by proposed EASA Acceptable Means of Compliance (AMC4-CAT.IDE.A.345) expected to be promulgated by EASA in 2012 immediately after the adoption of the above mentioned rules by the European Commission and clarifying that:

a) An HF - system is considered to be long range communication equipment;

b) Other two-way communication systems may be used if allowed by the relevant airspace procedures; and

c) Other" (e.g. SATCOM vocie) two-way communication systems may be used "if allowed by the relevant airspace procedures". Therefore aircraft operators established in the European Union, may ask to have installed on board one set of HF and one SATCOM if, from applicable ICAO Regional Supplementary Procedures (Doc 7030) or published AIPs, it emerges that both services are available for routine use along the intended routes (including diversions).

3.2.2.3 The proposed EASA rules mentioned above, would hence allow national authorities in the EU Member States to accept, as normal requirement for minimum number and type of communication equipment installed on aircraft intended to be used on long range routes, one set of SATCOM voice and only one set of HF radio, providing that said services are available for routine communications.

3.2.2.4 In principle installed equipment has to be operational when commencing a flight. However experience has demonstrated that temporary unserviceability may be in some cases be tolerated. Several ICAO Contracting States hence require aircraft manufacturers to provide a Master MEL, The MMEL contains a list of which equipment can be tolerated as unserviceable at commencement of flight and for how long. The MMEL is approved by the authority designated by the State of Design (e.g. FAA in the USA and EASA in the EU).

3.2.2.5 Aircraft operators are mandated (e.g. by rule OPS 1.030 in the EU) to establish a Minimum Equipment List (MEL), based upon, but no less restrictive than the relevant MMEL. The MEL is approved by the competent authority established by the State of the Operator or State of Registry.

3.2.2.6 If changes to the Minimum Equipment List (MEL) are desired to allow dispatch with one satellite voice communication system and only one HF radio system, the operator should obtain operational approval or acceptance from the State of the Operator or State of Registry.

3.2.2.7 On 28 June 2011 EASA has published NPA 2011-11 aiming at establishing common EU specifications for MMEL (and replacing JAA TGL 26). Therein it is clarified that since not all ATC facilities are yet adequately equipped to handle SATCOM data or voice as the primary means of communication, the relief for dispatch with one HF and a backup SATCOM is restricted to 3 calendar days, to ensure that reliance on SATCOM is limited. In other words in areas requiring two operational Long Range Communication Systems at least one must be HF-voice.

3.2.3 Criteria for aircraft operators

3.2.3.1 Aircraft operators should meet the following criteria:

a) Distribute advisory information within the flight operations department to ensure that all personnel concerned are aware of SATCOM concepts and procedures associated with the use of SATCOM for routine ATC communications (i.e. phraseology).

b) Assess operational requirements, establish policy and procedures, and incorporate them in appropriate documents, including:

1) Procedures to ensure that each participating aircraft is registered with their communication service provider;

2) Flight crew responsibilities for establishing and maintaining HF/VHF voice communications (SELCAL) with the appropriate OCA/FIR's;

3) Procedures on use of SATCOM voice in accordance with ATC communication procedures and guidance material provided in **Chapter 5**, including its use in relationship to other means of communication on the specific aircraft, e.g., CPDLC/ADS-C, FMS WPR, Oceanic clearance;

4) Contact information for the Aero Radio/ATS unit;

5) Procedures when SATCOM voice fails;

6) Procedures for reporting problems associated with SATCOM voice to appropriate monitoring agencies.

3.2.4 Aircraft equipage

3.2.4.1 The installations should be approved by the State of Registry or State of the Operator in accordance with FAA AC 20-150 (or equivalent), and verified to comply with the following:

a) RTCA DO-210D, Minimum Operational Performance Standards for Geosynchronous Orbit Aeronautical Mobile Satellite Services (AMSS)

b) RTCA DO-262A, Minimum Operational Performance Standards for Avionics Supporting Next Generation Satellite Systems (NGSS)

c) ARINC 741, Aviation Satellite Communication System.

d) ARNIC 761(Iridium & Inmarsat-2G)

e) ARINC 781 (Inmarsat-3G)

Note.— The above criteria apply only to the SATCOM voice installation when used for ATC communications. The communication equipment requirements as prescribed for the airspace operated in or by the State of Registry or State of the Operator are beyond the scope of this document.

3.2.5 Maintenance and in-service difficulties

3.2.5.1 The operator should establish procedures to report any problems its flight crews and dispatchers have with SATCOM voice operations in accordance with normal reporting practices.

3.2.5.2 The operator should establish procedures to ensure its flight crews and dispatchers are notified of significant degradation of SATCOM service, e.g., outage.

3.3 Flight planning

3.3.1 The operator should ensure that the proper information is included in the ICAO flight plan. Until Amendment 1 to the PANS/ATM becomes valid in November 2012 the following procedures should be followed.

a) Insert in item 10, Equipment, the letter "Z" to denote "other equipment".

b) Insert in item 18, Other information, the text "COM/" followed by the word SATVOICE, followed by further identification of the type of equipment such as INMARSAT or IRIDIUM.

Example:

```
(FPL-ACA101-IS
-B773/H-SHXWZ/SD
-EGLL1400
-N0450F310 L9 UL9 STU285036/M082F310 UL9 LIMRI
 52N020W 52N030W 50N040W 49N050W
-CYQX0455 CYYR
-EET/EISNN0026 EGGX0111 020W0136 CYQX0228 040W0330
 050W0415 REG/CFIUV SEL/FQHS COM/SATVOICE INMARSAT
 CODE/C0173E)
```

3.3.2 After Amendment 1 becomes valid, the appropriate indication(s) should be inserted in item 10, namely "M1" for an INMARSAT RTF capability, "M2" for an MTSAT RTF capability and/or "M3" for an Iridium RTF capability.

Example:

```
(FPL-ACA101-IS
-B773/H-SHXWM1M3/S
-EGLL1400
-N0450F310 L9 UL9 STU285036/M082F310 UL9 LIMRI
 52N020W 52N030W 50N040W 49N050W
-CYQX0455 CYYR
-EET/EISNN0026 EGGX0111 020W0136 CYQX0228 040W0330
 050W0415 REG/CFIUV SEL/FQHS CODE/C0173E)
```

3.3.3 When the necessary information for establishing contact with the aircraft can be derived from the ICAO 24-bit address, that information should be included in item 18 using the "CODE/" indicator as shown in the above examples.

Chapter 4. Controller and radio operator procedures

4.1 General

4.1.1 The underlying SATCOM voice technology (duplex mode/open mic) lends itself to a conversational mode of communications. Therefore, such use can create misunderstanding and confusion. When using SATCOM voice, normal RTF conventions must be followed in accordance with standard ICAO phraseology, as defined in Annex 10, Volume II, Chapter 5 and Doc. 8400.

4.1.2 On establishing SATCOM voice contact, care should be taken to ensure positive identification of the aircraft.

4.1.3 If unable to contact the aircraft via SATCOM voice for communication other than Level 1 / EMG, then reversion to any alternative means of communication medium should be followed, including HF, VHF, and data link, to establish positive voice communications for that flight.

4.1.4 If a radio facility or ATS unit recognizes that an aircraft is in imminent danger, the RO or controller must call the aircraft at the highest priority Level 1 / EMG if possible, and state the threat to the aircraft as part of the initial communication. If unable to contact the aircraft via SATCOM then reversion to any alternative means of communication medium should be followed, including HF, VHF, and data link, to establish positive voice communications for that flight and state the threat to the aircraft as part of the initial communication.

Example:

Radio operator	<Initiates call and line rings in flight deck>
Flight crew	Air France 465 go ahead.
Radio operator	Air France 465, Gander Radio, For collision avoidance , ATC clears <message>
Flight crew	Gander Radio, Air France 465, <read back message>

4.1.5 Even if there is an automated identification capability, the radio operator or controller must address the aircraft by its identification code Reg # and/or Flight ID for flight safety reasons. Additionally, manufacturers must take into account the human factors elements for ease of use when designing systems.

4.2 Controller procedures

Editor's note 3. — To be updated after the next version of Radio Operator procedures is finalized. We will either create a complementary procedure for Controllers or integrate it into the Radio Operator procedures.

4.3 Radio operator procedures

4.3.1 Outgoing calls – Radio operator initiated (ground-to-air)

4.3.1.1 **Figure 4-1**~~Figure 4-1~~ provides a flow chart for SATCOM voice calls initiated by the radio operator to the flight crew. **Table 4-1**~~Table 4-1~~ provides descriptions associated with each number flowchart item.

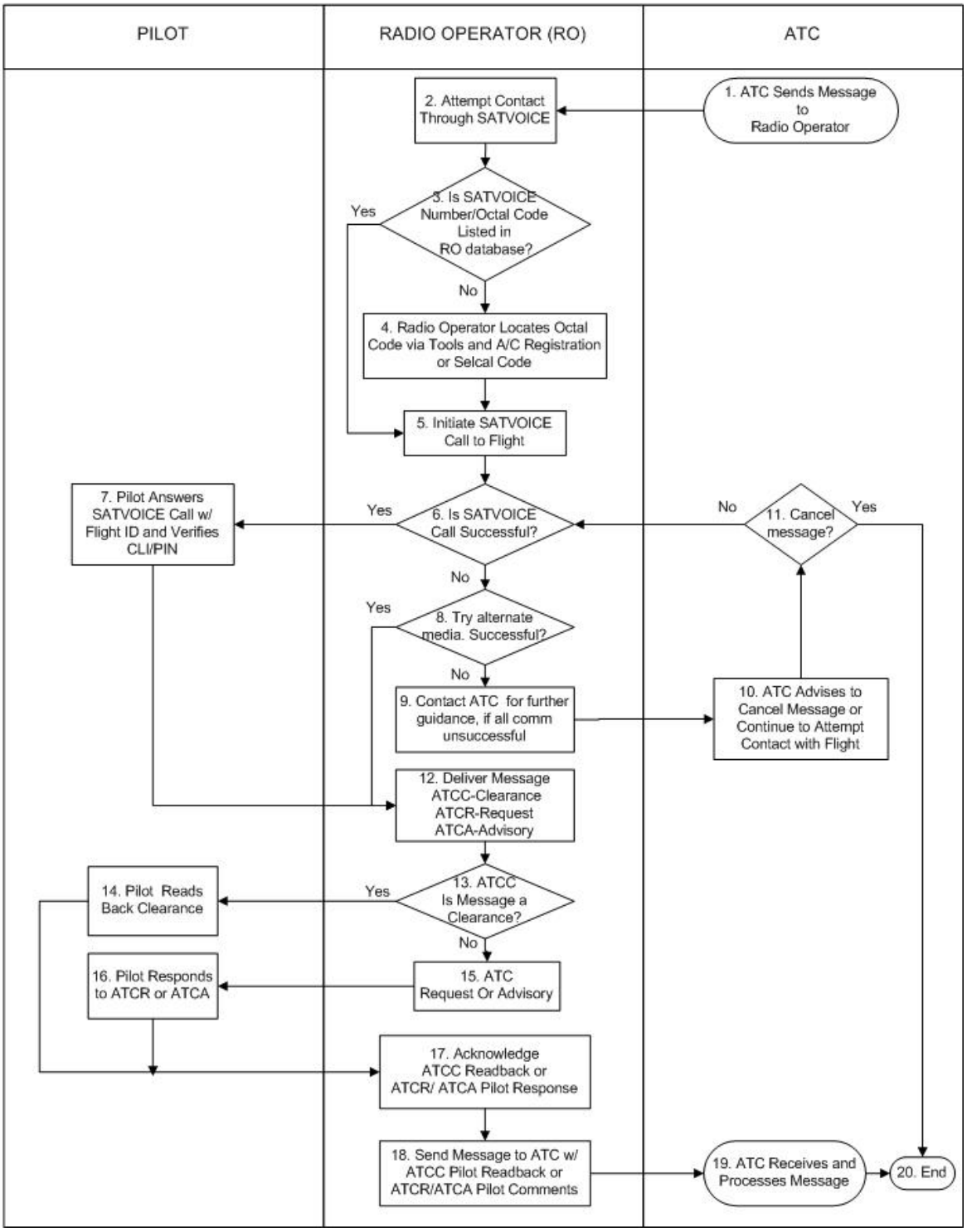


Figure 4-1. Ground to air (radio operator to flight crew) SATCOM voice flowchart

Table 4-1. Ground to air (radio operator to flight crew) SATCOM voice flow chart descriptions

Ref	Ground to Air Communication Process	What is done
1	ATC sends message to Radio Operator	ANSP/ATC inputs a message via ground network to Radio Operators within ATC agency or to their CSP.
2	Attempt contact through SatVoice	Radio Operator attempts SatVoice call if numbers are quickly available.
3	Is SatVoice number/octal code listed in RO database?	If SatVoice number is not previously available to Radio Operator, then he/she checks database for octal code or SatVoice number.
4	Radio Operator locates octal code via tools and A/C registration or Selcal code.	If SatVoice number is not readily available, other tools may be queried to cross reference Aircraft registration number and/or Selcal code.
5	Initiate SatVoice call to flight with appropriate priority level.	Once the Satcom number is available, the Radio Operator will initiate a call to the aircraft.
6	Is SatVoice call successful?	Decision point – is the SatVoice call to the aircraft successful?
7	Yes: Pilot Answers SatVoice call w/ Flight ID and Verifies CLI/PIN.	This branch indicates that the SatVoice call was successfully answered by the pilot, stating the Flight ID and verifying the CLI and PIN, which is displayed to the pilot.
8	No: Try alternate media. Successful?	Decision Point - Radio Operator tries another means of communication (such as reattempting SatVoice, trying HF, VHF, or other means). Is it successful now?
9	No: Contact ATC for further guidance, if all comm unsuccessful	If other means of communication are unsuccessful, then the Radio Operator will contact ATC to report failed communication attempt and obtain further ATC guidance.
10	ATC advises to cancel message or continue to attempt contact with flight.	Given previous status report to ATC by the Radio Operator, ATC will provide additional guidance on message delivery – either to cancel the message or to continue attempted delivery.
11	Cancel message?	Decision Point - Did ATC advise the Radio Operator to cancel any further message attempts? Continue through Yes (End Message) or No (Reattempt Delivery) options.
12	Yes: Deliver Message: ATCC – Clearance ATCR – Request ATCA - Advisory	With the successful contact either via SatVoice or alternate media, the Radio Operator will deliver one of the 3 types of messages – clearance, request or advisory.
13	ATCC – Is message a clearance?	Decision Point – Is the current message a Clearance message?
14	Yes: Pilot reads back clearance	If the current message is a Clearance, then the pilot will readback the Clearance verbatim to the Radio Operator. The Radio Operator is closely monitoring to ensure pilot readback is correct.
15	No: ATC Request or Advisory	Since the current message is not a Clearance, then it is determined to be a Request or Advisory.

Ref	Ground to Air Communication Process	What is done
16	Pilot responds to ATCR or ATCA	Since the current message is a Request or Advisory, it is not necessary for the pilot to read it back; therefore, he simply responds to it.
17	Acknowledge ATCC Readback or ATCR/ATCA Pilot Response.	The Radio Operator will acknowledge the message as appropriate. If it is a Clearance, the RO acknowledges the pilot's readback. However, if it is a Request or Advisory, the RO will just acknowledge the pilot's response for documentation back to ATC.
18	Send message back to ATC w/ ATCC Pilot Readback or ATCR/ATCA Pilot Comments.	Since this message activity started with an ATC Clearance, Request or Advisory, the Radio Operator is completing the communication back to ATC with the pilot's response – either documenting the pilot's readback to the Clearance or providing any comments from the pilot to the Request or Advisory.
19	ATC receives and processes message.	ATC receives the message sent from the Radio Operator with the pilot's response. ATC processes the message/information as appropriate.
20	End	End communication either due to successful delivery or cancellation direction by ATC.

4.3.1.2 The method of establishing ground initiated calls will be dependent on the technical/operational implementation at each one of the radio stations. However, some steps should be common to each station regardless of the technical/operational methodology employed. These are:

a) Identify the 8-digit ICAO code (octal) of the aircraft from radio operator database;

b) Initiate the dialing sequence ensuring CLI/PIN and security measures are in place;

c) Use priority levels defined in **Table 3-1**~~**Table 3-1**~~;

d) Wait for the flight crew to answer the call;

e) Confirm the aircraft call sign prior to delivering the clearance or message;

f) Initiate the conversation; and

g) Terminate the call after the dialog is finished.

Example:

Radio operator	<Initiates call and line rings in flight deck>
Flight crew	Gander Radio, Air France 465 go ahead. *Note.— The pilot will be able to identify the caller and address the facility accordingly.*
Radio operator	Air France 465, Gander Radio, <message>
Flight crew	Gander Radio, Air France 465, <read back message>
Radio operator	Air France 465, Gander Radio, readback correct, out

4.3.1.3 In cases where an ATC message is urgent or delivery time is critical, the most expeditious means of communications should be utilized.

4.3.2 Incoming calls – radio operator receives calls (air-to-ground)

4.3.2.1 **Figure 4-2**~~**Figure 4-2**~~ provides a flow chart for SATCOM voice calls received by the radio operator from the flight crew. Table x-x provides descriptions associated with each number flowchart item.

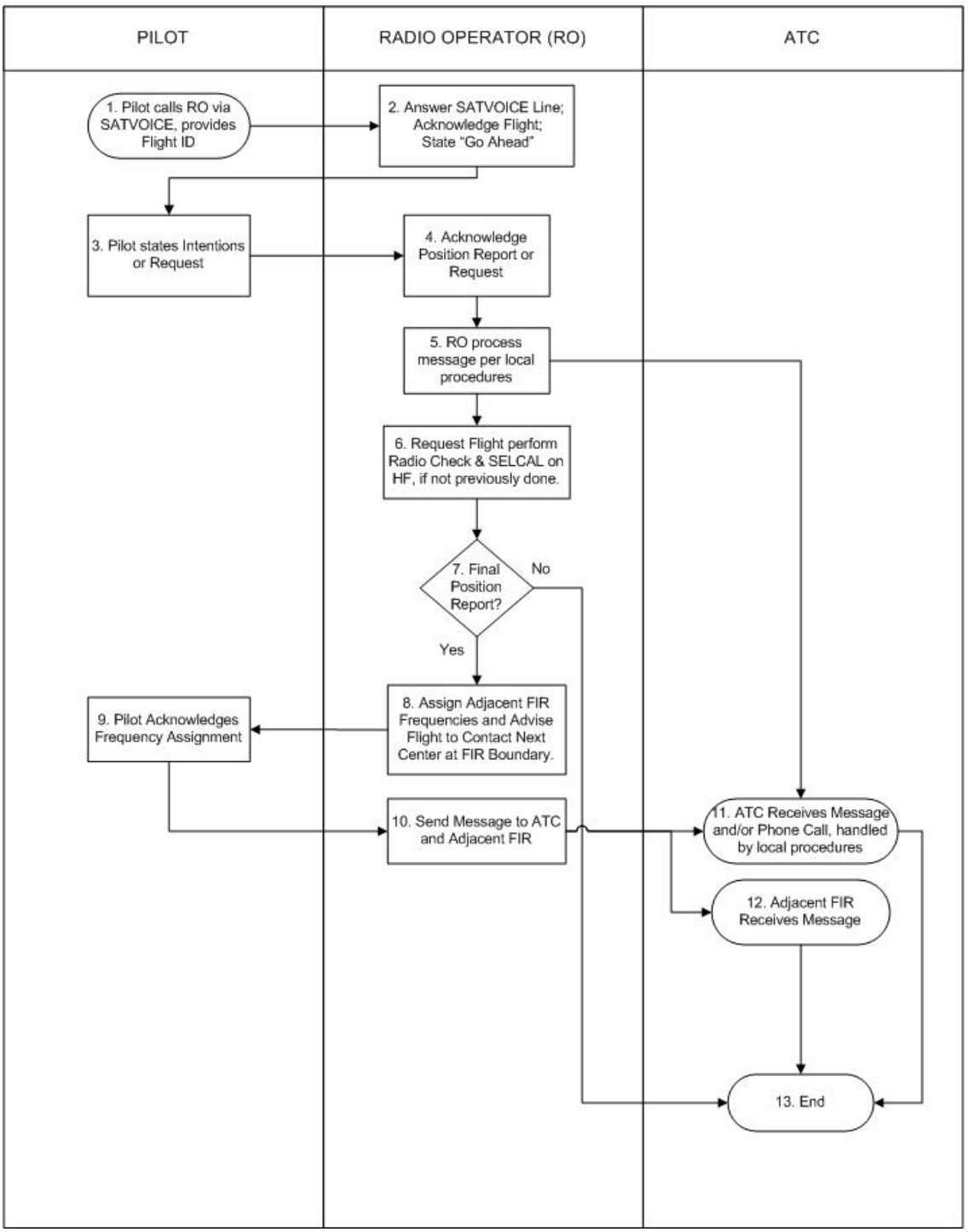


Figure 4-2. Air-ground (flight crew to radio operator) SATCOM voice flowchart

Table 4-2. Air-ground (flight crew to radio operator) SATCOM voice flowchart descriptions

Ref	Ground to Air Communication Process	What is done
1	Pilot calls RO via SatVoice, provides Flight ID	Pilot from an oceanic flight calls the Radio Operator via SatVoice. Pilot provides Flight ID.
2	Answer SatVoice line; acknowledge Flight; State "Go Ahead"	Radio Operator answers the SatVoice line and acknowledges the flight's call, stating "Go Ahead".
3	Pilot states intentions or Request	Pilot states his/her intentions for placing the SatVoice call, which could be an Initial Check-in, a Guard Change, a Pilot Request, or provides a Position Report
4	Acknowledge Position Report or Request	Radio Operator acknowledges the pilot's Position Report or his/her Request
5	RO process message per local procedures	Radio Operator relays Position Report or Request to ATC per local procedures.
6	Request Flight perform Radio Check & SELCAL on HF, if not previously done	After obtaining flight information for a new flight contact, the Radio Operator will request an HF Radio Check and SELCAL with the aircraft, which they will perform as soon as possible. Depending upon the configuration of communications assets within the Radio room, the SELCAL could be with the same Radio Operator who is on the SatVoice call, or the pilot could be transferred to another Radio Operator, handling those HF frequencies and radio assets.
7	Final Position Report?	Decision Point – Is this the pilot's final Position Report? This may determine activity with an adjacent FIR.
8	Yes: Assign Adjacent FIR Frequencies and advise Flight to contact next center at FIR Boundary.	When this is the pilot's final Position Report in the Radio Operator's FIR responsibility, then the Radio Operator provides the adjacent FIR frequencies to the pilot and advises the aircraft to contact the next center at the FIR boundary.
9	Pilot acknowledges Frequency Assignment.	Pilot acknowledges the HF or VHF Frequency Assignment for the next FIR boundary from the Radio Operator.
10	Send Message to ATC and Adjacent FIR	Radio Operator sends a message to ATC and the Adjacent FIR about flight status and/or pending entry into next FIR.
11	ATC Receives message and/or phone call, handled by local procedures	ATC will receive the Position Report or the Pilot Request from the Radio Operator. The Radio Operator may also call ATC depending upon local procedures.
12	Adjacent FIR Receives Message	The Adjacent FIR will receive the Position Report and flight status, in preparation of handling the flight as it enters their FIR.
13	End	End communication flow due to completion of communications activities, such as delivery of pilot Position Report or Request, and handoff to adjacent FIR, if appropriate, and/or updating of Radio Operator's flight information database.

4.3.2.2 For SATCOM voice calls made to a radio station, the radio operator should:

a) confirm the identification of the calling flight;

b) acknowledge message; read back the message or selected contents, as required; and;

c) if not already completed, provide primary and secondary HF frequencies and ensure flight establishes HF/VHF and SELCAL check, where required by the regulatory authority

Example:

	<line rings at aero radio>
Flight crew	<Initiates call and line rings at aero radio>
Radio operator	Flight calling Shanwick Radio, GO AHEAD *Note.— Radio operator does not need to know who is calling.*
Flight crew	Shanwick Radio, Speedbird 255, <message>
Radio operator	Speedbird 255, Shanwick Radio <read back message>
Flight crew	Shanwick Radio, Speedbird 255, ROGER
Radio operator	Shanwick Radio OUT

4.3.2.3 If the initial call from the flight crew to a radio station is made on SATCOM, the radio operator should:

a) receive and read-back the message, if required; and

b) allocate the primary and secondary HF frequencies and perform a SELCAL check on HF.

4.4 (Deleted)

4.5 Communication failures and emergencies

4.5.1 Loss of SATCOM Voice Connection

4.5.1.1 If the SATCOM voice connection is lost during a communication, the radio operator should:

a) attempt to contact the aircraft using any means at their discretion, e.g., SATCOM voice retry, HF (SELCAL), data link, VHF or relay through another aircraft, to establish positive voice communications for that flight; and

b) deliver the clearance or receive the message as appropriate.

4.5.2 Airspace emergencies – loss of controller or radio facility capabilities

4.5.2.1 In situations where the controller or radio facility loses capabilities, then the radio operator should use whatever means are available to provide information on the emergency situation and any directives, for example:

a) HF broadcast capability – Radio operators will transmit a voice broadcast on HF radio of emergency situation and any directives.

b) SATCOM voice broadcast capability – future development; and

c) Volmet broadcasts, if available.

Chapter 5. Flight crew procedures

5.1 General

5.1.1 Operators with data link equipped aircraft (CPDLC, ADS-C, and FMC WPR) operating in airspace where data link services are provided should use data link as their normal means of communications. Some normal ATC communications and most non normal communications will require use of voice communications. The flight crew should use either SATCOM or HF voice at their discretion. Urgency, type of message being communicated, current atmospheric conditions, and company standard operating procedures are all factors in determining which voice system to use.

5.1.2 Although the underlying technology lends itself to a conversational mode of communications, such use can create misunderstanding and confusion. Therefore, when using SATCOM voice, normal RTF conventions must be followed identical to HF communications in accordance with standard ICAO phraseology, as defined in Annex 10, Volume II, Chapter 5 and Doc 4444 chapter 12 and Doc. 8400.

5.1.3 On initial contact with a radio station, the flight crew should provide flight identification and request frequency assignment and perform a SELCAL check on HF. After a successful SELCAL check, all subsequent communications with that radio station may be performed via SATCOM Voice or HF voice based on regulatory requirements and company policies.

5.1.4 The flight crew should normally make calls to the radio station facility serving the airspace in which the aircraft is flying. If oceanic airspace has not been entered, the radio station serving the first oceanic centre should be contacted. If communications are lost with the current aero radio station, the flight crew should attempt contact with any other aero radio station to relay.

5.1.5 If a HF SELCAL check is required before or after entering a FIR, the flight crew should contact the radio operator and complete a HF SELCAL check. A check of the SATCOM voice system similar to a HF SELCAL is not required because the system will alert the crew if the system is not working properly.

5.2 Flight crew initiated

5.2.1 SATCOM short codes are published in State AIPs and some charts. Short codes may be stored in SATCOM avionics for easy access by the flight crew.

5.2.2 When contacting ATC crews should utilize the appropriate safety priority.

Example:

	<line rings at aero radio>
Flight crew	Arctic Radio, Continental 99, position report
Radio operator	Continental 99 Arctic Radio, go ahead
Flight crew	Arctic Radio, Continental 99, <message>

Radio operator	Continental 99, Arctic Radio, <read back message>
Flight crew	Arctic Radio, Continental 99 out

5.3 Flight crew receives call

5.3.1 The flight crew should visually confirm the priority of the incoming call and verify that it is an ATC priority call. Reply to calls utilizing standard phraseology (see **paragraph 5.1.2**)

5.3.2 The flight crew should not act on ATC instructions from SATCOM calls with other than ATC priority calls, and if in doubt terminate the call and initiate a new call for confirmation.

5.4 Oceanic clearances

5.4.1 Coordination of oceanic clearances should be in accordance with state AIPs.

5.5 Contingencies

5.5.1 SATCOM busy signal or no answer

5.5.1.1 Normally, when initiating a SATCOM voice call to a radio facility that supports SATCOM voice services, the flight crew should receive an answer. When a SATCOM voice call returns a busy signal or there is no answer, the flight crew should use alternative means of communications.

5.5.2 SATCOM Failure

5.5.2.1 If the aircraft SATCOM voice equipment has malfunctioned or for any other reason the SATCOM voice system is unavailable the flight crew should:

a) revert to an alternate means of communication; and

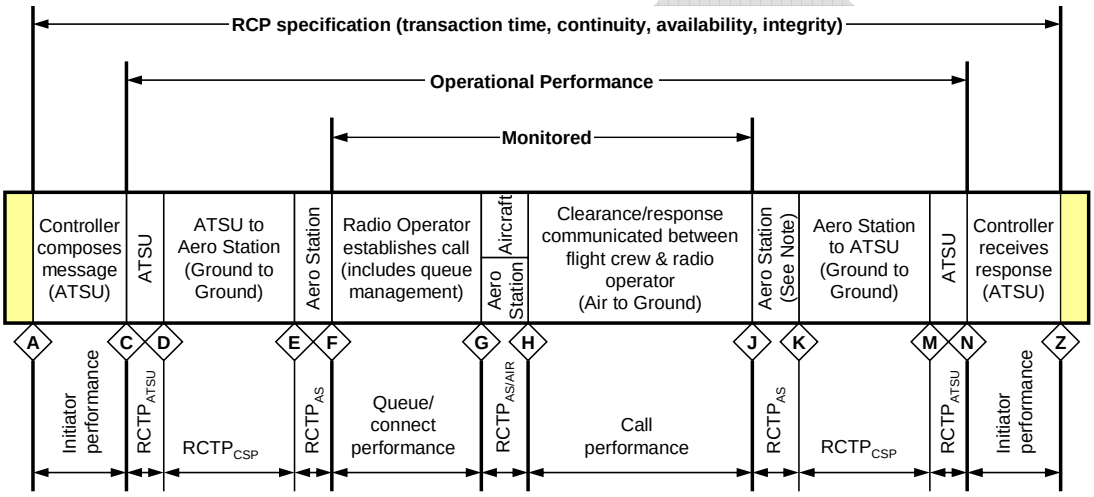
b) notify the radio station of the SATCOM voice failure.

Appendix A – RCP 400 specification – allocations for satellite voice communications

This appendix provides a supplement to the RCP 400 specification provided in the First Edition of the Global Operational Data Link Document (GOLD). The supplement includes the RCP allocations for satellite voice communications, consistent with RCP 400 "top sheet."

A.1 Terms and definitions

Refer to GOLD, Appendix B, paragraph B.1 for general terms and definitions applicable to RCP specifications. This section provides additional terms and definitions to describe the RCP allocations for radio operator satellite voice communications.



Note: The (J to K) component includes two concurrent processes:

(1) the aircraft and aeronautical station technically disconnect the call; which is assumed. Operationally, the call is disconnected when the flight crew and radio operator complete the call; and

(2) the aeronautical station sends the response to the network for delivery to the ATSU; its performance is denoted by $RCTP_{AS}$.

Figure A- 1. Typical voice communication transaction allocation – controller initiated via a radio operator using satellite voice communication

RCP specification	
Term	**Description**
Operational communication transaction	The process a human uses to initiate the transmission of an instruction, clearance, flight information, and/or request, and is completed when that human is confident that the transaction is complete.
Required communication performance	A statement of the performance requirements for operational communication in support of specific ATM functions.

RCP specification	
Term	**Description**
RCP specification	A specification (e.g. RCP 400) that represents the values assigned to RCP parameters for communication transaction time, continuity, availability and integrity, and allocations to ATSP, aircraft, CSP and operator.
RCP expiration time (ET)	The maximum time for the completion of the operational communication transaction after which the initiator is required to revert to an alternative procedure.
RCP nominal time (TT 95%)	The maximum nominal time within which 95% of operational communication transactions are required to be completed.
RCP continuity (C)	The required probability that an operational communication transaction can be completed within the communication transaction time, either ET or TT 95%, given that the service was available at the start of the transaction. Voice communications: This translates into 5 out of 100 calls not being able to conclude their voice transactions within the allotted time or the call could be disconnected for any reason, including aircraft maneuvers, switching satellites or any loss of service while on the call.
RCP availability (A)	The required probability that an operational communication transaction can be initiated when needed. Voice communications: This translates to any failure prohibiting the call to be initiated to include congestion (much like the analogy of a terrestrial mobile phone network). However this definition does not apply to a busy condition whereby the entity being called is already on the phone and does not have a way to put the existing call on hold or if able to, rejects the additional incoming call.

RCP specification	
Term	**Description**
RCP integrity (I)	The required probability that an operational communication transaction is completed with no undetected errors. *Note.— Whilst RCP integrity is defined in terms of the "goodness" of the communication capability, it is specified in terms of the likelihood of occurrence of malfunction on a per flight hour basis, e.g. 10^{-5}, consistent with RNAV/RNP specifications.* Voice communications: This translates to the ability to conduct the voice transaction with enough intelligibility to understand the verbal request. Additionally, this could also manifest in the crew executing an incorrect instruction because it was misunderstood. (It may not be clear at the time of this submittal, what type of error rate would reflect this condition, or if the read-back would mitigate or compound this).

/V transaction time	
Term	**Description**
Operational Performance	The portion of the transaction time (used for intervention) that does not include the times for message composition or recognition of the operational response. Voice communications: Operational Performance (C to N) = RCTP+ Queue/Connect Performance (F to G) + Call Performance (H to J)
Required Communication Technical Performance (RCTP)	The portion of the (intervention) transaction time that does not include the human times for message composition, operational response, and recognition of the operational response. Voice communications: $RCTP = RTCP_{ATSU} + RCTP_{AS} + RCTP_{AS/AIR} + RCTP_{CSP}$
Monitored Performance	The monitored combination of the time it takes to organize, prepare, dial and perform an interactive call plus the technical performance of the ground and air equipment. Voice communications: Monitored Performance (F to J) = $RCTP_{AS/AIR}$ + Queue/Connect Performance (F to G) + Call Performance (H to J)

/V transaction time	
Term	**Description**
Call Performance	The operational portion of the transaction time to prepare the operational response, and includes the recognition of the instruction, and message composition during an interactive call between the Radio Operator and Flight Crew, e.g. flight crew/HMI for intervention transactions. Voice communications: Call Performance = (H to J), where "H" denotes when the aircraft indicates an incoming call to the flight crew and "J" denotes when the callers operationally completes the call. (H to J) includes any tasks for the radio operator to send the message to the ATSU.
Queue/Connect Performance	The operational portion of the transaction time to organize and place the call either via a manual or automated dialing sequence depending on equipment at the RO facility. Voice communications: Queue/Connect Performance = (F to G), where "F" denotes when the message from the ATSU via the network is sent to the queue, and "G" denotes when the last digit of the dialing sequence is finished.
$RCTP_{ATSU}$	The summed critical transit times for an ATC intervention message and a response message, allocated to the ATSU system. Voice communications: $RCTP_{ATSU}$ = (C to D) + (M to N)
$RCTP_{CSP}$	The summed critical transit times for an ATC intervention message and a response message, allocated to the CSP system. Voice communications: $RCTP_{CSP}$ = (D to E) + (K to M)
$RCTP_{AS/AIR}$	The technical time for the air-ground network and associated components to initiate a call. Voice communications: $RCTP_{AS/AIR}$ = (G to H), where "G" denotes when the last digit of the dialing sequence is finished and "H" denotes denotes when the aircraft indicates an incoming call to the flight crew.

/V transaction time	
Term	**Description**
$RCTP_{AS}$	The summed critical transit times for an ATC intervention message and a response message allocated to the Aero Station. Voice communications: $RCTP_{AS}$ = (E to F) + (J to K), where (J to K) includes two concurrent processes: a) the aircraft and aeronautical station technically disconnect the call; which is assumed. Operationally, the call is disconnected when the flight crew and radio operator complete the call; and b) the aeronautical station sends the response to the ATSU via the ground-ground network; the performance is denoted by $RCTP_{AS}$.

Continuity	
Term	**Description**
C for operational performance	The proportion of intervention messages and responses that can be delivered within the specified operational performance time for intervention. Voice communications: Continuity would take into consideration any dropped calls.
C for RCTP	The proportion of intervention messages and responses that can be delivered within the specified RCTP for intervention. Voice communications: Continuity would take into consideration any dropped calls.
C for $RCTP_{ATSU}$	The proportion of intervention messages and responses that can be delivered within the specified $RCTP_{ATSU}$ for Intervention.
C for $RCTP_{CSP}$	The proportion of intervention messages and responses that can be delivered within the specified $RCTP_{CSP}$ for Intervention.
C for $RCTP_{AS/AIR}$	The proportion of intervention messages and responses that can be delivered within the specified $RCTP_{AS/AIR}$ for Intervention. Voice communications: Continuity would take into consideration any dropped calls.

Continuity	
Term	**Description**
C for $RTCP_{AS}$	The proportion of intervention messages and responses that can be delivered within the specified $RCTP_{AS}$ for Intervention.

Availability	
Term	**Description**
Service availability (A_{CSP})	The required probability that the communication service is available to all users in a specific airspace when desired.
Unplanned outage duration limit (minutes)	Time after the unplanned outage begins at which there is an operational impact. Measured from when an unplanned outage begins to when the ATSU receives notification that the service has been restored.
Maximum number of unplanned outages	Measured separately for each relevant operational airspace or Flight Information Region (FIR) over any 12-month period.
Maximum accumulated unplanned outage time (min/yr)	Measured by accumulating ***only*** the duration times for unplanned outages greater than the unplanned outage duration limit during any 12-month period. The accumulation is performed separately for each relevant operational airspace or FIR.
Unplanned outage notification delay (min)	Notification to the ATSU of an unplanned outage. Measured from when the unplanned outage begins to when the ATSU receives notification.
Aircraft system availability (A_{AIR})	The required probability of available capability on an aircraft with an average flight of 6 hours. *Note.— The actual aircraft system availability is computed assuming that the service is available in the relevant airspace.*

A.2 RCP 240 specification

Refer to GOLD, Appendix B, paragraph B.2 for RCP 240 specification.

A.3 RCP 400 specification

RCP Specification			
RCP specification		**RCP 400**	
Airspace specific considerations			
Interoperability	Specify interoperability criteria, e.g. FANS 1/A, satellite voice communications.		
ATS Function	Specify ATS function(s), e.g. applicable separation standard		
Application	Specify controller-pilot ATC communication intervention capability, e.g. CPDLC application per ICAO Doc 4444, and RTCA DO-306/EUROCAE ED-122, Annex A, satellite voice communications per SVGM.		
RCP parameter values			
Transaction time (sec)	**Continuity (C)**	**Availability (A)**	**Integrity (I)**
ET = 400	C(ET) = 0.999	0.999	Malfunction = 10^{-5} per flight hour
TT 95% = 350	C(TT 95%) = 0.95		
RCP monitoring and alerting criteria			
Ref:	**Criteria**		
MA-1	The system shall be capable of detecting failures and configuration changes that would cause the communication service to no longer meet the RCP specification for the intended function.		
MA-2	When the communication service can no longer meet the RCP specification for the intended function, the flight crew and/or the controller shall take appropriate action.		
Notes			
Note 1.— Rationale for the criteria provided in this specification can be found in ICAO Annex 11, ICAO Doc 4444, ICAO Doc 9689, and RTCA DO-306/ED-122. *Note 2.— The values for transaction times are to be applied to transactions that are representative of communication capability for the controller to intervene with a specific operator, aircraft type, and aircraft identification.* *Note 3.— If changes are made to the system capacity limits, as specified by the airspace requirements, and the changes cause the system to perform below the RCP specification, this would be considered a change in system configuration.*			

A.3.1 RCP 400/D allocations

Refer to GOLD, Appendix B, paragraph B.3.1 for RCP 240/D allocations applicable to CPDLC.

A.3.2 RCP 400/V allocations

The RCP 400/V allocations are applicable controller-initiated communications via a to radio operator using satellite voice communications.

A.3.2.1 Air traffic service provider (ATSP)

RCP communication transaction time and continuity criteria			
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**		**Component: ATSP**
Transaction Time Parameter	**ET (sec)** **C = 99.9%**	**TT (sec)** **C = 95%**	**Compliance Means**
Transaction Time **(A to Z)**	400	275	Analysis, CSP contract/service agreement. See also **paragraph A.3.2.2**.
RCP Time Allocations			
Initiator **(A to C) + (N to Z)**	30	20	Analysis, simulations, safety and human factors assessments
Operational Performance **(C to N)**	370	255	Monitored, CSP contract/service agreement. See also **paragraph A.3.2.2**.
Operational Performance Time Allocations			
Monitored Performance **(F to J)**	352	245	Initially, by analysis, simulations, safety human factors assessments Post-implementation monitoring
RCTP **($RCTP_{ATSU}$ + $RCTP_{CSP}$ + $RCTP_{AS}$ + $RCTP_{AS/AIR}$)**	25	15	Monitored, estimated, CSP contract/service agreement. See also **paragraph A.3.2.2**
RCTP Time Allocation			
$RCTP_{ATSU}$ **(C to D) + (M to N)**	4	2	Pre-implementation demonstration

RCP availability criteria			
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**		**Component: ATSP**
Availability parameter	**Efficiency**	**Safety**	**Compliance means**
Service availability (A_{CSP})	N/A	0.999	Contract/service agreement terms. *Note.— For guidelines to aid in the development of the contract/service agreement with the CSP, see **paragraph A.3.2.2**, RCP 400/D allocation to CSP for RCP availability criteria.*

RCP integrity criteria		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: ATSP**
Integrity parameter	**Integrity value**	**Compliance means**
Integrity (I)	*Note.— RCP integrity criteria related to RCP 400/D are the same as those related to RCP 240/D. See GOLD, **paragraph B.2.1.1**.*	

RCP monitoring and alerting criteria		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: ATSP**
Ref:	**Criteria**	**Compliance means**
All	*Note.— RCP monitoring and alerting criteria related to RCP 400/D are the same as those related to RCP 240/D. See GOLD, **paragraph B.2.1.1**.*	

RCP related safety requirements		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: ATSP**
Ref	**Related RCP Parameter**	**Safety requirement**
All	A, C, I	*Note.— Safety requirements related to RCP 400/D are the same as those related to RCP 240/D. See GOLD, **paragraph B.2.1.1**.*

A.3.2.2 Communication service provider (CSP)

RCP communication transaction time and continuity criteria			
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**		**Component: CSP**
Transaction Time Parameter	**ET (sec) C = 99.9%**	**TT (sec) C = 95%**	**Compliance means**
RCTP Time Allocation			
$RCTP_{CSP}$ (D to E) + (K to M)	10	6	Contract/service agreement terms
$RCTP_{AS}$ (E to F) + (J to K)	4	2	Contract/service agreement terms
$RCTP_{AS/AIR}$ (G to H)	7	5	Contract/service agreement terms *Note: Criteria are shared between aircraft system, ground system and air-ground network.*
Queue/connect performance (E to G)	75	60	Monitored, estimated, CSP contract/service agreement.
Call performance (H to J)	270	180	Initially, by analysis, simulations, safety human factors assessments Post-implementation, monitored, estimated

RCP availability criteria			
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: CSP**	
Availability parameter	**Efficiency**	**Safety**	**Compliance means**
Service availability (A_{CSP})	N/A	0.999	Contract/service agreement terms
Unplanned outage duration limit (min)	N/A	20	Contract/service agreement terms
Maximum number of unplanned outages	N/A	24	Contract/service agreement terms
Maximum accumulated unplanned outage time (min/yr)	N/A	520	Contract/service agreement terms
Unplanned outage notification delay (min)	N/A	10	Contract/service agreement terms

RCP integrity criteria		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: CSP**
Integrity parameter	**Integrity value**	**Compliance means**
Integrity (I)	*Note.— RCP integrity criteria related to RCP 400/D are the same as those related to RCP 240/D. See GOLD, **paragraph B.2.1.2**.*	

A.3.2.3 Aircraft system

RCP communication transaction time and continuity criteria			
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**		**Component: Aircraft system**
Transaction Time Parameter	**ET (sec) C = 99.9%**	**TT (sec) C = 95%**	**Compliance Means**
RCP Time Allocation			
Operational Performance Time Allocation			
Call performance (H to J)	270	180	Human-machine interface capability, pre-implementation demonstration
RCTP Time Allocation			
$RCTP_{AS/AIR}$ (G to H)	7	5	Pre-implementation demonstration *Note: Criteria are shared between aircraft system, ground system and air-ground network.*

RCP availability criteria			
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**		**Component: Aircraft system**
Availability parameter	**Efficiency**	**Safety**	**Compliance means**
A_{AIR}	N/A	0.999	Analysis, architecture, design, pre-implementation demonstration

RCP integrity criteria		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: Aircraft system**
Integrity parameter	**Integrity value**	**Compliance means**
Integrity (I)	*Note.— RCP integrity criteria related to RCP 400/D are the same as those related to RCP 240/D. See GOLD, **paragraph B.2.1.3**.*	

RCP monitoring and alerting criteria		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: Aircraft system**
Ref:	**Criteria**	**Compliance means**
All	*Note.— RCP monitoring and alerting criteria related to RCP specification 400/D are the same as those related to RCP 240/D. See GOLD, **paragraph B.2.1.3**.*	

RCP related safety requirements		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: Aircraft system**
Ref	**Related RCP Parameter**	**Safety requirement**
All	A, C, I	*Note.— Safety requirements related to RCP 400/D are the same as those related to RCP 240/D. See GOLD, **paragraph B.2.1.3**.*

A.3.2.4 Aircraft operator

RCP communication transaction time and continuity criteria			
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**		**Component: Aircraft operator**
Transaction Time Parameter	**ET (sec)** **C = 99.9%**	**TT (sec)** **C = 95%**	**Compliance Means**
RCP Time Allocations			
Operational Performance Time Allocations			
Call performance (H to J)	270	180	Procedural capability, flight crew training and qualification in accordance with safety requirements.
RCTP Time Allocation			
$RCTP_{AS/AIR}$ (G to H)	7	5	CSP contract/service agreement. Aircraft type design approval, maintenance.

RCP availability criteria			
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**		**Component: Aircraft operator**
Availability parameter	**Efficiency**	**Safety**	**Compliance means**
A_{AIR}	N/A	0.999	Aircraft type design approval, maintenance, properly configured user-modifiable software, e.g. ORT
Service availability (A_{CSP})	N/A	0.999	Contract/service agreement terms. *Note.— For guidelines to aid in the development of the contract/service agreement with the CSP, see* ***paragraph A.3.2.2****, RCP 400/D allocation to CSP for RCP availability criteria.*

RCP integrity criteria		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: Aircraft operator**
Integrity parameter	**Integrity value**	**Compliance means**
Integrity (I)	*Note.— RCP integrity criteria related to RCP 400/D are the same as those related to RCP 240/D. See GOLD,* ***paragraph B.2.1.4****.*	

RCP monitoring and alerting criteria		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: Aircraft operator**
Ref:	**Criteria**	**Compliance means**
All	*Note.— RCP monitoring and alerting criteria related to RCP 400/D are the same as those related to RCP 240/D. See GOLD,* ***paragraph B.2.1.4****.*	

RCP related safety requirements		
Specification: RCP 400/V	**Application: Controller intervention (GTA), Satellite voice**	**Component: Aircraft operator**
Ref	**Related RCP Parameter**	**Safety requirement**
All	C, I	*Note.— Safety requirements related to RCP 400/D are the same as those related to RCP 240/D. See GOLD,* ***paragraph B.2.1.4****.*