

**International Satellite Communication System
(ISCS)**

**World Area Forecast
(WAFS)**

Users Guide

April 2011

(Prepared by NWS/FAA)

International Civil Aviation Organization

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Chapter 1

Introduction to the International Satellite Communication System

1.1 Purpose

1.1.1 The purpose of this ISCS User Guide is to give an overview of the system and provide helpful information to potential users. It is intended to complement the technical manuals which will accompany the individual VSAT and workstation equipment. The ISCS User Guide is also available on the NWS website at:

<http://www.weather.gov/iscs/>

1.2 Introduction

1.2.1. The World Area Forecast System (WAFS) was established at the International Civil Aviation Organization (ICAO) Communications/Meteorology (COM/MET) Divisional Meeting (1982) held conjointly with the seventh session of the WMO Commission for Aeronautical Meteorology (CAeM) in Montreal. The objective of the system is to supply meteorological authorities and other users with forecasts of en-route meteorological conditions in digital form. This objective is achieved through a comprehensive, integrated worldwide, and uniform system (as far as practicable) in a cost-effective manner leveraging evolving technologies.

The meteorological information provided by the Washington World Area Forecast Center (WAFC), as distributed by the International Satellite Communication System (ISCS), complies with the Standards and Recommended Practices (SARPs) of Annex 3, Meteorological Service for International Air Navigation, as defined in Chapter 3 of Part I (Core SARPs) and in Appendix 2, Technical Specifications Related to World Area Forecast System and Meteorological Offices. The information includes:

- a) upper wind;
- b) upper-air temperature;
- c) upper-air humidity;
- d) direction, speed and height of maximum wind;
- e) tropopause height and temperature; and
- f) significant weather phenomena.
- g) * Compare to SADIS...differences in this list for e and f.

To facilitate computerized processing, this information is provided in standardized digital formats. Information in a) through e) is provided in the gridded binary (GRIB1 and GRIB2) formats (WMO FM 92-IX Ext. GRIB, and WMO Publication No. 306, Vol. 1, Part B). Information in f) is provided in the Binary Universal Format for Representation of meteorological data (BUFR) code (WMO FM 94-XII Ext. BUFR).

Note that the WAFS Internet File Server (WIFS) will replace the ISCS satellite broadcast as the primary means for users to obtain WAFS data products from the Washington WAFC effective 1 July 2012. See Appendix C for details.

1.2.2 The foregoing products are provided globally by the two WAFCs, London and Washington by satellite broadcast as part of the ICAO Aeronautical Fixed Service (AFS). WAFS products consist of aeronautical meteorological information in support of flight planning. There is therefore an obligation for ICAO to ensure that all ICAO Contracting States have access to all the WAFS data they may need through at least one component of the AFS.

1.2.3 The worldwide satellite communications are provided using four INTELSAT satellites. The United States provide three INTELSAT services for the distribution of WAFC Washington products over the Americas, Pacific and Eastern Asia, using an INTELSAT satellites based over the Atlantic, Pacific, and eastern Indian Oceans. The services provided by the United States are known as the International Satellite Communications System (ISCS).

1.2.4 The area outside of the Washington WAFC coverage is provided by the London WAFC by way of the Satellite Distribution System (SADIS). This ensures that all States are able to receive WAFS products using satellite communications from either WAFC, depending on their location. The "footprint" of the ISCS is shown in Appendix A.

1.2.5 ISCS delivers WAFS forecasts in digital format, as well as alphanumeric OPMET information required for pre-flight planning. Details about the data and products disseminated on ISCS are given in Chapter 2 of this guide.

1.3 Description of the system

1.3.1 ISCS support for WAFS is in response to ICAO requirements. ISCS and SADIS make up the worldwide WAFS program providing vital meteorological support for flight planning and air traffic management throughout the world. The purpose of ISCS/SADIS is to provide the worldwide aviation community with operational meteorological forecasts and information about meteorological phenomena required for flight planning and safe, economic and efficient air navigation.

1.3.2 ISCS provides a point to multi-point service on a 24-hour basis via satellite (see Appendix B). ISCS uplinks are situated at the three Gateways in Andover, Maine; Yacolt, Washington; and Fuchsstadt, Germany. WAFS data is provided from Washington WAFC Center in the United States and are uplinked from the hubs at Andover, ME to the INTELSAT satellite 903 located over the Atlantic Ocean and Yacolt, Washington for utilization of the INTELSAT 701, and Fuchsstadt, Germany for utilization of the INTELSAT 906 over the Pacific Ocean.

1.3.3 The data is delivered to the end user using Transmission Control Protocol/Internet Protocol (TCP/IP). A computer processing system (workstation or mini-computer) must be connected to the communications port of the network interface device. This computer system is selectable by the user, but the interface of the selected computer must be prepared to utilize Hughes Network Systems Program Director (PD) Receiver software to enable reception of IP multicast data stream. The system can be a stand alone workstation as the third component of the ISCS. This component receives the data stream and stores the data for retrieval and use. Authorized users of the WAFS may select any workstation from available commercial vendors who have met the functional requirements for an ISCS (WAFS) workstation. A list of vendors with WAFS ready computer systems can be obtained at <http://www.met-office.gov.uk/sadis/about/manufacturers.html>.

1.3.4 In addition to the satellite service, approved ISCS users can access all of WAFS data over the public Internet via the WAFS Internet File Server (WIFS) which serves as backup to ISCS for WAFS products. See Appendix C for details.

1.4 Management of ISCS

1.4.1 The Federal Aviation Administration (FAA), as the U.S. Meteorological Authority, identifies the requirements for the products and services for the Washington WAFC and ensures the operation of ISCS. The National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) is the provider of the WAFS products, and has responsibility for the management and operation of the ISCS. The FAA and NOAA/NWS have an Interagency Agreement that describes their respective roles and responsibilities.

1.5 Authorized access to ISCS

1.5.1 It is incumbent upon user States to arrange access to the satellite broadcasts for the reception of WAFS digital products and OPMET data, and to arrange for their national distribution, in line with the provisions of Annex 3, Section 2.1. In order for the authorities in the individual States to retain control over the national distribution it is necessary to identify those users who are authorized to receive the ISCS broadcast directly. Authorized users are defined in the Air Navigation Plans, Volume II, Facilities and Services Implementation Document.

1.5.2 Access to the ISCS broadcast will be based upon advice by the meteorological authority of the respective State as defined in Annex 3, Chapter 1, and Chapter 2, paragraph 2.1.4 and will be communicated to ICAO for inclusion in the ANP/FASID.

Guidelines for Authorized Access to the World Area Forecast System (WAFS) Satellite Broadcast are provided in Appendix D.

1.6 ISCS Provider State and User State Responsibilities

1.6.1 The United States Provider State bears all costs associated with generating WAFS data and making it available via satellite broadcast to User States. It is incumbent upon the User States to arrange for access to the satellite for reception of the WAFS data. Access to the ISCS broadcast is free based on the user's purchase of compatible End User Data Circuit-terminating Equipment (DCE), and the use of PD receiver software on their WAFS computer processing system. Para. 3.1.1 provides information on the DCE equipment and software required by End Users to receive WAFS data products via the ISCS. Lastly, the User must register with the NWS ISCS Program Manager listed in Chapter 4 of this Users Guide.

Chapter 2

Products and Data Broadcast in ISCS

2.1 Overview of products and data broadcast on ISCS

2.1.1 Information provided on the WAFS broadcasts is defined in ICAO Annex 3, Meteorological Service for International Air Navigation, Chapter 3. This information is divided into four formats:

- a. Grid point information in gridded binary (GRIB1 and GRIB2) format;
- b. Significant Weather (SIGWX) information in Portable Network Graphics (PNG) format;
- c. SIGWX information in BUFR format; and
- d. OPMET information in character-oriented format.
- e. Volcanic ash graphics in T4

2.1.2 The required areas, flight level, and forecast times are established by Regional Air Navigation agreements, and listed in the applicable regional ICAO Air Navigation Plan.

2.2 Grid Point Data (GRIB1 and GRIB2)

Grid point data is provided in two formats, GRIB1 and GRIB2. GRIB1 data is scheduled to be terminated in 2013 in accordance with the long term plan of the World Area Forecast System Operations Group (WAFSOPSG). Users receiving this data must have a data processing system, such as the WAFS workstation, which can read, decode, and manipulate data for the user's specific purpose. WAFS products prepared in GRIB1 and GRIB2 format are transmitted as a series of bulletins. Each bulletin contains a grid point field of one parameter at a single level.

2.2.1 GRIB1 Data

2.2.1.1 Grid point data is prepared by WAFS Washington and coded in the WAFS thinned GRIB1 format (See the Manual on Codes, WMO Pub. No. 306, Volumes I.1 and I.2.). Users receiving this data must have a data processing system which can read, decode, and manipulate data for the user's specific purpose.

2.2.1.2 WAFS products prepared in GRIB1 format are transmitted as a series of bulletins. Each bulletin contains a grid point field of one parameter at a single level, as a continuous bit stream sequence of bytes within a communications envelope. Part I - Technical description of the document titled "Gridded Binary (GRIB1 Code) Data on a "Thinned" Grid, from WAFS London and Washington," describes the precise details of the data format.

2.2.1.3 WAFS thinned GRIB1 are on a global horizontal grid divided into eight segments, four each in the Northern and Southern Hemispheres. Each segment is 90° in length, starting either side of the 30° W meridian, covering the Equator to each Pole. Decoding software available from WAFS Washington enables the information to be interpolated and presented on a regular latitude/longitude grid.

2.2.1.4 GRIB1 are prepared four times daily, valid at 6, 12, 18, 24, 30 and 36 hours after synoptic data time (0000, 0600, 1200, and 1800 UTC). Forecasts are made available for transmission as soon as technically feasible, but no later than six (6) hours after the standard time of observation.

2.2.1.5 Grid point forecasts in GRIB1 format prepared by WAFS Washington are shown in Table 1.

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Table 1: ISCS Gridded Products (GRIB1)

	AMSL	Surface	1000	850	700	600	500	400	300	275	250	225	200	150	100	070	Trop	Max Wnd
upper U-component wind			x	x	x		x	x	x		x		x	x	x	x		
upper V-component wind			x	x	x		x	x	x		x		x	x	x	x		
upper temperature			x	x	x		x	x	x		x		x	x	x	x		
upper relative humidity			x	x	x		x	x	x									
altitude of upper levels			x	x	x		x	x	x		x		x	x	x	x		
tropopause altitude																	x	
tropopause temperature																	x	
trop U-component																	x	
trop V-component																	x	
U-component max wind																		x
V-component max wind																		x
altitude of max wind																		x
temperature at max wind																		x
surface temperature		x																
surface U-component wind		x																
surface V-component wind		x																
surface pressure		x																
surface relative humidity	x																	
mean sea level pressure	x																	
Total precipitation		x																
Convective precipitation		x																
Total grids = 66																		

2.2.2 GRIB2 Data

2

2.2.2.1 GRIB2 data is currently available on ISCS. The same data sets are available in GRIB2 as are in GRIB1 (e.g., wind, temperature, humidity, etc). While not available on the ISCS Satellite broadcast; additional GRIB 2 Cumulonimbus (CB) Clouds, Turbulence, and Icing forecasts, are accessible (on a trial basis) on the WIFS (see Appendix C for details). To obtain more information on the implementation of GRIB2 users should refer to the final report of the Fifth Meeting of the WAFS Operations Group (WAFSOPSG):

<http://www2.icao.int/en/anb/met-aim/met/wafsopsg/Pages/default.aspx>

2.2.2.2 Notable GRIB2 Characteristics:

- GRIB 2 grid will be regular 1.25 x 1.25 degree (unthinned).
- New vertical levels at 350 hectopascals (hPa) (~FL270), 275hPa (~FL320) and 225hPa (~FL360), applicable to wind, temperature and geopotential height fields.
- New vertical levels at 800hPa (~FL060) for icing; and 350hPa (~FL270) for Clear Air Turbulence (CAT).
- Eliminate use of octants and issue GRIB 2 data as a global field of data for each element.
- In Cloud Turbulence (ICT) is combined layer cloud and convective cloud turbulence
- Tropopause Height limit of FL530 in WAFS London GRIB1 to be changed to FL600 in GRIB2. Reference levels to tropopause height for GRIB1 and GRIB2 for WAFS Washington are different. Users should refer to the WAFS Change Notice Board for further information.
- Issuance times:
 - 4 issues per day, with Daily Time (DT) 00, 06, 12 and 18 UTC.
 - 11 time steps at 3 hourly intervals T+6 to T+36.

- Data Points:
 - 27,576 GRIB 1 global data points with thinned 1.25 x 1.25 degree grid (i.e. 3447 data points per octant x 8 octants).
 - 41,472 GRIB 2 global data points with regular (unthinned) 1.25 x 1.25 degree grid (i.e. 5184 data points per octant x 8 octants).
 - ~50% increase in the number of global data points over present thinned GRIB 1 (27,576 increases to 41,472).
- Bulletins:
 - GRIB 1 bulletin ~4kb per octant, to 1st approximation (i.e. 2352 bulletins totals ~10mb)
 - GRIB 2 bulletin would be ~6kb per octant (i.e. ~50% increase).
 - GRIB 2 bulletin ~48kb in size containing global field of data.
 - 1078 GRIB 2 bulletins per run containing global field of data.
- Data volume
 - Data volume ~52mb per run before compression (1078 bulletins @ ~48kb each).
 - This is a five-fold increase before compression in WAFS data volume via the ISCS satellite compared to current GRIB 1 broadcast.

2.2.2.3 Detailed information concerning upper-air gridded forecasts can be found in ICAO Annex 3, Appendix 2.

2.3 Significant Weather PNG Charts

2.3.1 SIGWX forecasts supplied in PNG facsimile form are issued four (4) times daily, and are valid at 0000, 0600, 1200, and 1800 UTC for the areas of coverage shown in Appendix A. The transmission of each forecast is completed as soon as technically feasible but at least 15 hours before its valid time. The SIGWX forecasts include, as appropriate to flight:

- a. thunderstorms
- b. tropical cyclones
- c. moderate or severe turbulence (in cloud or clear air)
- d. moderate or severe icing
- e. widespread sandstorm/dust storm
- f. above FL250, cumulonimbus cloud associated with a. to f.
- g. tropopause heights
- h. jetstreams
- i. information on volcanic eruption locations producing ash clouds of significance to aircraft operations. This is depicted with a volcanic eruption symbol at the volcano's location, and at the side of the chart, the volcanic eruption symbol, the name of the volcano, latitude/longitude, and a reminder users should check the latest Significant Meteorological Advisories (SIGMET) and Notices to Airmen (NOTAM) or Notices to Airmen for Volcanic Ash (ASHTAM) issued for the area concerned
- j. information on location of an accidental release of radioactive materials into the atmosphere, of significance to aircraft operations, comprising the radioactivity symbol at the accident's site, and at the side of the chart, the radioactivity symbol, latitude/longitude of the site of the accident

2.4 Significant Weather BUFR Files

2.4.1 SIGWX forecasts are issued using BUFR code form follow the specifications included in WMO Publication No. 306, Manual on Codes, Volume I.2, Part B – Binary Codes. Forecasts of SIGWX prepared by WAFS Washington are issued four times daily, valid at 0000, 0600, 1200, and 1800 UTC. The transmission of each forecast

will be completed by 0700, 1300, 1900 and 0100 UTC, respectively. Forecasts of SIGWX include all the items listed in paragraph 2.3.1 above, and include global information between FL250 and FL630 (SWH), and limited geographical areas listed in the applicable regional ICAO Air Navigation Plan between FL100 and FL250 (SWM).

2.4.2 BUFR is a standard binary format approved by the WMO for efficient storage of meteorological features. To produce a BUFR file, two elements are needed: a raw data file and a set of tables containing descriptors. When raw data is encoded, each data value is attached to a descriptor defining what the data represents. The decoding process reads the BUFR file, looks up the descriptor in the relevant table, and writes out the information in the proper format. Binary BUFR files contain a set of tables with descriptors. Descriptors must be decoded from a set of common tables on the local machine in order to understand what the values represent. To this end, BUFR messages are very small and machine independent. They can be understood and decoded by any BUFR decoder having the latest tables available.

2.4.3 SIGWX data in BUFR format is independent of the background or projection. Only the information describing the feature is encoded. For example, a CLOUD area is a list of points with the height of bases and tops, and cloud type and amount attributes attached. There are no rules on how the cloud area should be drawn, or how the attributes are displayed. On SIGWX charts this is shown as a box, sometimes with an arrow to the area, but this information is determined by the graphical display program.

2.4.4 BUFR does not provide information on how to visually represent data. However, ICAO Annex 3 includes guidance on how meteorological features should be depicted on charts. SIGWX BUFR messages prepared by AWC use the following WMO headers:

Elements in BUFR Message

SWH Jetstreams
 SWH Clear Air Turbulence
 SWH Cumulonimbus
 SWH Tropopause height
 SWH Surface Fronts
 SWH/SWM Tropical Storms, Sandstorms and Volcanoes
 SWM Tropopause height
 SWM Jetstreams
 SWM Surface Fronts
 SWM cloud, in-cloud icing and turbulence
 SWM Clear Air Turbulence

WMO HEADER

JUWE96 KKCI
 JUCE00 KKCI
 JUBE99 KKCI
 JUTE97 KKCI
 JUFE00 KKCI
 JUVE00 KKCI
 JUOE00 KKCI
 JUTE00 KKCI
 JUJE00 KKCI
 JUNE00 KKCI
 JUME00 KKCI

Note. — Amendment 74 to ICAO Annex 3 removed requirement for surface fronts and convergence zones on WAFS SIGWX forecasts. To minimise downstream impacts for users by withdrawing the related BUFR bulletins, the two WAFCs have continued to transmit SWH frontal system bulletins (JUFE00 EGRR/KKCI), but they are empty (i.e. contain no data).

2.5 Operational Meteorological (OPMET) Information in Character-Oriented Format.

2.5.1 OPMET information includes Routine Aviation Weather Reports (METAR), Special Routine Aviation Weather Reports (SPECI), Terminal Aerodrome Forecasts (TAF), Significant Meteorological Information (SIGMET) and special Air-reports (AIREPs). Volcanic Ash Advisory (VAA) and Tropical Cyclone Advisory (TCA) messages will also be included on the broadcast.

2.6 Backup

In case of interruption of WAFC operations, its functions will be carried out by the London WAFC. Approved ISCS users can also access WIFS as either the primary or back-up (to the ISCS satellite broadcast) means for users to obtain WAFS products from the Washington WAFC. See Appendix C for details.

2.7 Annexes to the User Guide

2.7.1 OPMET, forecasts and data products that are available to users under the footprint of the ISCS can be found in Annexes 1 through 4.

Annex 1 can be accessed at:

<http://www2.icao.int/en/anb/met-aim/met/sadisopsg/SADIS%20User%20Guide/SADIS%20User%20Guide%20-%20Fourth%20Edition/Annex%201.pdf>

Annex 2 and 3 can be accessed at:

<http://www.weather.gov/iscs/documents.htm>

Annex 4 can be accessed at:

<http://www2.icao.int/en/anb/met-aim/met/sadisopsg/SADIS%20User%20Guide/SADIS%20User%20Guide%20-%20Fourth%20Edition/Annex%204.pdf>

Annex 1 identifies all the AOP and non-AOP aerodromes that are recognized by ICAO and guides the OPMET data available on the ISCS data-stream. However a listing in Annex 1 does not necessarily mean that the OPMET data is on the ISCS broadcast. Of about 450 locations, 40 or so sites do not report a TAF or an Observation, especially for those aerodromes identified as being non-AOP. Annexes 2 and 3 are provided to identify the aerodromes that are provided on the ISCS broadcast. Annex 2 lists the aerodromes in terms of location indicators and States, while Annex 3 lists the aerodromes in terms of bulletin numbers and location indicators of aerodromes contained in each bulletin. Annex 4 lists all the forecast products that are provided via the ISCS broadcast.

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Chapter 3

Recommended Basic Requirements for Data Processing Systems

3.1 General requirements

3.1.1 To receive WAFS data products via ISCS, the ISCS service provider (Verizon Business) recommends users obtain a Prodelin Series 1251 satellite antenna (part # 1251485L), a low noise block-downconverter (or LNB), and a Comtech satellite modem (part # CDM-570/L-IP). Users are then free to choose their own processing and display systems to connect to the VSAT according to their own individual requirements. However, per para. 1.2.3, the user requires a processing and display system with Hughes Network Systems Program Director (PD) Receiver software to enable reception of the IP multicast data stream. See paragraph 4.4 for contact information at Verizon Business for obtaining user equipment and PD Receiver software.

3.1.2 Users should investigate whether or not their own message switch and/or computer system is ISCS compatible. Users are also advised to check that any display system which they may consider purchasing is capable of generating products which comply with the formats and specifications laid down in Annex 3, including the generation of products from GRIB- and BUFR coded bulletins. It is recommended that users consult with a number of different suppliers prior to being committed to expenditure.

3.1.3 Users should check specific system configurations with individual suppliers.

3.1.4 A set of recommended basic requirements for VSAT data processing systems is given in Appendix E.

3.1.5 Data processing systems for processing these data must ensure the integrity of the information and be compatible with the ISCS delivery of data. This data will be presented to the end system as TCP/IP. For flight safety reasons it is essential that any data outside of their validity period are not retained on the system and displayed for operational use. However, the system should ensure that data received via ISCS are stored and displayed for a user on request during their validity period, or until they are amended by a subsequent updated version.

3.1.6 The data stored on the system should be made available to a user by visual reference on a screen display, and printed for permanent reference, e.g. as flight documentation. All products either displayed or printed should include a clear reference to the date and time of access and the validity times of the data. Systems should be programmed to avoid data from a previous day being incorrectly used. It should be noted that there is an obligation for States to retain flight documentation for at least 30 days, in case of an inquiry (Annex 3, 9.4.6). This storage requirement should be considered by users when making their choice of end-user system.

3.1.7 A number of the display packages enable users to manipulate the information presented to the workstation in BUFR format. This may be a useful feature for users who wish to use their workstation for the production of national products. However it is important that users appreciate that any modification to the meteorological content of information transmitted via ISCS invalidates that information as being a WAFS product. In such a case the product becomes a national product. It is imperative that such a change is clearly reflected in the legend that would be assigned to the product.

3.2 Sources of information regarding potential suppliers of equipment to process/display products and data broadcast on ISCS

3.2.1 A list in alphabetical order of potential suppliers is available on request from:

<http://www.metoffice.com/sadis/about/manufacturers.html>

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Chapter 4

User Support

Current contact information is available at <http://www.weather.gov/iscs/>

4.1 Technical support by WAFC Washington

End users of ISCS equipment may obtain technical support directly from WAFC Washington. The staff will assist in any way possible to resolve problems experienced by users if the fault lies within ISCS. They may of course find that the fault lies within the user's own receiving equipment downstream of the VSAT.

4.2 24-hour helpline/faults desk

ISCS/NWS 24-hour Network Operations Technical Control Center

Tel.: + 00 (1) 301-713-0902
Fax: + 00 (1) 301-587-1773
E-mail: toc.nwstg@noaa.gov

Problems with End User DCE Equipment (VSAT, LNB, or Satellite modem):

A trouble shooting guide is available at:
http://www.weather.gov/iscs/pdf/ISCS_RCV_ONLY_Manual_v5_1.pdf

4.3 General contact facilities during routine office hours US East Coast Time

Address:

US Dept of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
1325 East West Highway
Silver Spring, MD 20910

ISCS Program Leader

Patrick Gillis NWS/ISCS +00(1) 301-713-1743 x 104 patrick.gillis@noaa.gov

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Michael Graf +00(1) 301-713-1726 x 117 michael.graf@noaa.gov

4.4 Assistance in Purchasing ISCS compatible VSAT equipment

4.4.1 Eric Christiansen

Verizon Business Account Manager

Email) Eric.Christiansen@verizonbusiness.com

Tel) 703-343-6045

4.5 How To Register Your Site

In order for your site to be aware of and be considered for any possible changes to ISCS, please send the contact information for your site to the ISCS Program Manager (see Chapter 4). The contact information should include the following:

1. Primary and Secondary Point of Contact for your site
2. E-mail address, Telephone and FAX numbers of point of contact
3. E-mail address, Telephone and FAX numbers for Operations Center of your site
4. Days and Hours of operation for your site
5. Postal and street address for your site
6. Your INTERNET web page address should your site/organization have one

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Chapter 5

Glossary

Abbreviations terms and acronyms

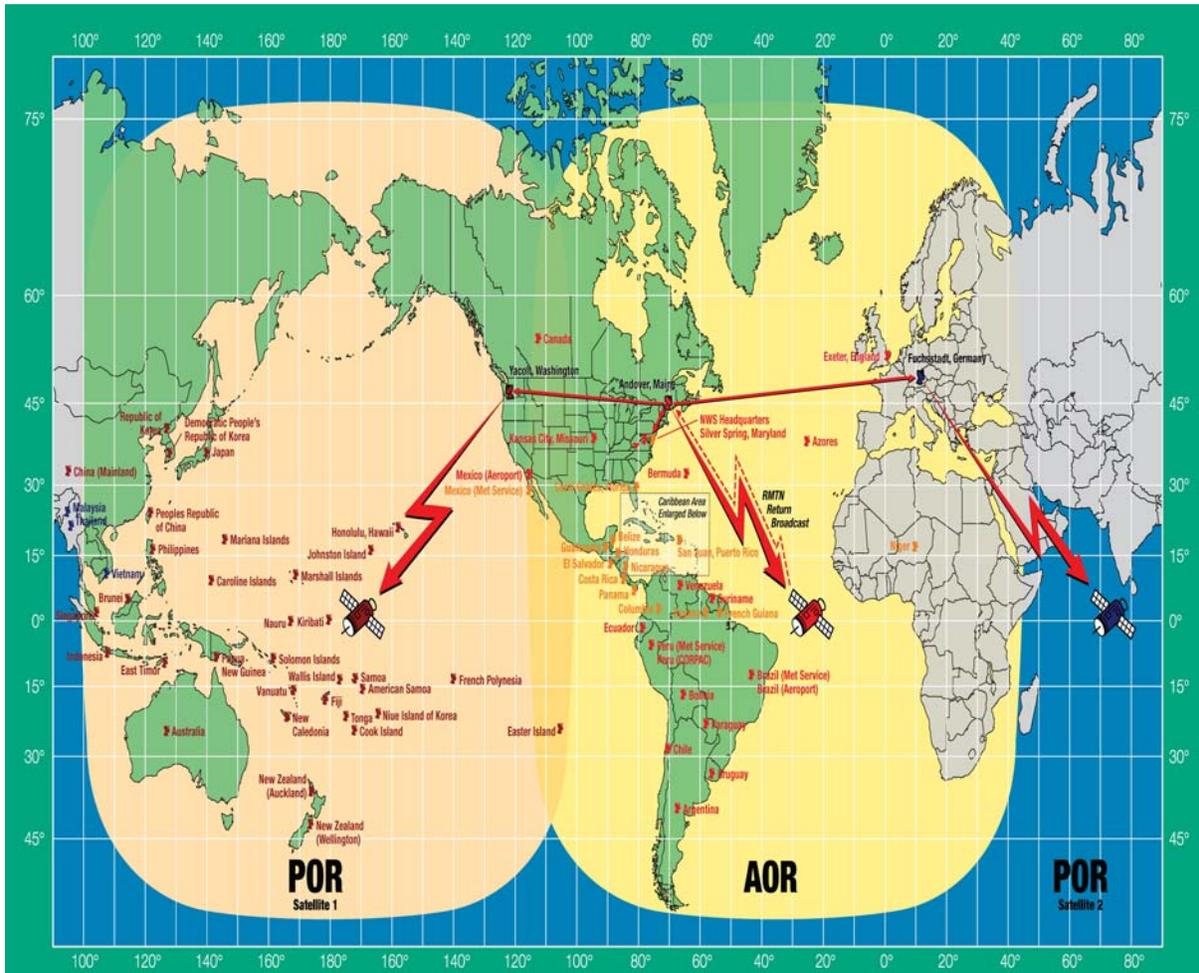
AFI	Africa-Indian Ocean (ICAO region)	OPMET	Operational meteorological (information) (ICAO region)
AFS	Aeronautical fixed service	PAC Pacific	Pacific Ocean Region
AFTN	Aeronautical fixed telecommunication network	POR	Portable Network Graphics
AIREP	Air-report	PNG	Radiation hazard
AMBEX	AFI MET Bulletin Exchange (scheme)	RADHAZ	Regional air navigation (meeting, agreement)
ANP	Air navigation plan	RAN	Regional OPMET Bulletin Exchange
AOR	Atlantic Ocean Region	ROBEX	SADIS Operations Group
APANPIRG	ASIA/PAC Air Navigation Planning and Implementation Regional Group	SADIS	South American (ICAO region)
APIRG	AFI Planning and Implementation Regional Planning Group	SADISOPSG	SADIS Cost Allocation and Recovery Administrative Group
ASECNA	Agency for the Safety of Aerial Navigation in Africa and Madagascar	SAM	Information concerning en-route weather phenomena which may affect the safety of aircraft operations
BER	Bit error rate	SCRAG	Significant weather (charts, forecasts)
BMG	Bulleting Management Group	SIGMET	Aviation selected special weather report
BUFR	Binary universal form for the representation of meteorological data	SIGWX	High Level SIGWX Charts
CAeM	Commission for Aeronautical Meteorology (WMO)	SPECI	Mid Level SIGWX Charts
CAR	Caribbean and Central America (ICAO region)	SWH	Aerodrome forecast
C-band	5-6 GHz	SWM	United Kingdom
COM	Communications	TAF	Coordinated Universal Time
DCE	Data circuit-terminating equipment	UK	Very small aperture terminal
DRO	Data receive only	UTC	World Area Forecast Centre (London and Washington)
DT	Daily Time	VSAT	World area forecast system
EANPG	European Air Navigation Planning Group	WAFS	World Meteorological Organization
EUR	European (ICAO region)	WMO	World Weather Watch (WMO)
FBU	Flight briefing unit	WWW	
FIR	Flight information region		
FL	Flight level		
GOS	Global observing system (WMO)		
GRIB	Gridded binary code (WMO)		
GTS	Global Telecommunication System (WMO)		
hPa	Hectopascals		
IATA	International Air Transport Association		
ICAO	International Civil Aviation Organization		
INTELSAT	International Telecommunications Satellite Organization		
IP	Internet Protocol		
ISCS	International Satellite Communication System		
ITA	International Telegraph Alphabet		
Kb	Kilobit		
Ku-band	14/12 GHz		
LDC	Least developed countries		
LNB	Low noise block		
Mb	Megabit		
METAR	Aviation routine weather report		
MHz	Megahertz		
MID	Middle East Regional Office, Cairo (ICAO)		
MIDANPIRG	Middle East Air Navigation Planning and Implementation Regional Group		
NAM	North American (ICAO region)		
NAT	North Atlantic (ICAO region)		
NATS	National Air Traffic Services		

Reference Documents

Air Navigation Plan — *Africa-Indian Ocean Region* (Doc 7474)
Air Navigation Plan — *Asia and Pacific Regions* (Doc 9673)
Air Navigation Plan — *Caribbean and South American Regions* (Doc 8733)
Air Navigation Plan — *European Region* (Doc 7754)
Air Navigation Plan — *Middle East Region* (Doc 9708)
Air Navigation Plan — *North Atlantic, North American and Pacific Regions* (Doc 8755)
Air Navigation Plan — *North Atlantic Region* (Doc 9634)
AFI MET Bulletin Exchange (AMBEX) Handbook (available from the ICAO WACAF and ESAF Offices)
Regional OPMET Bulletin Exchange (ROBEX) Handbook (available from the ICAO APAC Office)
Catalogue of OPMET Data in European MET Data Banks (available from the ICAO EURNAT Office)

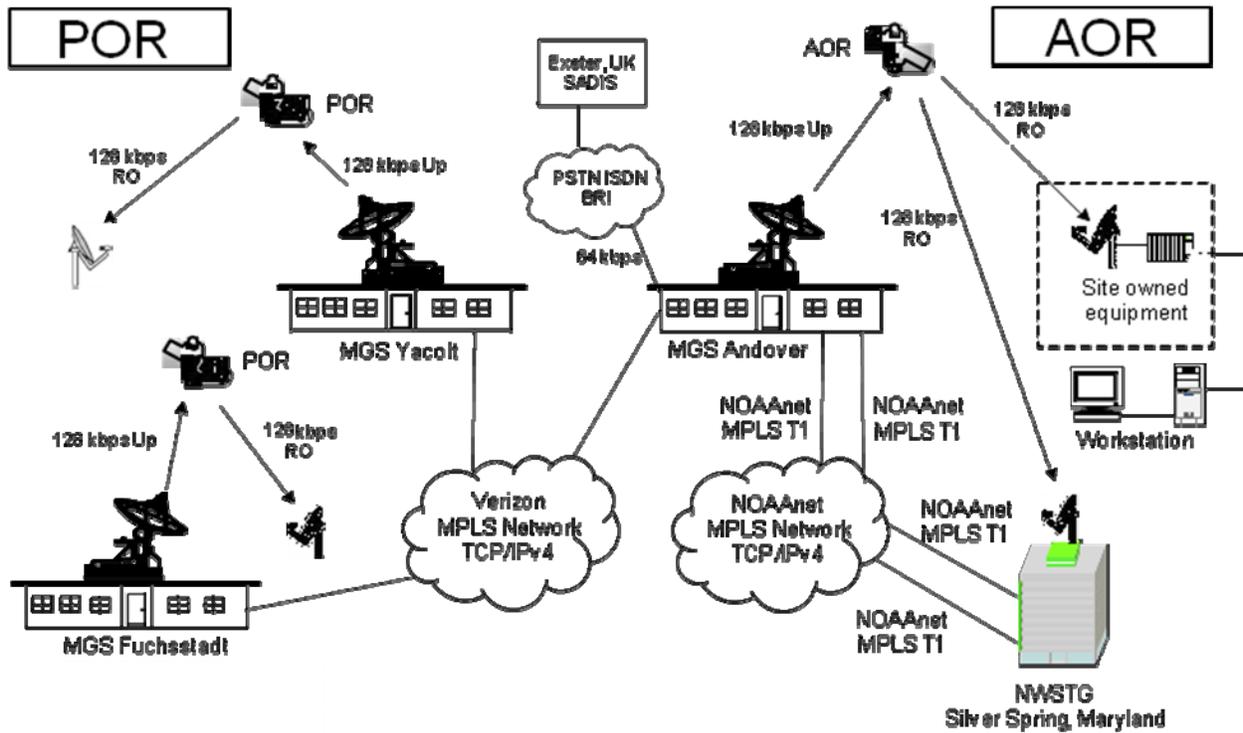
Appendix A

ISCS Footprint



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International Satellite Communications System (ISCS-G2e)



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Appendix C

WIFS Access

The World Area Forecast System (WAFS) Internet File Server (WIFS) is provided by the Washington World Area Forecast Center (WAFC). In addition to the ISCS satellite service, approved ISCS users can access all WAFS data over the public Internet via WIFS. WIFS will replace the ISCS satellite broadcast as the primary means for users to obtain WAFS data products from the Washington WAFC effective 1 July 2012. WIFS is currently operationally available for use as either the primary or back-up (to the ISCS satellite broadcast) means for users to obtain WAFS products from the Washington WAFC. WIFS is also available as back-up to both SADIS FTP and SADIS 2G users. WIFS does not provide a “push” facility; users will have to collect “pull” data by initiating an HTTPS session over the internet. WIFS is available 24x7.

WIFS is in compliance with both ICAO Document 9855 (guidelines on the Use of the Public Internet for Aeronautical Applications) and the FAA’s Advisory Circular 00-62 (defines requirements to become a Qualified Internet Communications Provider (QICP)). Additionally, WIFS supports the dissemination of WAFS and related products via the internet in accordance with ICAO Annex 10.

Information on registering as a WIFS user and accessing the system can be obtained from the WIFS Users Guide.

This document is available via the internet at <https://aviationweather.gov/wifs/page/open/id/5>. In addition to information on accessing WIFS, the Users Guide also includes, but is not limited to details related to; Products and Data Available on WIFS, WIFS Data Retrieval Process, WIFS Directory Structures and File Formats, WIFS Support Web Site, WIFS Customer Support, and WIFS User Troubleshooting Guidelines.

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Appendix D

Guidelines for Authorized Access to the World Area Forecast System (WAFS) Satellite Broadcast

Note — Noted by the ICAO Council on 5 July 1995 (145/24)

1. General

1.1 The satellite broadcast constitutes a sub-system of the ICAO aeronautical fixed service (AFS) providing an international point-to-multipoint telecommunication service via satellite for the dissemination of aeronautical information to ICAO Contracting States.

1.2 The aeronautical information disseminated by the satellite broadcast includes primarily operational meteorological (OPMET) information consisting of the WAFS upper wind and temperature and significant weather forecasts in binary and facsimile formats, and alphanumeric messages.

1.3 Through the use of the satellite broadcast, Contracting States may wish to meet their obligation under Article 28 of the Convention on International Civil Aviation regarding the supply to users of meteorological information for the provision of meteorological service for international air navigation.

2. Authorized access to the satellite broadcast

2.1 It is the prerogative of each Contracting State to determine the distribution of the OPMET information to users, in the State concerned, as well as means, links and information flow to be used for this purpose. In view of this, it is for each Contracting State to determine the users in the State concerned to be provided with the authorized access to the satellite broadcast.

2.2 Where the meteorological service for international air navigation is provided by or through arrangements made by the Meteorological Authority in compliance with the standard contained in 2.1.4 of Annex 3 - *Meteorological Service for International Air Navigation* to the Convention on International Civil Aviation, the Meteorological Authorities, World Area Forecast Centers, Regional Area Forecast Centers and aerodrome and other meteorological offices should fully enjoy the benefits of the satellite broadcast to receive the OPMET information broadcast. Furthermore, it is at the discretion of each Contracting State to determine, on advice from its Meteorological Authority, whether any of the following users will be provided with authorized access to the satellite broadcast: operators; air traffic services units; search and rescue services units; aeronautical information services units; volcanic ash and tropical cyclone advisory centers; and other aeronautical users.

2.3 Each Contracting State will notify ICAO and also the ISCS Program Manager (see Chapter 4) regarding the users in that State it has authorized to access the satellite broadcast.

Appendix E

Data Processing Systems

1. Recommended basic requirements for data processing systems

The system should :

- a. interface with IP protocols (UDP multicast and FTP);
- b. have ample capacity to receive the data required by the user (facsimile charts, GRIB coded data, alphanumeric information);
- c. have sufficient speed to display and process data in near real time;
- d. NOT be capable of displaying or printing time expired data or charts;
- e. be user friendly for documentation in an ATC/FBU environment;
- f. be PASSWORD protected for ATC/FBU;
- g. ensure that products are displayed in ICAO Annex 3 compliant formats; and
- h. ensure that if any modifications to the meteorological content of transmitted information takes place it is with the clear understanding that the product ceases to be a WAFS product, and this is automatically reflected in any associated chart legends.

2. Specific requirements for digital grid point (GRIB1 and GRIB2) data and digitally coded SIGWX data

The system should:

- a. display wind and temperature information generated from the GRIB1 and GRIB2 data, and SIGWX information from the BUFR data on a map background in the appropriate ICAO Annex 3 format;
- b. select the map area for a selected route;
- c. be able to zoom in on a selected area;
- d. display all the grid point data along a route;
- e. print the screen display;
- f. display valid data with the correct date and time group at all times;
- g. sure that the standard ICAO areas are available on the system as map area defaults;
- h. able to produce wind and temperature charts from GRIB1 and GRIB2 data, and SIGWX charts from BUFR that are largely identical to the equivalent T4/BUFR products;
- i. be able to produce charts that span the international date line, and cover all of the standard ICAO areas; and
- j. have the capability to automatically generate ICAO Annex 3 compliant charts from the GRIB1, GRIB2 and BUFR code forms.

3. Specific requirements for PNG facsimile charts and BUFR charts

The system should:

- a. display WAFS upper-air and SIGWX chart;
- b. display charts with the correct orientation and map projection;
- c. be able to zoom into part of a chart if required with a valid date and time displayed at all times; and
- d. print whole charts on A4 paper.

4. Specific requirements for OPMET information in alphanumeric format

The system should:

- a. display all OPMET information in alphanumeric format (METARs - SA, TAFs -, FT and SIGMETs - WS, WV, WC and special AIREPs – UA, tropical cyclone and volcanic ash advisories — FK, FV, and GAMETs – Fas and AIRMETs - WAs).
- b. display only valid OPMET information by FIR, bulletin, country or route;
- c. include an option to select all data;
- d. be able to build a user's own route list which can be saved for future use;
- e. display SIGMETs at all times and in particular when linked by requests for TAF and METAR information by FIR, country or selected route; and

- f. print out OPMET information.

5. General information and advice when implementing a data processing system

- a. establish how the hardware will be supported in your country;
- b. determine hardware reliability and the mean time between failures and what parts are likely to fail;
- c. determine if the supplier holds spares and how many other systems have been sold in your country;
- d. identify the cost of spares and turn-round time in getting new spares;
- e. does the hardware carry sufficient extended warranty. Is it worth the extra cost?
- f. does the supplier provide a 'hot-line' for customer support, what is its availability, is it in your own language?
- g. identify the cost of additional copies of the application software and operating software;
- h. prepare information on the required layout of where the VSAT and the data processor are to be installed;
- i. determine whether or not remote systems are required and the cost of terrestrial circuits;
- j. identify, as much as possible, the volume of data and the type of products that are required to be processed - through WAFC Washington - and ensure that your system will be able to cope and meet future requirements cheaply and effectively;
- k. identify the cost of software upgrades and enhancements that will be required when the WAFS product suite changes; and
- l. review the ICAO hardware and software procurement guidelines available from the SADIS website at www.metoffice.gov.uk/sadis/news/software_procure_guide.html.

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List of Annexes

Annex	Title of Annex
Annex 1	OPMET information required from aerodromes to be included on the ISCS broadcast
Annex 2	OPMET information on the ISCS broadcast - listed in terms of aerodromes /location indicators and States
Annex 3	OPMET information on the ISCS broadcast - listed in terms of bulletin numbers and location indicators of aerodromes contained in each bulletin
Annex 4	WAFS forecasts disseminated on ISCS

Annex 1

OPMET information of AOP and non-AOP aerodromes

Listing of aerodromes can be accessed at

<http://www2.icao.int/en/anb/met-aim/met/sadisopsg/SADIS%20User%20Guide/SADIS%20User%20Guide%20-%20Fourth%20Edition/Annex%201.pdf>

Annex 2

OPMET information on the ISCS broadcast - listed in terms of aerodromes /location indicators and States can be accessed at

<http://www.weather.gov/iscs/documents.htm>

Annex 3

OPMET information on the ISCS broadcast - listed in terms of bulletin numbers and location indicators of aerodromes contained in each bulletin can be accessed at

<http://www.weather.gov/iscs/documents.htm>

Annex 4

WAFS forecasts disseminated can be accessed at

<http://www2.icao.int/en/anb/met-aim/met/sadisopsg/SADIS%20User%20Guide/SADIS%20User%20Guide%20-%20Fourth%20Edition/Annex%204.pdf>

Annex 1 can be accessed at:

<http://www2.icao.int/en/anb/met-aim/met/sadisopsg/SADIS%20User%20Guide/SADIS%20User%20Guide%20-%20Fourth%20Edition/Annex%201.pdf>

Annex 2 and 3 can be accessed at:

<http://www.weather.gov/iscs/documents.htm>

Annex 4 can be accessed at:

<http://www2.icao.int/en/anb/met-aim/met/sadisopsg/SADIS%20User%20Guide/SADIS%20User%20Guide%20-%20Fourth%20Edition/Annex%204.pdf>

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