WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

OPAG ON INFORMATION SYSTEMS AND SERVICES

AD HOC INTERNATIONAL FORUM OF USERS OF SATELLITE DATA TELECOMMUNICATIONS SYSTEMS (SATCOM FORUM)

Paris, France, 3-4 October 2013

FINAL REPORT

DISCLAIMER

Regulation 42

Recommendations of working groups shall have no status within the Organization until they have been approved by the responsible constituent body. In the case of joint working groups the recommendations must be concurred with by the presidents of the constituent bodies concerned before being submitted to the designated constituent body.

Regulation 43

In the case of a recommendation made by a working group between sessions of the responsible constituent body, either in a session of a working group or by correspondence, the president of the body may, as an exceptional measure, approve the recommendation on behalf of the constituent body when the matter is, in his opinion, urgent, and does not appear to imply new obligations for Members. He may then submit this recommendation for adoption by the Executive Council or to the President of the Organization for action in accordance with Regulation 9(5).

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(group picture)

EXECUTIVE SUMMARY

The *ad hoc* international Forum of users of satellite data telecommunication systems (Satcom Forum) was held at the headquarters of the Intergovernmental Oceanographic Commission (IOC) of UNESCO in Paris, France, from 3 to 4 October 2013, and was chaired by Mr David Meldrum (United Kingdom). 33 participants from 12 countries, and representatives of the satellite data telecommunication service providers, and the satellite equipment manufacturers also attended the meeting.

The objective was to build on the previous session (Toulouse, April 2012) to determine whether the Forum should become an established expert group, meeting on a regular basis. The future Forum is meant to provide an international mechanism, covering the wide user base that exists within the co-sponsoring Organizations, to address remote data communication requirements – including tariff negotiations as needed – for automatic environment observing systems using satellite data telecommunication systems (Satcom systems).

The meeting reviewed the World Meteorological Organization (WMO) and IOC user requirements for the collection of meteorological data from remote areas (including buoys, ship-based observing systems, seal level observing stations, Automatic Weather Stations, Polar Observations, profiling floats, and animal tracking). It reviewed the capabilities and the tariff schemes of the satellite data telecommunication systems that are mostly being used for the collection of environmental data from remote areas, and discussed the role that they could play in the future Forum. The meeting noted that the future Forum is meant to provide guidance to the WMO and IOC users on the use of Satcom systems, including guiding them on how to make the best arrangements for the purchase of airtime. The Forum will provide detailed information on satellite systems capabilities so that users will be able to make informed decisions on which system to use.

Regarding tariff negotiation issues, the meeting agreed that the current Argos Joint Tariff Agreement (JTA) should eventually operate as an independent programme of the future Forum.

The meeting established an interim Executive Committee for the Satcom Forum to drive the workplan, which should lead to the formal establishment of the Forum by the sponsoring Organizations. The meeting reviewed the draft Terms of Reference of the Satcom Forum, proposed some changes to reflect the proposed reporting of the future Forum to the Executive Bodies of WMO and IOC through the Commission for Basic Systems (CBS) Management Group, and the GOOS Steering Committee respectively.

The participants at the meeting were invited to review the draft Terms of Reference and operating principles of the Satcom Forum, by 31 October 2013

The meeting requested the interim Executive Committee, on the basis of this meeting's discussions, to update the workplan leading to the formal establishment of the Forum by the co-sponsoring Organizations by 31 October 2013.

The meeting issued ten recommendations listed in ***Annex X***.

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GENERAL SUMMARY

1. ORGANIZATION OF THE SESSION

1.1 Opening of the Forum

1.1.1 The Chairperson of the Organizing Committee, Mr David Meldrum (UK) opened the *ad hoc* International Forum of Users of Satellite Data Telecommunication Systems (Satcom1) at 0900 hours on Thursday, 3 October 2013, at the UNESCO Headquarters, Miollis Annex Salle 13 in Paris, France. He welcomed the participants to this event, and thanked the Intergovernmental Oceanographic Commission (IOC) of UNESCO for hosting it.

1.2 Dr Mitrasen Bhikajee, Deputy Executive Secretary of the IOC of UNESCO, welcomed the participants to UNESCO and Paris, on behalf of IOC Executive Secretary, Dr Wendy Watson-Wright. He recalled that for oceanography, the arena of satellite communications for environmental sciences must be one of the most transformative developments of the past several decades. Through satellite communications a fleet of autonomous measurement devices now spanned the globe taking measurements in oceans hundreds of miles from the nearest human and during even the worst ocean weather. The world now relied on Argo profilers and the Drifting Buoys to provide essential information for weather and ocean monitoring. Without the satellite technology, none of what we relied upon for our global ocean observation systems would be possible today. And now this technology had expanded into the biological sciences through animal tagging and tracking.

1.3 Dr Bhikajee recalled that the world of satellite communications was obviously a very complex mixture of technology, commerce, research and international agreements. The collaborations between governments, industry and research institutes which had made global satellite communication possible had for years been facilitated and encouraged by international organizations, such as the UN. The IOC was pleased that it might play a small roll in this initiative to build a stronger collaboration where the collective interests of the Satellite Data Telecommunication (Satcom) users and providers could be represented. By sharing knowledge and ideas it was expected that the informed discussions of the Satcom Forum would build a stronger informed user base which would be served by a more responsive and dedicated industry.

1.4 He further explained that as a global intergovernmental organization with a mandate in ocean science, observations and capacity building, the IOC participation in this Forum was beneficial to the IOC member states who use satellite data telecommunication services. Dr Bhikajee therefore expressed the IOC support to this process.

1.5 The WMO Secretariat representative also welcomed participants to the meeting on behalf of Mr Michel Jarraud, Secretary-General of the World Meteorological Organization (WMO). He warmly thanked the IOC of UNESCO for hosting the event.

1.6 He recalled that WMO applications provided the means to prevent, mitigate, and adapt to the impacts of weather, climate, and water on the environment and human activities. These applications included for example climate, weather and water monitoring, prediction and warnings, natural disasters risk reduction, support of disaster-relief operations and for planning preventive measures for adapting to and mitigating the negative effects of climate change. A wide range of surface-based and space-based observing systems provided information about the Earth's atmosphere and surface, all of which was used for these applications. He also stressed that climate applications, and the Global Framework for Climate Services (GFCS) that was now developing, were increasing the demand for high quality, documented, and traceable observations of known uncertainty, including historical data.

1.7 Through the implementation of the WMO Integrated Global Observing System (WIGOS), and in collaboration with partner Organizations such as the IOC, the WMO was making efforts to establish an integrated, comprehensive and coordinated observing system that satisfied in a cost-effective and sustained manner the evolving observing requirements of WMO Members. The Members of WMO and

partner Organizations such as the IOC were contributing to WIGOS implementation by providing a substantial part of the observations required by the WMO applications.

1.8 The meeting noted that surface-based observing systems were routinely deployed, operated, and maintained, and enhancements are promoted, for filling gaps in data sparse regions. Whenever real-time telecommunication was required, and when ground-based telecommunication systems such as mobile telephone systems were not available – for example in remote areas – observing stations often relied on satellite data telecommunication for the collection of the observations they made. In 2011, in the framework of the implementation of WIGOS, the WMO Sixteenth Congress supported the establishment of a Forum of users of satellite data telecommunication systems covering a wide user basis, and to address remote data communication requirements - including tariff negotiations as needed - for automatic environment observing systems coordinated through WMO and partner organizations such as IOC.

1.9 The WMO Secretariat representative concluded by assuring the commitment of WMO to support and strengthen this activity through its Commission for Basic Systems (CBS).

1.10 The list of participants at the meeting is provided in ***Annex II***.

1.2 Adoption of the agenda

1.2.1 The meeting adopted its agenda, as reproduced in ***Annex I***.

1.3 Working arrangements

1.3.1 The local organizer for the session outlined various local arrangements. The session agreed its hours of work and other logistical arrangements. The Secretariat introduced the session documentation.

2. BACKGROUND INFORMATION AND RATIONALE FOR THE FORUM

2.1 Mr Etienne Charpentier (WMO) provided background information, and explained the rationale leading to the decision of the WMO Sixteenth Congress (Cg-XVI, Geneva, Switzerland, 16 May – 3 June 2011) to initiate the establishment of the Forum covering a wide user base, and to address remote data communication requirements - including tariff negotiations as needed - for automatic environment observing systems coordinated through WMO and partner organizations such as IOC.

2.2 The Satcom Forum is meant to be an entirely self-funded body jointly sponsored by the WMO and the IOC of UNESCO in the view to address the requirements of these two Organizations for the timely collection of environment data from observing platforms.

2.3 The main goals are (i) to ensure proper coordination amongst the users of satellite data telecommunication systems and to represent their collective interests in working with the satellite telecommunication service providers in order to advance the awareness and understanding of user requirements; (ii) to advance the awareness and understanding of available and planned capabilities; (iii) to facilitate adoption of interoperability and quality standards and principles; and (iv) to provide guidance to best meet user needs of each considered application. The Forum is expected to allow the reduction of satellite data telecommunication costs for the transmission of observations from observational platforms to data processing centres on land, and to better address user requirements for high temporal and vertical resolution data, and improved timelines.

2.4 The preparatory workshop for the establishment of an International Forum of Users of Satellite Data Telecommunication Systems (Satcom Forum) (Toulouse, France, 23-27 April 2012) recommended organizing an ad hoc Satcom Forum in 2013 to prove concept, and established an organizing committee.

2.5. Participation at this *ad hoc* Satcom Forum is open to all representatives of the WMO and IOC communities. Representatives from the main Satcom service providers were also invited to deliver relevant information to the Satcom users.

2.6 This *ad hoc* Satcom Forum shall in particular review available technologies, share experiences, and address the user requirements in the view to document capabilities, and identify strengths and weaknesses of the different satellite data telecommunication systems to address the requirements of specific uses related to the collection of observations from remote observing platforms. The meeting will also review the operating principles and Terms of Reference of the future Forum. These will then be submitted to the WMO and IOC through the CBS and then the WMO Executive Council, and through the GOOS Steering Committee (GSC) for approval respectively.

3. REVIEW OF THE OUTCOME OF THE PREPARATORY WORKSHOP, TOULOUSE, APRIL 2012

3.1 Mr Meldrum reported on the outcome of the preparatory workshop for the establishment of an international Forum of users of satellite data telecommunication systems (Satcom Forum), which was held in Toulouse, France, from 23 to 27 April 2012.

3.2 The workshop had reviewed the WMO and IOC user requirements for the collection of environmental data from remote areas, as well as various satellite data telecommunication systems that are currently being used for the collection of such data. It was noted the following outcome of the workshop:

- The future Forum is meant to provide guidance to the WMO and IOC users on the use of Satcom systems, including guiding them on how to make the best arrangements for the purchase of airtime.
- The Forum will provide detailed information on satellite systems capabilities so that users will be able to make informed decisions on what system to use.
- The workshop agreed that discussions will have to take place regarding the need for a centralized system (One-Stop Shop) for data processing, quality control, formatting of collected observations in WMO & IOC formats, and distribution to end users (e.g. the Global Telecommunication System – GTS – of the WMO World Weather Watch – WWW). The workshop acknowledged the value of the One-Stop Shop proposal, and agreed that this should eventually be a matter of discussion for the future Forum.
- It was agreed that that the current Argos Joint Tariff Agreement (JTA) should eventually operate as an independent sub-group of the future Forum.
- The draft Terms of Reference of the Satcom Forum, and its operating principles, and workplan were reviewed and updated.
- An organizing committee for this *ad hoc* Satcom Forum was established.

3.3 In reviewing the previous meeting, Mr Meldrum also drew attention to a number of practical issues that he had noted:

- The global environmental Satcoms market was probably only of the order of a few 10s of $M per year and as such was unlikely to be attractive to the major players in the field, whose annual income was several 100 $M. Nonetheless the market was growing year-on-year.
- However, for many autonomous systems the Satcoms energy budget dominated the overall energy budget, meaning that increased use of Satcoms by this platform sector was likely to be energy limited.
- The meeting was polarized along the WMO-IOC axis, meaning that the wildlife sector and other UN agencies and NGOs were effectively not represented.
- For platform operators, access to technical detail and help could be extremely frustrating and irksome, as Satcom system helplines were frequently managed by technically-inexpert sales and marketing personnel.

- This alone justified the Forum as an exchange mechanism for technical help and best practice guidance.
- It remained to be seen whether the Forum could be effective in negotiating a better tariff structure for the environmental community.
- The Forum should aspire to make an effective difference by pooling experience and by being more agile and responsive to emerging user needs and technology developments than the conventional intergovernmental process.

3.4 The meeting agreed on the following:

- The future Forum should help to improve the interest of the service provider community to address the "WMO and IOC market".
- The Quality Control procedures proposed by the Data Buoy Cooperation Panel (DBCP) for Satcom collected data could be seen as a template (see DBCP Technical Document No. 37[1]).
- Many of the practical issues outlined in para 3.3 remained paramount if the Forum were to be effective. Any group or committee that might be formed to progress the Forum concept should address these in order to demonstrate that the Forum could make a positive difference. (***action; interim executive committee; 2015***).

4. REVIEW OF EXISTING SATELLITE DATA TELECOMMUNICATION SYSTEMS, AND EVALUATION MECHANISMS TO BE PROPOSED WITHIN THE FORUM

4.1 Data Collection System (DCS) on Geostationary Meteorological Satellites

4.1.1 Mr Sean Burns (CGMS[2] Secretariat, and EUMETSAT) provided an overview on the current status of Data Collection Services on Meteorological Satellites, focusing on geostationary satellites. The meeting noted that Data Collection Systems (DCS) are operated by the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), the National Oceanic and Atmospheric Administration (NOAA, USA), the Japan Meteorological Agency (JMA, Japan), the China Meteorological Administration (CMA, China), the Indian Space Research Organization (ISRO, India), and Roshydromet (Russia). The first three DCS above are coordinated by the CGMS, and provide global coverage except for the Polar Regions.

4.1.2 Mr Burns provided technical information on DCS capabilities, including frequency bands, data dissemination, Data Collection Platform (DCP) types, data-rate (including High Rate DCP (HRDCP), at 1200bps), as well as on the EUMETSAT, the National Oceanic and Atmospheric Administration (NOAA), and JMA space segments and their evolution. The meeting noted that about 131 operators from 68 countries are currently using the EUMETSAT DCS, with about 1100 allocated regional DCPs, and 650 transmitting DCPs. The introduction of HRDCPs for NOAA and EUMETSAT should allow DCPs to be used for more diverse environmental applications, where more data, more often is a requirement. The addition of forward error correction to the HRDCP specification makes the system more robust against interference.

4.1.3 The meeting noted that DCS is currently being used for (i) collecting meteorological data from remote observing stations, (ii) water management (e.g. measurement of precipitation, river levels, river flow rates and water quality; including alert mode for flood warnings), (iii) tsunami monitoring (i.e. collecting data from tsunameter buoys). Access to the EUMETSAT DCS is free, provided the data is environmental, and it is made available on the GTS.

4.1.4 The CGMS, fully supports the Satcom Forum initiative, which it is hoped will allow Satellite Service providers, equipment manufacturers, current and potential users to coordinate more closely; in particular to lead to greater utilization of Meteorological Satellites.

1 Guide to buoy data quality control tests to perform in real-time by a GTS data processing centre - ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/dbcp/Dbcp37-QC/DBCP37-QC-Guide-v1.pdf

2 Coordination Group for Meteorological Satellites

4.2 Inmarsat

4.2.1 There was no representative of Inmarsat at the meeting. Nevertheless, Mr Meldrum provided an overview of his understanding of the Inmarsat capabilities for the collection of environmental data from remote observing stations.

4.2.1 Overall, Inmarsat, still an intergovernmental organization, and its commercial offshoot ISAT, seemed to be focusing their business model on the provision of near-global (no polar coverage) broadband services. In this respect they were the current market leader and it seemed unlikely that they would have a market motivation to engage with the environmental community.

4.2.2 The marine observation community had for some time exploited the obligation for all shipping above 300 Gross Registered Tonnage (GRT) to carry Inmarsat C (SAT-C[3]) to comply with the Global Maritime Distress and Safety System (GMDSS) provisions in order that that pre-existing channel might be used for the reporting of marine observations in a timely fashion. In particular, the use of the 'Code 41'[4] prefix allowed these observations to be submitted without cost to the submitter, a significant factor in encouraging ship operators to require their personnel to submit observations. Unfortunately the SAT-C service seemed to be scheduled to be withdrawn, with unknown adverse impact on current marine observation activities.

4.2.3 Additionally it was noted that some SAT-C users (notably India, as presented to the meeting) had unexplained issues with data delays, amounting to several minutes, in the use of SAT-C. This was an area of concern, especially for tsunami warning, and was noted by the meeting.

4.2.4 The meeting made a number of recommendations reflected in ***Annex X*** (***recommendation***).

4.3 Iridium

4.3.1 Mr Paul Hill of JouBeh Technologies presented an overview of the Iridium system on behalf of Mr Reece Pitts of Iridium Communications Inc. He provided an update on Iridium's commercial subscriptions (611,000 as of the end of March 2013) and their publically released financial data to describe the positive health of the network. A description of their vertical markets, reseller eco system and applications was also provided and a M2M case study. JouBeh also provided a brief summary of data transceiver evolution.

4.3.2 The meeting noted that some of the Iridium Value Added Resellers (VARs) were processing the collected data in geophysical units, undertaking automatic quality control checks , and encoding of the data in the appropriate code form for GTS distribution purposes (e.g. BUFR[5]-) . From that perspective, the meeting recommended to establish a certification process for companies providing GTS data distribution service on the basis of environmental data collected via satellite (***recommendation***).

4.3.3 The meeting noted that most of any latency associated with Short Burst Data (SBD) is essentially due to downstream Internet services (e.g. e-mail) and is not inherent in the Iridium service *per se*.

4.3.4 The meeting further noted that the Iridium service has not yet been authorized in all countries (e.g. India, China).

4.4 Argos

4.4.1 Mr Bill Woodward, CLS America, provided an overview of the Argos data collection and

3 http://www.inmarsat.com/services/maritime-safety/inmarsat-c
4 See http://www.wmo.int/pages/prog/amp/mmop/inmarsat_les.html for the list of LES accepting Code41
5 Binary Universal Form for the Representation of meteorological data (FM 94)

location system beginning with an historical summary of scientific and operational achievements by the physical science (ocean/meteorology) community and the wildlife monitoring community, all of which had Argos as a common thread through them.

4.4.2 He described the Argos system as a visionary, governmental cooperative Data Collection and Location System dedicated to environmental science that has functioned, and expanded, for more than 35 years under intergovernmental Memoranda of Understanding (CNES[6], NOAA, EUMETSAT, ISRO), and for which the service is operated by the CNES agent, CLS.

4.4.3 Mr Woodward outlined the expectations of Argos with regard to the establishment of the future Forum, by suggesting that the Forum can benefit from the longtime experience of satellite communications service providers like CLS, in particular by building upon their years of close involvement and interaction with the scientific and operational communities. The Forum would be expected to foster best practices in science, as well as promote the sustainability of international centres such as the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) *in situ* Observations Programme Support Centre (JCOMMOPS) and to support the evolution of new initiatives such as the WMO-led Global Framework for Climate Services (GFCS).

4.4.5 The Forum could stimulate the best use of Satcom services, promote the idea of moving from simply competitive airtime procurement to comparable and proven end-to-end user services. The Forum could also strongly endorse the development of standard Service Level Agreements (SLA) commitments to fit with users' requirements and pre-existing practices (operational commitment, performance reporting, quality control, best delivery practices). Lastly, Mr Woodward stressed that it is critical that the activities of the Forum be implemented with a strategy compatible with both governmental and commercial service provider constraints.

4.5 Orbcomm

4.5.1 Ms Mariuxi Chavez, and Mr Tony Hopko provided an overview of Orbcomm, which provides a satellite based M2M network that primarily carries short messages in near real time. Orbcomm was designed for general population communications, mainly phone pager service, so little coverage was established above 45 degrees. Orbcomm specializes in short data packets with relatively low latency and has built this into a sustainable business with over 800k subscribers. The Orbcomm Network, the Subscriber OG1 Network, has been in operation for over 14 years and has over 600,000 users participating in the network. Orbcomm has 17 OG2 satellites in production at the current time and will be launching them with the next generation of services shortly.

4.5.2 The meeting noted that OG2 satellites will host up to three M2M networks. The current OG1 Subscriber network, the new higher capacity OG2 Subscriber network, and the new OG2 Subscriber high margin network that is lower capacity, but allows for smaller terrestrial terminals. The networks each emphasize slightly different features that allow the users to participate in a network that is best suited to them. The OG1 Subscriber network is currently operational. The OG2 networks will come on line following the launch of the OG2 satellites. Since Orbcomm directly controls access to the networks Orbcomm has the capability and flexibility to meet user requirements on a global scale.

4.5.3 The meeting noted that Orbcomm promised continued development and close cooperation with their users, and that they were prepared to be flexible in developing tariff solutions that might be beneficial to the user community, including low volume users who might otherwise be deterred by large monthly fixed charges. Orbcomm reported that its flexibility can go from working with a scheme similar to JTA to a VAR per regions (Africa, Europe, Americas) where the same price would be applied to any member of the Forum. Also, price plans could be elaborated in different scenarios adjusted to the different users.

4.6 Globalstar

6 Centre National D'Etudes Spatiales (France)

There was no representative of Globalstar attending the meeting. However it was noted that the system had significant capability in terms of its satellite infrastructure and its data services to be of continued interest to the Forum, and the meeting asked that Globalstar continue to be invited to any future session of the Forum.

4.7 Other systems

4.7.1 Under this agenda item, Mr D. Meldrum reminded the meeting that many applications might be better served by terrestrial communications systems, such as mobile phone networks using Global System for Mobile Communication (GSM) and General Packet Radio Service (GPRS). In general the energy demands of such systems were small compared to Satcom solutions, and data latency was favourable. However, such networks were not globally available, and could fail under the extreme conditions (e.g. flood, earthquake, storm) that needed imperatively to be assessed in real time. As a result, the meeting recommended that for operational systems (and in particular for disaster risk reduction purposes), any critical GPRS/GSM telemetry solution should be supported by a backup Satcom system, and that Satcom service providers needed to recognize their importance in this regard and not impose punitive fixed charges for a backup service. (**recommendation**).

5. USERS' REQUIREMENTS

5.1 WMO and IOC requirements

5.1.1 Requirements for remote AWS

5.1.1.1 Francesco Sabatini (CNR[7]-IBIMET[8], Firenze - Italy) reported on the use of Satcoms for Automatic Weather Stations on behalf of the CBS Expert Team on Surface-Based Observations (ET-SBO). Details of his presentation are provided in ***Annex IX***.

The meeting agreed that the Forum could/should contribute to:

(i) providing a forum of discussion and resolution of matters of mutual concerns between the participants
(ii) expanding the applications and use (even as a back up telemetry system) of Satellite data transmission
(iii) developing a practical basic format for tender specifications for satellite telemetry hardware/service procurement
(iv) developing a web based repository of satellite systems/providers available over the countries, as well as the type of service profile suggested for a specific application, with an approximate indication of the hardware and the service costs.

5.1.2 Hydrological stations

5.1.2.1 Dr Wolfgang Grabs (WMO) reported on the use of satellite communication in hydrological applications. A number of Satcom applications were presented. He highlighted however that the majority of present-generation hydrological information systems in operations or planned - including in the WMO – WHYCOS program - are biased to use GSM/GPRS communication systems and relatively few hydrological observation networks prefer satellite communication systems. Amongst the reasons why GSM/GPRS systems are currently preferred are:

- Hydrological Services are not familiar with Satcom systems;
- There is a lack of user guidance in the selection of Satcom systems;
- Hydrological services prefer to use nationally-controlled communication systems, rather than

7 Consiglio Nazionale delle Ricerche (Italy)
8 Istituto di Biometeorologia

depending on foreign system operators;
- Operating and installation costs are perceived as (or are actually) high;
- Technical skill requirements for the operation of Satcom systems are perceived as (or are actually) high.

5.1.2.2 The meeting noted that where Satcom is used in hydrological information systems, mostly Geostationary (GEO) satellites are utilized. For many applications including station in high-relief areas, Low Earth Orbit (LEO) based systems are technically preferable.

5.1.2.3 Dr Grabs made the point that most manufacturers of hydrometeorological equipments have solutions to include satellite communication solutions.

5.1.2.4 He stressed the fact that there is an emerging recognition of the need of communication systems on the basis of the “FAIL – SAFE” concept, based on the need to ensure un-interrupted communication especially in the event of severe hydrometeorological conditions such as floods. A typical solution is the use of GSM/GPRS communication as a baseline communication. When GSM/GPRS network breakdown occurs for a number of reasons, automatic switching to a Satcom system is enabled to ensure continued data flow. An example of the application of this concept and solution is the Hindu-Kush Himalaya Regional Flood Information System (HKH-HYCOS) using Iridium as a back-up Satcom solution.

5.1.2.5 Dr Grabs recommended to the meeting to engage in the development and promotion of guiding materials to potential satellite communication users that enable these potential users to obtain an overview of available systems and their suitability under various aspects such as in meeting requirements of hydrological services, technical specifications as well as service delivery characteristics, cost of installation and operation of satellite communication systems and technical skills required to operate such systems.

5.1.2.6 The meeting concurred with this recommendation, and agreed that such guiding materials should be developed, with inclusion of synthetic description of the capabilities of the relevant Satcom systems, using metrics to be agreed upon (***recommendation***). Some useful Satcom criteria and draft metrics are provided in ***Annex VIII***.

5.1.3 Requirements for polar observations

5.1.3.1 Mr Johan Stander (SAWS, South Africa) reported on polar observations requirements on behalf of the WMO Executive Council Working Group on Polar Observations Research and Services (EC-PORS). He explained that the Antarctic provides an exceptional challenge for telecommunications. Observing stations are far from the national telecommunications networks of their operating countries so that alternative methods of collecting information are needed. Unique challenges facing the operators of stations in the Antarctic mean that it is appropriate for the WMO Information System (WIS) documentation to record the method of transmission of Antarctic observations from the observing station to the GTS.

5.1.3.2 The meeting noted that the area of interest of EC-PORS encompasses not only the Arctic and Antarctic, but also the third pole of mountainous regions covered with snow and ice. These are remote areas, with little infrastructure and as such have specific demands for transmission of meteorological observations. Energy is frequently an issue, so transmissions need to be low power and short. Data speed (i.e. bandwidth in kb/s) is not an issue as the information being sent is low volume. However the transmission needs to be reliable, and the data need to be at a forecasting centre within 20 to 30 minutes of the observation being transmitted. In these regions, using geostationary satellites can be a problem because of the satellites' low altitude or screening by terrain.

5.1.3.3 The meeting also noted that WMO Regions are now preparing Regional WIS Implementation Plans, but that at this time no progress has been made to prepare a WIS Implementation Plan for Polar Regions.

5.1.3.4 The meeting noted that the following telecommunications methods are used by the Antarctic Observing Network (AnTON) stations as notified to WMO Secretariat by February 2013:

- E-Mail (1)
- VSAT (3)
- Argos (50)
- HF radio/HF modem (1)
- DCP (2)
- HF Voice (1)
- Satellite circuit (3)
- UHF (1)
- UHF Voice (1)
- HF/TTY-TELEX (1)
- HF-LSB TTY 50 (1)
- HF-SSB (5)
- HF-SSB Voice (1)
- HF-USB Voice (2)
- Inmarsat (7)
- Intelsat (2)
- Iridium (5)
- Unknown (18)

5.1.3.5 Mr Stander also provided the following comments on behalf of EC-PORS:

- Iridium is almost instantaneous as it gets bounced round the satellites: some users get the E-mailed data within a couple of minutes of it being sent.
- ARGOS is slower as it has to be captured at a download station as the capability does not exist to transfer the messages between satellites as it does with Iridium.
- The data being sent are generally very small if using Argos or SBD Iridium data transmissions.

5.1.3.6 Also, EC-PORS has expressed requirements for (i) lower Satcom tariffs, (ii) faster data transfer for forecast models, and (ii) WMO group rate for satellite transmissions.

5.1.3.7 The meeting further noted that both the DBCP and the WCRP-SCAR International Programme for Antarctic Buoys (IPAB) consider the Satcom Forum initiative as very important and wish to contribute. In particular, IPAB has formulated the following requirements for Polar Observations:

- Main issues are continuous coverage of high latitudes (90N - Arctic), with sufficient band width, e.g. increase Iridium SBD size to 1000 bytes.
- Amount of data transmitted and how frequent, real time/delayed mode to be decided.
- More data could be sent e.g. with Rudics system, which should be simplified.
- What are various service provides such as Globalstar plans for Polar Regions?

5.1.3.8 The meeting recommended to establish a mechanism to allow for a useful dialogue to take place between the users and the Satcom service providers in particular for (i) informing Satcom providers about user requirements; and (ii) informing users about Satcom capabilities. Appropriate metrics should be developed for both aspects. (***recommendation***)

5.1.4 Buoys (drifters)

Luca Centurioni (SIO[9], USA) reported on the Satcom requirements of the Global Drifter Program (GDP), which maintains a global array of 1,250 Lagrangian drifters in the ocean to measure horizontal current at a depth of 15 m, sea surface temperature and atmospheric pressure. The drifters have several physical and power constraints, which, together with the need for data telemetry in a truly global sense, limit the choice of available satellite communication options. The GDP is fully committed

9 Scripps Institution of Oceanography (USA)

the make the drifter data available to the GTS and as such it needs to work with satellite service providers that can ensure the drifter data are posted to the GTS with a minimal lag from the time at which the measurements are taken, preferably not exceeding 60 minutes. Minimizing such delay is essential to maximize the scope of the drifter data with respect to applications such as data assimilation in numerical weather prediction models.

5.1.5 Ship-based observations

5.1.5.1 Mr Pierre Blouch (EUMETNET[10]), Chairman of the JCOMM Ship Observations Team (SOT) Task Team on Satellite Communications (TT-Satcom), presented an overview of the two kind of existing ship stations: conventional Voluntary Observing Ships (VOS) and Shipborne Automatic Weather Stations (S-AWS). He then gave some outlines on their requirements in matter of satellite communications and on the present practices.

5.1.5.2 The meeting noted that strong constraints include global coverage, good timeliness and reliability, location at the time of the observation and optimised costs. Presently, there were no real constraints with regard to data volume (messages are generally shorter than 100 bytes), power supply, space and two-way mode. However, this latter feature was more and more appreciated. In the future, solar-powered basic S-AWSs, comprising a barometer, a GPS and a transmitter could easily be envisaged. Power consumption wouldl have to be optimised on these easy-to-install stations.

5.1.5.3 S-AWS are fitted with their own transmitters and the communication costs are paid by the National Meteorological Service (NMS) that installed the station. Of note was a rapid growth of the use of Iridium SBD in Canada and Europe (25% of all ship messages sent onto the GTS in 2012) rather than other systems such as Inmarsat-C Data Mode, DCPs and Argos.

5.1.5.4 On conventional VOS, observation messages are sent either by email – if the companies agree to bear the related costs -, or through the GMDSS terminal of the ship with different techniques (SAC41, SEAS, E-SURFMAR[11] half compression). In this latter case, the transmission is free of charge for the ship since it is paid by a NMS. The Global Maritime Distress and Safety System (GMDSS) is presently based on Inmarsat-C but its modernization is under study.

5.1.5.5 SOT participating members are waiting for more information about the future of the GMDSS. Mr Blouch, who regretted the absence of representatives from Inmarsat and IMSO at the Forum session, proposed to take advantage of this evolution to build a fairer tariff scheme than the one currently in force with SAC41 communications. In this scheme, communications are presently paid by the NMS that receives the data, not that which recruited the VOS. The meeting requested the interim Executive Committee to discuss the issue with the SOT in the view to propose a fair long term tariff scheme solution regarding the use of the Inmarsat system for the collection of ship-based observations (***action: interim Executive Committee; 2015***).

5.1.5.6 Mr Blouch was asked about the possible use of the Automatic Identification System (AIS), possibly relayed by satellite. He replied that the VOS community is aware of the AIS system and of its capacity to report weather observation messages ashore. In case the system appears cost effective, future S-AWS will have to be interfaced with AIS equipment.

5.1.6 Sea level observations

5.1.6.1 Mr Thorkild Aarup (IOC) gave a presentation on the use of data transmission methods within the Global Sea Level Observing System (GLOSS) and the four regional tsunami warning systems in the Caribbean, Pacific, Indian Ocean and NE Atlantic, Mediterranean and connected seas.

5.1.6.2 Since the Indian Ocean Tsunami (26 December 2004) the global sea level community has put much effort into upgrading national tide gauge networks to transmit data in real time both to GLOSS data centers and the tsunami alert centers. The GLOSS community has in its Implementation Plan of

10 Economic Interest Grouping (EIG) of European National Meteorological Services
11 EIG EUMETNET Surface Marine Operational Service

2012 put emphasis on establishing continuous Global Navigation Satellite System (GNSS) stations co-located with sea level stations, in order to measure absolute sea level change. Such continuous GNSS stations have their own data transmission needs that in general are considerably higher than those for a tide gauge.

5.1.6.3 The meeting noted that the IOC Sea Level Station Monitoring Facility[12] tracks sea level data received in real time from different network operators through a number of different communications channels. The aim of the service is to (i) to provide information about the operational status of global and regional networks of real time sea level stations; and (ii) to provide a display service for quick inspection of the raw data stream from individual stations.

5.1.6.4 Mr Aarup reported that there are presently 721 real time stations, which are tracked on the web-site from 122 national agencies or institutions provide data to the web-site. The web service allows for the analysis of transmission services and performance. Of the 721 sea level stations that are presently tracked in real time, 393 stations report via the GTS (the large majority via the public geostationary satellites GOES, Meteosat and MTSAT) and 328 are non-GTS (i.e. FTP, web service, email, and based on telephone, GPRS/GSM, Internet/ADSL, BGAN, Iridium).The vast majority of sea level stations that deliver data via the GTS now largely use 5-15 min transmission slots. Some tide gauge operators have over last five years started using BGAN and Iridium (Chile, Indonesia, Germany, UK, US).

5.1.6.5 Mr Aarup showed a comparison of performance for the various transmission options for sea level stations based on studies done by Hernandez and van Hoorne. These are reproduced in ***Annex XI***.

5.1.6.6 In closing, Mr Aarup summarized that the typical data transmission need for a real time sea level station co-located with a continuous GNSS station is about 1 MByte per day. The sea level community has also expressed a wish for bidirectional communication. He also highlighted interest in the sea level community for exploring the use of GMS emergency channels for tsunami monitoring. In addition he also highlighted the need for continued Meteosat coverage over the Indian Ocean in support of the Indian Ocean Tsunami Warning System.

5.1.7 Argo and other profilers

5.1.7.1 Mr Martin Kramp (JCOMMOPS) reported on behalf of the Argo Steering Team and Argo Coordinator, Mr Mathieu Belbeoch (JCOMMOPS) on SatCom related issues and requirements of the Argo programme.

5.1.7.2 He introduced the Argo programme and its status of now more than 3500 floats in all sea-areas, with contributors from almost 30 different countries. Mr Kramp also reported on the mission of JCOMMOPS, now supporting five of the core programs (Argo, SOT, GO-SHIP[13], DBCP, OceanSITES[14]) of the Global Ocean Observing System, and the pressing need to coordinate operations between the various involved nations and programs. This is particularly true regarding deployment needs of autonomous instruments.

5.1.7.3 Mr Kramp recalled the historical partnership between the ocean observing community and Service Argos/CLS, where JCOMMOPS is hosted. This partnership permits access to incoming instrument meta-data before submission of the data to anybody else, enabling JCOMMOPS to monitor networks efficiently and completely unfiltered. Setting up similar partnerships with all involved Iridium-Value Added Resellers (VARs) is an administrative issue for JCOMMOPS. Similar related issues with Iridium are expected regarding the need of 24/7 operational data and support services, whilst the corresponding experience with CLS for Argos is very positive.

5.1.7.4 The meeting noted that Argo floats do not use the Orbcomm system anymore since 10 years.

12 http://ww.ioc-sealevelmonitoring.org
13 Global Ocean Ship-Based Hydrographic Investigations Programme
14 http://www.oceansites.org/

A quarter of the currently active floats use Iridium (CSD[15], SBD, RUDICS[16]), all the others use Argos, with until now only very few Argos-3 floats. But since 2012, more than half of new deployed floats use Iridium. Tests with the Chinese system BeiDou are underway. The meeting noted the Argo strategy to diversity the use of Satcom as this is felt important for sustained Ocean Observing Systems.

5.1.7.5 Mr Kramp stressed that harmonized data formats are needed, and high bandwidths for new Argo floats, in particular for multidisciplinary sensors (BGC[17]). Traditionally, only 100 sea-levels could be measured (CTD[18]), but 1000 levels are now the target. The surface time should be short, which was not always possible with Argos, but easy to achieve with Iridium. At the same time, saving energy always helps to increase the float lifetime, which could meanwhile be 10 years. Commitments for such a period or longer are now expected from the SatCom providers.

5.1.7.6 The TC reported on a possible security problem with Iridium, and potential destruction of instruments through spam or other e-mails to an instrument address. Whitelists must be used to avoid such an event.

5.1.7.7 Mr Kramp stressed that in particular expensive multi-sensor instruments should have an independent secondary Satcom system on board, in case of problems with the main system. If a GPS fails, a Doppler position (as traditionally performed by Argos) is also possible with Iridium, but there are limitations (mainly with RUDICS). Secondary systems could also play a crucial role regarding a growing need to retrieve instruments at sea.

5.1.8 Other requirements (e.g. animal trackers)

Wildlife Tracking Perspective

5.1.8.1 Dr Kim Holland (U of Hawaii), and Dr Bernie McConnell (SMRU[19]) presented an overview of the Satcom requirements of the wildlife scientific community. In addition, Ms Melinda Holland (Wildlife Computers) provided information on the perspective of the animal tracking equipment manufacturers.

5.1.8.2 The meeting noted that wildlife trackers comprise a very diverse group that works on a wide range of species that inhabit all ecosystems (terrestrial, avian, marine). Just within the marine sector, there is a wide spectrum of target species with different life history strategies. Thus, while it would be beneficial to have an advocacy group to represent this sector in negotiations with satellite service providers, the diversity of research interests makes it difficult to envision how an advocacy group might be formed or structured. One possibility is to link the JTA meetings with conferences such as Bio-Logging. The meeting, while noting that Bio-Logging is for primarily for tracking marine mammals and birds, invited the Satcom1 participants at 5th International Bio-Logging Science Symposium (BLS5[20] , 22-26 September 2014, Strasbourg, France) to promote formation of a group at this event to represent the collective interests of the marine animal tracking community with regard to Satcom (Bernie McConnell to lead, assisted by Kim Holland and Melinda Holland) (***action; Bernie McConnell; Sept. 2014***). Satellite tag manufacturers play a crucial role in linking users with satellite services and, as such, their involvement in the JTA process should be encouraged. The meeting also noted that the Ocean Tracking Network (Canada), while essentially interested in acoustic telemetry, is also interested in Satcom.

5.1.8.3 The meeting noted that wildlife trackers share the common requirement that tags need to be as small as possible and this inevitably impacts the amount of energy available for prolonged deployments and for effective transmission of data to satellite. Thus, satellites that can accept low power transmissions are critical to the wildlife tracking community. The fact that most marine animals spend very short periods at the surface also dictates that satellite uplinks should require no handshake or very rapid establishment of communication channels. Appropriate data latency specifications can

15 Circuit Switched Data
16 Router-Based Unrestricted Digital Internetworking Connectivity Solutions
17 Biogeochemical
18 Conductivity Temperature and Depth
19 Sea Mammal Research Unit (UK)
20 http://bls5.sciencesconf.org/

vary from a few minutes to several months; real time data transfer is not critical to most tracking applications. Two-way communication between tag and satellite would allow more efficient data transfer and thus could significantly improve tag energy budgets.

5.1.8.4 The meeting noted the concerns expressed by Drs Kim Holland and Bernie McConnell that, even though wildlife researchers now comprise 50% of Argos users, current Argos pricing structures may result in some users of marine animal-borne transmitters paying disproportionately higher rates than users of buoy or terrestrial platforms. Argos system representatives stated their willingness to explore more adaptive approaches to pricing for various user types.

5.1.8.5 The progressive miniaturization of Iridium modems holds the possibility that in the future, this provider may be able to provide suitable platforms for marine animal tracking. Similarly, Argos intends to implement significant technical advances in the near future that are intended to improve tag energy budgets and improve geolocation estimates.

5.1.8.6 The meeting recalled that there is increasing interest in the ocean community to make ocean measurements such as CTD from marine animals (seals, sharks).

The use of ground data telecommunication infrastructure

5.1.8.7 The meeting agreed that use of the ground data telecommunication infrastructure such as GSM, GPRS, UMTS[21], should as much as possible be used whenever feasible, but recognized that (i) either this was not always possible, or (ii) that Satcom can provide for a robust backup solution (in particular in natural disaster situation where the collected data are the most needed).

Potential for using submarine cables for the collection of oceanographic data

5.1.8.8 As an indication of how the environmental observation community was engaging in dialogue with a wide range of communications service providers, Mr David Meldrum informed the meeting about the joint ITU/WMO/IOC initiative to instrument future subsea telecommunications cables with sensors for climate monitoring and disaster warning. Since the first workshop (Rome, 2011) a Joint Task Force (JTF) had been formed, drawing on a wide representation from the science, industry and regulatory communities. Initial industry fears that sensor-equipped cables would imperil the integrity, profitability and legal status of subsea cables had gradually subsided and all parties were now optimistic that JTF objectives could be achieved.

5.1.8.9 In particular, progress had been made at the most recent workshop (Madrid, 2013) towards establishing a pilot project that would demonstrate the technical feasibility and societal benefit of an instrumented cable. Strong arguments were made in favour of a tsunametry pilot because of its relative ease of implementation, its immunity to the vandalism and storm damage that affected the existing network, and its potential for demonstrating important societal benefit. Further information on the JTF initiative can be found on the web[22].

5.2. Radio frequency issues in relation to data collection

5.2.1 Mr Eric Allaix (Météo France) reported on behalf of WMO's Commission for Basic Systems (CBS) Steering Group on Radio Frequency Coordination on the actual and future usage of frequency bands allocated to meteorological community in the International Telecommunication Union (ITU) in relation to data collection using satellite systems.

5.2.2 Some specific frequency bands were highlighted due to their constraints and specific usage.

5.2.3 A focus, in relation with particular agenda items of the next World Radiocommunications Conference (WRC) planned in 2015 was made.

21 Universal Mobile Telecommunications System (UMTS)
22 http://www.itu.int/en/ITU-T/climatechange/task-force-sc/Pages/default.aspx

5.2.4 In the framework of these agenda items, the studies made in the frequency bands hereafter have to be followed with a particular attention : 401-403 MHz, 1675-1710 MHz an 3400-4200 MHz.

5.2.5 In the framework of the WRC-15 preparation, it was mentioned the necessity to be vigilant and reactive regarding some studies from others communities hoping to obtain rights in frequency bands of main interest for data collection using satellite systems. Furthermore information regarding technical characteristics of equipment deployed for the different satellite applications described during this Satcom Forum would help to ensure their protection.

5.2.6 It was pointed out the importance of support of administrations and close cooperation needed to ensure the protection of spectrum used or planned to be used by meteorological or commercial satellite. To this aim, dialogue between each participant and his national frequency authority is encouraged.

5.3 Data processing and exchange

5.3.1 Mr Etienne Charpentier (WMO) reported on the requirements for data processing and exchange.

5.3.2 He recalled that WMO and IOC applications provide means to prevent, mitigate and adapt to impacts of weather, ocean, climate and water on the environment and human activities. Relevant activities include monitoring (e.g. climate monitoring), prediction (e.g. numerical weather prediction), issuing warnings (e.g. tropical cyclones, storms, floods, droughts, heat-waves, cold waves, wildfires …), natural disaster risk reduction, support of disaster-relief operations, planning preventive measures for adapting to and mitigating negative effects of climate change, etc. He further stressed that for services to be delivered to end users (e.g. policy makers) data must be made available in both real-time and delayed mode to a number of related activities, including operational and research modelling, data assimilation (analysis/re-analysis), model verification, operational activities (e.g. maritime forecasting), satellite calibration, validation, disaster response, and climate applications (monitoring, variability/predictability, modelling). The meeting recalled that climate applications and services are increasing the demand for high quality, documented and traceable observations of known uncertainty, including historical data

5.3.3 Mr Charpentier then provided an overview of the data management procedures commonly used at the following steps, including challenges:

- On-board data processing
- Use of the downlink data transmission
- Transmission of the data from the observing platform to the data processing centre via satellite
- Data management at the data processing centre, including conversion to geophysical units, quality control, encoding in WMO codes
- Data distribution to end users through the WMO Information System (WIS) (e.g. using BUFR code for time critical applications, and GTS distribution)
- Quality information feedback mechanisms.

5.3.4 The meeting agreed that the Forum can be a place to exchange ideas on the above aspects.

6. CREATING DIALOGUES AND POTENTIAL FOR DEVELOPING COOPERATIVE MECHANISMS

6.1 The meeting discussed how to create or strengthen dialogues between the user community and satellite operators on one hand, and the satellite equipment manufacturers on the other hand.

6.2 The meeting noted that there are many elements within the community which Satcom is interested in servicing. These include platform manufacturers, satellite system operators, value added resellers, data channels, and users. The dialogue between the manufacturers and the users of

platforms utilizing satellite communication systems is often the most prescient to the purposes of the Satcom community. This is the relationship in which user explicit requirements are heard and the equipment which is deployed in the field is delivered. Users and manufacturers, naturally, have complementary capabilities and requirements. The manufacturers are often refereed to as Value Added Manufacturers (VAMs) by the satellite communication community. VAMs want to create equipment which is of real value to users. Users want real value from the equipment they purchase and they want a forum to acquire objective matrices to compare the available communication options. Satcom may help create these forums.

6.3 The meeting agreed that while the community includes many experts who understand the scientific and technical requirements, useful forums are needed to facilitate this communication. It is proposed that Satcom explore the use of (i) conferences and expositions where users would make scientific and technical presentation, and vendors would be offered table to display their equipments; (ii) social media (explore existing sites, and define #hashtags), and (iii) Internet forums like Wikipedia (***recommendation***). The meeting proposed to initiate a pilot project to explore these forums and make recommendations and requested Mr Sybrandy to lead this activity (***action; A. Sybrandy; 2014***).

6.4 In general it was accepted that the manufacturer was the most important interface between the user (who might be unable to express detailed satcoms requirements) and the Satcom service provider. Past history had shown that manufacturers were generally (but not always) able to provide impartial advice to users and act as 'matchmakers' between the user and the eventual Satcom service provider. This once again underlined the importance of the Forum, should it continue, in acting as a free and impartial clearing house to assist potential users in identifying their best satcoms solution, should they need one.

7. TARIFF ISSUES

7.1 Review of the current pricing of data telecommunication services

Argos example

7.1.1 As a prelude to a wider discussion of tariff-related issues and the possible role of the Forum, Mr Meldrum sketched out some background to the Argos JTA and the ways it had moved over the years to accommodate a wide range of user requirements. For many years the JTA has used, and continues to use, a cost-recovery business model, whereby the costs of providing the end-to-end Argos service, which include airtime, data processing, user support and GTS insertion, has been recovered through user charges. The metric for system use has traditionally been the 'platform-year', namely the system usage of a platform whose transmissions had been received in each UTC day during a calendar year. No account is taken of data volumes transferred or any other more precise metric for system usage or occupancy.

7.1.2 However, in 2004 the JTA decided to better charge on the basis of system use, and the concepts of the 'active month' and 'active day' were introduced. On this basis, any platform whose transmissions were received at any time during a calendar month would incur the 'active month' fee. This was somewhat analogous to the monthly fees charged by other service providers, except that no fee was payable if the platform had been inactive during the month.

7.1.3 The 'active day' charge was levied if activity was detected during a particular UTC day. In fact, to more fairly charge for usage, the day was divided into four 6-hour timeslots, and charges were levied by active timeslot. This was a move towards reducing the costs attributed to platforms which were received for only a short period each day. In practice this had the potential for increasing the costs for some user groups, primarily animal trackers that had been using the Limited Use Service available under the previous Tariff structure, and 'soft landing' schemes were introduced by CLS to cushion the impact on these users This highlighted the strength of the JTA mechanism , in that considerable efforts were made to accommodate the concerns of the animal tracking community despite the fact that this community was insufficiently well organized to attend JTA sessions and to

argue its case. Actions are in place within the JTA to encourage the wildlife community to organize and be represented at the JTA meetings.

7.1.4 Also in 2004, the JTA agreed that CLS should invoice users in arrears on the basis of their usage, rather than seeking up-front block payments from national representatives (ROCs) as had previously been the case.

7.1.5 In 2006, in order to better understand the system occupancy issues and to quantify occupancy by platform class, CLS invited Mr Meldrum to analyse six months of traffic from JTA platforms by platform class. The study showed that indeed, in terms of occupancy, animal trackers usage was relatively low. This study was presented to the JTA session in La Jolla in 2006, at which four representatives of the animal tracking community attended, with CLS support**.** In the resulting negotiations, the JTA took a significant step towards reducing the cost impact of the new tariff structure on animal trackers by introducing a cap of 12 'active days' on charges imposed in any calendar month. Consequently, under the current Tariff animal trackers pay no more than a maximum of 12 days of charges even if they transmit for more than 12 days that month. In further response to these findings, in 2011 the JTA reduced the occupancy component of the 'active day' charge for animals by 50%[23].

7.1.6 The meeting thanked Mr Meldrum for presenting his analysis, but in noting that the study was several years old, asked that it be repeated. In this regard, Mr Meldrum indicated his willingness to repeat the task if so invited. (**recommendation**). The meeting also noted that the wildlife tracking community was extremely diverse, consisting largely of small independent research groups with fragmented funding streams, and that providing a service to this community could be very taxing and time-consuming for all concerned. Nonetheless substantial benefits could accrue to the community if it were able to create a body that might better represent it in places such as the Forum (see 5.1.8.2).

General discussion on tariff issues

7.1.5 More generally, the meeting identified the following types of Satellite data telecommunication systems, which tariff schemes are defined and managed differently:

(i) Those systems that are free to use – Met Satellites. The cost of the satellites and the associated ground systems is borne by Agencies. In the case of EUMETSAT it is the member states and WMO Programmes: for NOAA and JMA their respective governments. There are restrictions on use – it must be environmental data and be made available on the GTS.
(ii) Those that are run on a cost recovery basis such as the Argos system, where tariff is negotiated through the JTA.
(iii) Those that come under a free market, e.g. Iridium, Orbcomm, Inmarsat, and Globalstar. Here it is interesting to analyse whether a body such as the Forum, acting on behalf of users, could be in a position to negotiate better prices or whether the role is more to give users indicative information on prices. The resource/governance issues required for each role would be very different. The diversity of users and user requirements will also have to be taken into account. Additionally each satellite operator operates different business models – resellers with Iridium, and directly with Orbcomm. So it is difficult for the Forum to provide for a negotiating arena, but al least, the Forum offers a platform for exchanging views, and information on what is available in the market, and can help each individual programme to negotiate its tariff with any given Satcom provider depending upon its specific user requirements.

7.2 The Argos Joint Tariff Agreement model

7.2.1 Mr Frank Grooters, representing the Argos Joint Tariff Agreement (JTA), reported that the Argos system was created in 1978 by CNES, NASA and NOAA as a scientific tool for understanding our environment, by collecting and relaying meteorological and oceanographic data around the world.

23 The daily active charge "B" coefficient has two terms: B1 (for occupancy) and B2 (for workload), in 2011 the JTA reduced the B1 term for the animal tracking category from 3 Euros to 1.5 Euros (i.e. by 50%) making the total "B" coefficient for that category to now be 7.5 Euros,

7.2.1 Three years later an international consortium, the Argos Joint Tariff Agreement (JTA), was established to facilitate negotiations between the scientific Argos User Community and the Argos Service Provider with the aim to achieve global beneficial tariff rates for the user community on the one hand, based on an efficient and effective end-to-end and cost-recovery system operated by the service provider.

7.2.3 The annual negotiations in the JTA were covering system use, operations cost, user requirements and tariff proposals. The conclusion of these negotiations was reflected in a Global Agreement for the use of the Argos system and was valid for one year.

7.2.4 Mr Grooters explained that the mandate of the JTA was carefully and in detail described in its Operating Principles, including also the Basic Aims and Principles, the Terms of Reference of the JTA and the Terms of Reference of the JTA members.

7.2.5 With reference to the two pillars supporting the Argos system, the operations of the system under the responsibility of the Argos Operations Committee (OpsCom) and the financial element in the system under the JTA, Mr Grooters explained that the JTA was responsible to the OpsCom through an annual reporting mechanism.

7.2.6 Because the JTA is meeting on an annual basis, the JTA had established an Executive Committee to support JTA activities during the intersessional period.

7.2.7 Although the style of negotiations in the JTA had changed over the years, the JTA had worked very successfully for 33 years to the benefit of both the (semi) governmental and scientific users and the service provider, not the least because of the open and respectful style of the discussions between the service provider and the Argos users.

7.2.8 In conclusion, Mr Grooters recalled that the 33rd meeting of the JTA took place in Paris, prior to the Satcom meeting, again resulting in a negotiated and beneficial tariff agreement for the year 2014, as will be reflected in the 2014 Global Agreement.

7.3 Specific tariff negotiating schemes that might be managed through the Forum

7.3.1 Mr Johan Stander (SAWS, South Africa) lead the discussion on how to develop strategies for establishing tariff negotiation schemes that might be managed through the Forum in the future in order to provide affordable data collection from remote observing platforms. The meeting agreed with the following principles:

(i) A financial strategy to be developed should be compatible with both Government and communication strategies, which will be an end to end service (non stop) to address the WMO, IOC, and other user requirements, as well those of the GFCS;
(ii) There are multiple systems being used, although only Argos with the JTA offers an existing negotiating scheme, which has proven very successful;
(iii) Data quality, availability and quantity have to be considered, and gaps in data sparse areas (e.g. Southern Ocean) need to be recognized in such a way that perhaps reduced tariff should be proposed for the platforms transmitting from such areas;
(iv) Data Collection System from Meteorological Geostationary Satellites could be recognized as a programme within the Forum benefiting from free service provided the data are environmental, and are made available on the GTS;
(v) The user perspective should be taken into account, and the concept of cost per “amount of data transmitted” should perhaps be replaced by the one of cost per “amount of correct or useful data reaching the end users”. Criteria such as data timeliness should also be considered realizing that there are different data timeliness requirements between different types of users;
(vi) There is no “one size fits all” when it comes to satellite data telecommunication to address the needs of the WMO and IOC users but users should be able to make an informed decision on

what system to use on the basis of appropriate metrics to be developed by the Forum. The Forum should act as a pool of information on best practices;

(vii) There are benefits to be gained in promoting the development of uniform data management, including for the collection of the instrument/platform metadata, and data processing systems with appropriate decoding and conversion to geophysical units, quality control, encoding to WMO codes, distribution and archival. Data processing costs have to be considered. Tender processes should be investigated (e.g. see One Stop Shop proposal discussed at the Satcom preparatory workshop);

(viii) The user community must promote reliability and sustainability of satellite data telecommunication (for example, some observing platforms such as Argo profiling floats are deployed for operational periods which can last as long as 10 years, and it is important to assure continuity of Satcom service during their whole lifetime). In particular, the DCS should target data availability of at least 98%;

(ix) Noting that the ”data rate” offered by a particular Satcom system was not necessarily a useful metric for assessing adequacy of that system with the user needs, the meeting agreed that the potential amount of useful data that can be collected within a day was a better metric;

(x) Recognizing that the ratio of the Satcom budget compared with the overall budget to deploy and operate an observing platform could in some cases become prohibitive, the meeting invited the Satcom users to pay attention to this criteria when negotiating prices with Satcom service providers.

7.3.2 Referring to the discussion under paragraph 7.1.5, the meeting agreed that the choice of the Satcom users depended on multiple requirements (e.g. data throughput, global/regional coverage, availability, timeliness, energy consumption, size of tags, availability of added value services, sustainability of the service provider, etc), and that the following models could be proposed for negotiating tariffs:

- **Tariff negotiation programme within the Forum**: “JTA” like programme within the Forum whereby a group of users can negotiate tariff for a specific satellite data telecommunication system. Such a programme will have to define and agree on its operating principles.
- **Preferential programme associated to the Forum**: Programme like the one proposed by the Geostationary Meteorological Satellite agencies, which provide free services for environmental data users under certain conditions;
- **Independent negotiation programme**: Free negotiations by the users (for their own programmes) with specific satellite data telecommunication service providers, noting that consolidate information from the Satcom can strengthen these users in their negotiations.

7.3.3 The meeting also recommended that special tariffs should be negotiated for low data rate applications (***recommendation***).

7.3.4 The meeting noted with appreciation that the Satcom service providers attending the meeting expressed their intent to be flexible in negotiating tariff with their users.

8. ORGANIZATIONAL ISSUES

8.1 Interim Executive Committee

8.1.1 The meeting established an interim Executive Committee for the Satcom Forum to drive the workplan, which should lead to the formal establishment of the Forum by the sponsoring Organizations. The Terms of Reference and membership of the organizing committee are provided in ***Annex VII***.

8.2 Draft Terms of Reference of the Forum

8.2.1 The meeting reviewed the draft Terms of Reference of the Satcom Forum as updated by the preparatory workshop for the Satcom Forum, and then (i) updated by the JTA, and (ii) simplified by the

Secretariat. The meeting agreed that the changes proposed by the JTA should be reflected in the operating principles.

8.2.2 The meeting proposed some further changes to reflect the proposed reporting of the future Forum to the Executive Bodies of WMO and IOC through the Commission for Basic Systems (CBS), and the GOOS Steering Committee respectively.

8.2.3 The meeting invited participants to review the Terms of Reference, and to provide comments to the interim Executive Committee no later than 31 October 2013 (***action; participants; 31 Oct. 2013***).. The new proposed terms of reference as reviewed by the participants by the 31 October 2013 deadline are provided in ***Annex III***.

8.3 Operating principles of the Forum

8.3.1 The meeting was invited to review the draft operating principles of the Satcom Forum, by 31 October 2013 (***action; participants; 31 Oct. 2013***). It was noted that the operating principles include details about the future Forum governance, roles and responsibilities of the Satcom Forum Chair, and Executive Committee, frequency of meetings, and reporting procedures. The draft operating principles as reviewed by the participants by the 31 October 2013 deadline are provided in ***Annex IV***

8.4 Workplan

8.4.1 The meeting requested the interim Executive Committee, on the basis of this meeting's discussions, to update the workplan leading to the formal establishment of the Forum by the co-sponsoring Organizations (***action; interim Exec. Committee; 31 Oct. 2013***).

8.4.2 The updated workplan as reviewed by the interim Executive Committee by the 31 October 2013 deadline is provided in ***Annex V***.

9. RECOMMENDATIONS TO THE WMO AND IOC EXECUTIVE BODIES

9.1 The meeting agreed that the draft Terms of Reference of the future Forum, finalized by the interim Executive Committee to the CBS Management Group (MG) with the goal to present the outcome of the Satcom establishment process to the WMO Executive Council sixty sixth Session in 2014 (***action; Secretariat; June 2014***) for further guidance. They should also be submitted to the GOOS Steering Committee (GSC) (***action; Secretariat; 15/11/2013***).

10. ANY OTHER BUSINESS

Satcom Forum test of concept

10.1 Recalling that this meeting was a test of concept of the Satcom Forum, the meeting agreed that this *ad hoc* Forum had been extremely useful to initiate a dialogue between the different types of users of satellite data telecommunication systems, with the Satcom service providers, and the equipment manufacturers. It helped to bring new ideas for future collaborations in the best interest of the Satcom users. The meeting requested the interim Executive Committee to address the following issues:

- What should be the format of Satcom Forum meetings?
- How to enhance feedback from the Satcom providers?
- Is there a need to establish a Trust Fund, seek contributions to this Trust Fund, and propose how the collected funds should be spent ?
- What additional sponsors should be approached in order to consolidate the Forum's user base (e.g. WWF, Movebank …) ?
- Are there emerging technologies to be considered ?

Role of JCOMM

10.2 The meeting recognized that the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) has been a stronger supporter of the Satcom Forum for a good reason: it is one of the most important user of Satcoms in the WMO and IOC community, and has in its Terms of Reference to look at the collection of marine meteorological and oceanographic data from the global ocean, an area where the only mean to collect such data it to use Satcoms. Under these circumstances, the meeting felt strongly that the Forum should not only be placed under the umbrella of the WMO Commission for Basic Systems (CBS), but also under JCOMM. It therefore recommended that the Satcom Forum becomes a joint JCOMM-CBS body (***recommendation***).

Widening the scope of the Forum

10.3 As discussed several times during the meeting, it was agreed that the scope of the Forum should as much as possible be widened, in terms of the user communities represented. From that perspective, the meeting agreed that organizations such as the World Wildlife Fund (WWF[24]), Movebank[25], and Bio-Logging[26] should be approached in the view to invite them to join the Forum as co-sponsors (***recommendation***). The meeting requested the interim Executive Committee to address this issue (***action; interim Exec. Committee; ASAP***).

11. CLOSURE OF THE SESSION

11.1 In closing the session, the Chairperson, Mr David Meldrum thanked IOC of UNESCO for the excellent facilities, support and hospitality that had been provided for the meeting. He also thanked the participants and the Secretariat for their valuable contributions during the meeting.

11.2 Mr Meldrum noted that the extensive and frank debate that had taken place between all participants had resulted in a number of positive outcomes, and real progress since the previous session:

- the open recognition that no single system could respond to all user requirements;
- the willingness of those service providers present to respond positively to these diverse requirements, despite the fact that the environmental communications budget might only represent a small part of their overall business;
- that small data volume users might nonetheless have a crucial role to play (e.g. in disaster warning) and that they should not be deterred by large fixed communication costs.

11.3 The recommendations arising from this meeting are listed in ***Annex X***.

11.4 The meeting closed at 1700 on Friday 4 October 2013.

24 http://www.wwf.org/
25 https://www.movebank.org/
26 http://bls5.sciencesconf.org/

ANNEX I

AGENDA

1. ORGANIZATION OF THE SESSION

1.1 Opening of the Forum

1.2 Adoption of the agenda

1.3 Working arrangements

2. BACKGROUND INFORMATION AND RATIONALE FOR THE FORUM

3. REVIEW OF THE OUTCOME OF THE PREPARATORY WORKSHOP, TOULOUSE, APRIL 2012

4. REVIEW OF EXISTING SATELLITE DATA TELECOMMUNICATION SYSTEMS, AND EVALUATION MECHANISMS TO BE PROPOSED WITHIN THE FORUM

4.1 Data Collection System (DCS) on Geostationary Meteorological Satellites

4.2 Inmarsat

4.3 Iridium

4.4 Argos

4.5 Orbcomm

4.6 Globalstar

4.7 Other systems

5. USERS' REQUIREMENTS:

5.1 WMO and IOC requirements

5.1.1 Requirements for remote AWS
5.1.2 Hydrological stations
5.1.3 Requirements for polar observations
5.1.4 Buoys
5.1.5 Ship-based observations
5.1.6 Sea level observations
5.1.7 Argo and other profilers
5.1.8 Other requirements (e.g. animal trackers)

5.2. Radio frequency issues in relation to data collection

5.3 Data processing and exchange

6. CREATING DIALOGUES AND POTENTIAL FOR DEVELOPING COOPERATIVE MECHANISMS

7. TARIFF ISSUES

7.1 Review of the current pricing of data telecommunication services

ANNEX II

LIST OF PARTICIPANTS

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ANNEX III

DRAFT TERMS OF REFERENCE FOR AN WMO-IOC INTERNATIONAL FORUM OF USERS OF SATELLITE DATA TELECOMMUNICATION SYSTEMS

The International Forum of users of satellite data telecommunication systems is an entirely self-funded body jointly sponsored by the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, of the United Nations in the view to address the requirements of these two Organizations for the timely collection via satellite of environmental data from observing platforms.

The Forum shall:

- Provide coordination amongst the users of satellite data telecommunication systems (SDTS) and represent their collective interests in working with the satellite telecommunication service providers and the industry in order to advance the awareness and understanding of the user requirements;
- Advance the awareness and understanding of available and planned capabilities;
- Facilitate adoption of interoperability and quality standards and principles as needed;
- Investigate and propose as needed cooperative and tariff negotiation mechanisms on the use of satellite data telecommunication systems;
- Facilitate the preparation of technical advice and guidance that will optimize STDS choices for each considered application.
- Report to the executive bodies of WMO and IOC through the Commission for Basic Systems (CBS), the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), and the GOOS Steering Committee respectively.

Membership is open to all representatives of the co-sponsors stakeholders.

ANNEX IV

DRAFT OPERATING PRINCIPLES OF THE WMO-IOC INTERNATIONAL FORUM OF USERS OF SATELLITE DATA TELECOMMUNICATION SYSTEMS (FORUM)

Table of contents

1. Introduction

The International Forum of Users of Satellite Data Telecommunication Systems (Forum) of the World Meteorological Organization (WMO), and the Intergovernmental Oceanographic Commission of UNESCO (IOC) provides for an international mechanism covering a wide user basis from the co-sponsoring Organizations, to address remote data communication requirements – including tariff negotiations as needed – for automatic environment observing systems using satellite data telecommunication systems (Satcom systems).

The goal of the Forum is to maximize coordination amongst users of Satcom systems in order to represent their collective interests with regard to Satcom systems requirements, and tariffs. By sharing knowledge and ideas, the users can make informed decisions about the use of Satcom systems, influence the developments of those systems to better address their requirements, and provide a strong user base for negotiating with the Satcom service providers in order to optimize their observing systems in the most cost-effective way, and maximize usefulness of these systems (e.g. data return, data timeliness, platform life-time).

Forum's stakeholders include:

i. Representatives of co-sponsoring Organizations Members/Member States (ROMs);
ii. Representatives of Users Groups (FRUGs);
iii. Representatives of the Secretariats of the co-sponsoring Organizations;
iv. Representatives of the Satcom systems operator and service providers (Observers);
v. Representatives of the satellite equipment manufacturers (Observers).

2. Basic aims and principles of the Forum

2.1 The Terms of Reference of the Forum are adopted by the relevant WMO Technical Commission(s) such as the Commission for Basic Systems (CBS), and the GOOS Steering Committee. They are given in Annex A. The basic aims of the Forum are defined in its Terms of Reference.

2.1 The basic principles of the Forum are as follows:

i. The Forum decides on its Operating Principles, which particularly define the aims and principles of the Forum; the roles and responsibilities of the stakeholders and the Secretariats of the co-sponsors; the Terms of Reference of the Executive Committee; the structure and frequency of meetings; and their desired outcome; the reporting procedure of the Forum; as well as the Terms of Reference of the sub-programmes;
ii. Membership is open to all representatives of the co-sponsors stakeholders. Invitations to participate in the Forum are issued by the Secretariats of the co-sponsors to their respective Members/Member States, as well as to their relevant programmes and bodies. Representatives of the satellite data telecommunication providers, and the platform transmitter manufacturers can participate in the Forum as observers. Representatives of the Secretariats of the co-sponsors participate as ex-officio members of the Forum;
iii. The benefits of Forum participation should be shared equally amongst all participants (Users);
iv. The information validated by the Forum (e.g. user requirements, performances of Satcom systems, recommendations) should be shared within the Forum and with the wider community of the co-sponsoring Organizations on a free and unrestricted basis;
v. Decisions shall be agreed unanimously by the Forum. If decisions cannot be agreed unanimously, they will be deferred to the Executive Committee for further discussion and decision.
vi. The Forum may wish to initiate and establish sub-programmes of the Forum to address the particular requirements and needs of a specific Satcom system or user group. Sub-programmes of the Forum should following the general principles below:

1. The sub-programme shall follow the aims and principles of the Forum;

2. The sub-programme shall define the scope of its activities;
3. The sub-programme shall propose its Terms of Reference to be approved by the Forum;
4. The sub-programme shall define and agree on its Operating Principles.

2.2 The Argos Tariff Agreement (JTA) exists under the Argos OPSCOM authority. The Argos JTA contributes as a sub-programme of the Forum on the basis of the ToR and Operating Principles of the JTA agreed upon at the regular sessions of the JTA. Its scope is to address requirement for using the Argos system, and to provide a mechanism for negotiating Argos Tariff amongst Argos governmental users. The Terms of Reference of the JTA are provided in Annex I.

2.3 The Forum will particularly undertake the following activities to achieve its aims:

i. Review available technologies, user requirements, and share experiences in the view to document capabilities, and identify strengths and weaknesses of the different satellite data telecommunication systems to address specific user requirements. Examples of satellite capability criteria to be considered are provided in Annex J. If appropriate, the Forum will propose common approaches for specific user needs,
ii. Make proposals for establishing cooperative mechanisms through the Data Collection Platform (DCP) services of meteorological satellites;
iii. Facilitate adoption of interoperability and quality standards and principles as needed;
iv. Facilitate negotiations between users and the satellite data telecommunication system operators for (i) inclusion of specific user requirements in their respective development programmes; and (ii) continuity of cost-effective data telecommunication services by encouraging tariff negotiating schemes such as the existing Argos Joint Tariff Agreement (JTA); and
v. Facilitate negotiations with the manufacturers of platform transmitters for the inclusion of specific user requirements in future models of the transmitters.

3. The stakeholders' representation

3.1 Representatives of the co-sponsoring Organizations Members/Member States (ROMs)

ROMs are representing the Satcom users of a Member or Member State of the co-sponsoring Organizations. The Terms of Reference of the ROMs, including mechanism for their nomination are provided in Annex B.

3.2 Representative of a User Group (FRUG)

3.2.1 A Representative of a User Group (FRUG) is an individual who can represent the overall consensus view of a significant user community regarding the use of Satcom systems. Such communities might reasonably include the operators of specific environmental observing stations, e.g. Automatic Weather Stations (AWS), polar observing stations, data buoys, floats, ice platforms, animal tags, ship stations and airborne stations, or bodies with agreed international responsibilities for the promotion, sponsorship or validation of any aspect of environmental observation using Satcom systems (e.g. IOC, WMO, FAO[1], WWF[2]). The FRUG will work with Satcom system providers and the Forum Executive Committee to identify opportunities that might bring the Forum session into closer contact with his/her user group, with a view to establishing within that group the benefits of the Forum process.

3.2.2 The Terms of Reference of a Forum Representative of a User Group (FRUG), including mechanism for their nomination are provided in Annex C.

3.3 Satcom system providers

1 Food and Agriculture Organization of the United Nations
2 World Wildlife Fund

3.3.1 The Satcom system providers are the agents operating the Satcom systems space and ground segments,. They normally promote the use of the satellite systems they are responsible of. Those services are usually provided at a cost to the users. Their representatives are observers in the Forum.

3.3.2 The role of the Satcom system providers with regard to the Forum is:

i. to report to the Forum on developments and operations, related to the use and performances of their respective Satcom systems;
ii. to report to the Forum on their pricing policy and structure (unless confidential information);
iii. to collect requirements from the user community and implement required solutions when possible;
iv. to interface with the participating space agencies to assist in providing system upgrades if recommended;
v. to interface with manufacturers to certify their transmitter products and to provide engineering assistance to them to insure their hardware operates correctly and efficiently with the Satcom systems, thereby increasing and optimizing Satcom systems usage;
vi. if applicable, to develop and maintain the ground system and the Global/Regional/National data processing centres; in the contrary, to provide liaison with the operators of the ground systems, and data processing centres in this regard;
vii. if applicable, to operate the Satcom systems ground segment; in the contrary, to provide liaison with the operators of the ground systems in this regard;
viii. if applicable, to operate the data processing centres under quality of service agreements and deliver data collected to the user community according to international standard data exchange requirements and protocols; in the contrary, to provide liaison with the operators of the data processing centres in this regard;
ix. to monitor and control the overall performances of the Satcom systems so as to guarantee the level of quality and continuity of service;
x. to promote the use of the Satcom systems and market new user communities, with the goal of minimizing the cost of using Satcom systems;
xi. to support users through responsive customer service for any request, claim or declaration of equipment;
xii. to support the Forum Executive Committee in Forum management and operations as might be needed;
xiii. to support ROMs as needed especially by facilitating access to and interaction between them and the user communities.

3.4 Representatives of the satellite equipment manufacturers

3.4.1 The representatives of the satellite equipment manufacturers (e.g. platform transmitter/transceiver terminals) can also participate in the Forum as observers.

3.4.2 The role of the satellite equipment manufacturers with regard to the Forum is:

i. to report to the Forum on the characteristics, performances, and costs of satellite equipment available or under development to be used for the transmission of environmental data from/to observing platforms in remote areas;
ii. to collect requirements from the user community and implement required solutions when possible;
iii. to monitor and control the overall performances of the equipment so as to guarantee the level of quality of Satcom data transmission;
iv. to inform whether their transmitter/transceiver products are certified;
v. to support users through responsive customer service for any request, claim or declaration of equipment;
vi. to support the Forum Executive Committee in Forum management and operations as might be needed;

vii. to support ROMs as needed especially by facilitating access to and interaction between them and the user communities.

3.4 The Secretariats of the co-sponsoring Organizations

The World Meteorological Organization (WMO), and the Intergovernmental Oceanographic Commission (IOC) of UNESCO recognize that Satcom systems are important components for the implementation and sustainability of global environmental observing networks. WMO and IOC endorse the Forum as a mechanism to cost-effectively address the requirements of their Programmes and Co-sponsored Programmes, in particular in terms of Satcom and related data processing, quality control, data encoding according to international standards, and data distribution to their end users. In order to facilitate the Forum achieving its goals, the Secretariats of the co-sponsoring Organizations will provide support to the Forum Chairperson in the following manner:

i. Working with the Forum Executive Committee (Forum-EC), and its Chairperson to identify hosts for the regular meetings; and to work with the hosts to gather and disseminate logistical information to the participants;
ii. Providing financial assistance and administrative support to Forum participants who have been nominated by the Forum-EC to receive such assistance;
iii. Issuing Forum meetings' invitation letters to the ROMs with copies to the representatives of the co-sponsoring Organizations Members/Member States;
iv. Managing the documentation in preparation of the Forum meetings;
v. Participating at the Sessions of the Forum and its Executive Committee meetings;
vi. Preparing the session's final report template, and collaborating with the Chairperson, the Forum Executive Committee, and nominated individuals for recording the Session's decisions, and issuing reports of Forum Sessions;
vii. Finalizing the issuance and distribution of Session reports of the Forum to the co-sponsoring Organizations Members/Member States, as well as to the ROMs and other participants;
viii. Coordinating and communicating with the ROMs, the Forum Chairperson and the Executive Committee on all related issues during the intersessional periods;
ix. Serve as members of the Forum Executive Committee (*ex officio*).

The representatives of the co-sponsoring Organizations will participate in Forum Sessions as stakeholders, representing the interests of those Organizations.

Reimbursement to the co-sponsoring Organizations for their Administrative support may be made by the Forum based on voluntary contributions from the stakeholders. The amount reimbursed is to be reviewed annually by the Forum-EC and approved by the Chairperson for the upcoming session.

4. Forum office bearers

4.1 The Forum elects a Chairperson and vice-Chairperson at Forum Sessions. The primary duty of the Chairperson is to ensure that the Forum activities and negotiations proceed in as open and equitable a way as possible, and to assist in reconciling the needs of Satcom systems stakeholders through fair discussions. The Chairperson chairs the Forum sessions, and represents the Forum during intersessional periods. The Chairperson also leads the Forum Executive Committee. The vice-Chairperson shall deputize for the Chairperson in his/her duties if required by the Chairperson.

4.2 The Terms of Reference for the Forum Chairperson, and the Forum vice-Chairperson, details about their election and terms are provided in Annexes D and E respectively.

5. The Forum Executive Committee (Forum-EC)

5.1 The function of the Forum Executive Committee (Forum-EC) is to conduct the sessional and intersessional business, as well as all other matters in support of the Chairperson's duties to meet the needs of the Forum members.

5.2 The Terms of Reference of the Forum Executive Committee are provided in Annex F.

6. Regular meeting of the Forum

6.1 Structure

The Satcom Forum meeting is an open meeting that solicits views from its stakeholders (ROMs, FRUGs, representatives of the satellite operators, , and manufacturers of satellite equipment) in the view (i) to understand the state of the art regarding available Satcom systems, their potential for improvements, (ii) to address the needs of these bodies through discussions, and sharing of information for taking the best of each Satcom system, and (iii) to attempt to reconcile those needs through negotiation regarding future service level provision and costs.

The structure of the meeting consists of deliberative and report producing 3-day sessions organized typically every 2 years that are directed by the Chairperson to achieve the desired outcome. It is expected that the agenda, as adopted by the Forum at the start of the session, will be followed.

The Forum Session should be every two years, but the schedule may be changed at the discretion of the Chairperson.

6.2 Desired outcome:

The meeting is to be an open Forum for all ROMs and FRUGs to discuss and agree by consensus on any matter that affects their use of the Satcom systems. Outcome includes a final report of the meeting with a record of decisions and recommendations by the Forum. Information on the evaluated performances, and costs of existing Satcom systems for the collection of environmental data from remote observing platforms can also be an outcome of the meeting.

6.3 Invited participants

There is an open invitation to all stakeholders to attend the Forum regular meetings. However, official invitation by the co-sponsoring Organizations will be made to the following:

- ROMs representing the users of Satcom systems of Members/Member States of the co-sponsoring Organizations
- FRUGs representing specific Satcom systems user groups

Representatives of the Satcom systems operators and service providers, representatives of the satellite equipment manufacturers, and other interested parties are welcome to attend the Forum regular meetings. Formal invitation letters may be issued to them by the Secretariat on case by case basis.

6.4 Secretariat

It is expected that Secretariat support for the Forum meetings will be provided by the co-sponsoring Organizations on a rotating basis.

6.5 The typical agenda for Forum meetings is provided in Annex G.

7. Typical intersessional workplan and reporting process

The actual workplan will be implemented by the Chairperson and will include a combination of meetings, teleconferences, and email. A typical intersessional workplan and the reporting process is

detailed in Annex H.

ANNEX A

TERMS OF REFERENCE OF THE INTERNATIONAL FORUM OF USERS OF SATELLITE DATA TELECOMMUNICATION SYSTEMS

[this annex will include the Terms of Reference of the Forum, once approved by the WMO and IOC Executive Bodies]

ANNEX B

TERMS OF REFERENCE OF THE SATCOM FORUM REPRESENTATIVE OF THE CO-SPONSORING ORGANIZATIONS MEMBER/MEMBER NATION/MEMBER STATE (ROM)

The Representative of the co-sponsoring Organizations Member/Member State (ROM):

1. shall be nominated by the Permanent Representative of a WMO Member or the Action Addressee of an IOC Member State;

2. should collect evolving requirements from Member/Member Nation/Member State users of Satellite Data Telecommunication systems (Satcom systems) and bring these to the attention of the Forum;

3. could designate an alternate to act on its behalf at Forum meetings by means of a letter to the Forum Chairperson;

4. decides on nominations and proposals put forward by the Forum Executive Committee (Forum-EC);

5. is the only authority in the Forum to represent the Member/Member Nation/Member State user groups and to decide on matters relevant to the Terms of Reference of the Satcom Forum;

6. should initiate interaction with their users, or act as the focal point when deemed to be appropriate or being considered necessary;

7. will provide basic support to existing and new users based on information made available by the Forum or Satcom system providers;

8. interact with Satcom system providers when deemed to be necessary or required;

9. participate in the regular negotiations initiated by the Forum for the tariff and service level of specific Satcom systems;

10. monitor the usage of the Satcom systems by its users;

11. will provide a report to the Forum meeting at least one month prior to the meeting date, in a format following the current reporting structure;

12. should, upon request of Satcom system providers, not distribute or communicate commercially sensitive information provided by Satcom system providers to the ROMs.

ANNEX C

TERMS OF REFERENCE OF A SATCOM FORUM REPRESENTATIVE OF A USER GROUP (FRUG)

Satcom Forum Representatives of a User Group (FRUGs) are designated through either of the following mechanisms:

i. An agency or consortium (candidate) who wishes to be represented through a FRUG consults with the Satcom Forum Chairperson to check whether there is already a FRUG representing a similar community in the Satcom Forum;
ii. If such a FRUG already exists, the candidate negotiates whether it could be represented through that FRUG;
iii. If such a FRUG doesn't already exist, the candidate provides the Chairperson with the proposed Terms of Reference for the FRUG, and the name of the individual proposed to be the FRUG, and requests these to be added in the list of FRUGs;
iv. The Chairperson consults with the Forum-EC, and makes an informed recommendation to the next Forum session whether the new FRUG should be accepted or not;
v. The FRUGs are formally endorsed at the regular Forum sessions.

In this context a Representative of User Group' (FRUG) is defined as follows, with the following Terms of Reference:

i. A FRUG will be an individual who can fairly represent the overall consensus view of a significant user community regarding the use of Satcom systems. Such communities might reasonably include the operators of specific environmental observing stations, e.g. Automatic Weather Stations (AWS), polar observing stations, data buoys, floats, ice platforms, animal tags, ship stations and airborne stations, or bodies with agreed international responsibilities for the promotion, sponsorship or validation of any aspect of environmental observation using Satcom systems (e.g. IOC, WMO, FAO, WWF).
ii. The FRUG will work with Satcom system providers and the Forum Executive Committee to identify opportunities that might bring the Forum session into closer contact with his/her user group, with a view to establishing within that group the benefits of the Forum process.
iii. It is accepted that for certain user groups (e.g. animal trackers), accreditation as above might be difficult to establish in the short term. Nonetheless the Forum-EC will work proactively to seek and encourage the identification of FRUGs as essential components of the Forum.
iv. Notwithstanding the above, the Forum sessions are open with observer status to any interested person (see Forum TORs).
v. If accredited, a FRUG will be obliged to consult as widely as possible with his/her user community regarding their use and expectations of the Satcom systems, and to make the results of these consultations publicly available well in advance of Forum sessions.
vi. The FRUG will also be expected to act as an impartial focal point for the dissemination of relevant information regarding Satcom systems that might be of benefit to his/her user community.
vii. In return, the FRUG will receive a letter of accreditation, and may be able to request some level of financial support from the Forum for attendance at meetings and for other activities approved by the Forum-EC.
viii. The FRUG will work with Satcom system providers and the Forum-EC to identify opportunities that might bring the Forum session into closer contact with his/her user group, with a view to establishing within that group the benefits of the Forum process.

ANNEX D

TERMS OF REFERENCE OF THE SATCOM FORUM CHAIRPERSON

The primary duty of the Chairperson is to ensure that the Forum activities and negotiations proceed in as open and equitable a way as possible, and to assist in reconciling the needs of Satcom systems stakeholders through fair discussions. The Chairperson chairs the Forum sessions, and represents the Forum during intersessional periods. The Chairperson also leads the Forum Executive Committee.

The Forum shall elect a Chairperson and vice-Chairperson at Forum Sessions. The term for the Chairperson will be for four years. The Chairperson shall be eligible for re-election in his/her capacity as Chairperson, but only for one subsequent term.

Terms of Reference for the Forum Chairperson:

1. The Chairperson shall be impartial and shall not favor any particular group, organization or country;

2. In consultation with the Executive Committee (Forum-EC), the Chairperson shall prepare the agenda, and confirm the venue for the annual session for distribution by the secretariat;

3. The Chairperson shall conduct the annual session of the Forum, and promote free, equitable and open discussion of agenda items;

4. The Chairperson shall convene intersessional meetings of the Forum-EC as necessary;

5. The Chairperson shall regularly liaise with Satcom system providers with regard to developments that might impact the Forum and its members;

6. The Chairperson shall routinely circulate information to the Forum participants during the intersessional period as appropriate;

7. The Chairperson shall deputize the vice-Chairperson if required;

8. The Chairperson shall represent the agreed views, decisions, and requirements of the Forum at various appropriate meetings, and report back on the outcomes to subsequent meetings of the Forum-EC and Forum;

9. The Chairperson, assisted by members of the Forum-EC if required, shall prepare and finalize reports of the Forum and its Forum-EC, and submit them to the Secretariats for publication if necessary;

10. The Chairperson shall seek contributions to the Satcom Forum Trust Fund, advise on the use of the funds, and authorize spending following consultation with the Forum-EC in accordance to the guidance provided by the Forum;

11. The Chairperson, in consultation with the Forum-EC and other stakeholders, shall review candidate representatives of user groups (FRUGs), and make informed recommendation in this regard to the Forum;

ANNEX E

TERMS OF REFERENCE OF THE SATCOM FORUM VICE-CHAIRPERSON

The Forum shall elect a Chairperson and vice-Chairperson at Forum Sessions. The term for the vice-Chairperson will be for four years. The vice-Chairperson shall be eligible for re-election in his/her capacity as vice-Chairperson, but only for one subsequent term.

Terms of Reference for the Forum vice-Chairperson:

- The Chairperson shall deputize the Vice-Chairperson for all of the duties (except for item number 7 of the Forum Chairperson's ToR) if required.

ANNEX F

TERMS OF REFERENCE OF THE SATCOM FORUM EXECUTIVE COMMITTEE

The function of the Forum Executive Committee (Forum-EC) is to conduct the sessional and intersessional business, as well as all other matters in support of the Chairperson's duties to meet the needs of the Forum members.

Terms of Reference

The specific tasks of the Forum-EC are to:

1. Assist the chairperson in the preparation of reports, and their submission, if needed, to the Secretariats of the co-sponsoring Organizations for distribution.

2. Annually review the functions and duties of the Forum and recommend any changes to the Chairperson for discussion and approval at the Forum Session.

3. Analyze the Forum budget, and advises the Chairperson.

Membership

1. The membership shall include:

i. Chairperson
ii. Vice-Chairperson
iii. Three additional members proposed by the Chairperson and elected by the Forum. These members will serve a term of 4 years with an optional 4-year appointment
iv. Representatives of the Forum sub-programmes
v. Representatives of the co-sponsoring Organizations (*ex officio*)
vi. Representative of Operators and service providers of Satcom systems (*ex officio*)
vii. Representative of Satellite equipment manufacturers (*ex officio*)

2. Careful consideration should be made to ensure a proper mix that represents co-sponsoring Organizations Members/Member Nations/Member States, user groups, and subject matter experts.

Meetings

1. As necessary, the Chairperson will convene and organize all Forum-EC meetings. The meetings can be in person, or teleconference.

2. If decisions are needed by the Forum-EC as permitted/requested by the Forum Session or the Chairperson during the inter-session, elections for those decisions may be organized with a quorum consisting of at least four members of the Forum-EC, including the Chairperson or his nominated deputy.

ANNEX G

TYPICAL AGENDA FOR A SATCOM FORUM SESSION IN YEAR *YYYY*

1. ORGANIZATION OF THE MEETING

    1.1 OPENING OF THE MEETING
    1.2 ADOPTION OF THE AGENDA
    1.3 WORKING ARRANGEMENTS
    1.4 SELECTION OF THE WRITING GROUP (WG)[3]

2. REPORT OF THE CHAIRPERSON OF THE FORUM

    2.1 REPORT ON THE FORUM-EC
    2.2 REVIEW OF ACTIONS

3. USER GROUP REPORTS

4. REPORT ON THE SUB-PROGRAMMES

5. REPORT ON THE DEVELOPMENT OF SATCOM SYSTEMS

6. REVIEW OF USER'S REQUIREMENTS AND ISSUES

7. SATCOM SYSTEMS REVIEW, AND PERFORMANCE EVALUATION

8. REPORT ON TARIFF ISSUES AND RELEVANT NEGOTIATIONS BY THE FORUM SUB-PROGRAMMES

9. REVIEW OF THE OPERATING PRINCIPLES

10. FUTURE PLANS AND PROGRAMMES

11. ANY OTHER BUSINESS

12. ELECTION OF THE CHAIRPERSON, VICE-CHAIRPERSON, and FORUM-EC MEMBERSHIP

13. DATE AND PLACE OF THE NEXT MEETING

14. CLOSURE OF THE MEETING

3: The purpose of the WG is to assist the Secretariats in taking the minutes and compiling a draft report of the proceedings for approval of the Forum.

ANNEX H

TYPICAL SATCOM FORUM INTERSESSIONAL WORKPLAN AND REPORTING PROCESS

Step no.	***Time frame***	***Step/Action***
1	T0-5 months	Invitation letters issued by the co-sponsoring Organizations for the next Forum session
2	T0-4 months	Contributors are invited by the Secretariat to provide written input for the Forum Session (deadline 1 month)
3	T0-1 months	Preparatory documents for the Forum Session are made available to all participants through website
4	T0	Forum Session
5	T0+2 months	E-mail from the Secretariat informing ROMs about the achievements of the Forum session (final report on the web)
6	T0+3 months	Chairperson consults with Forum-EC, outlines the work to be accomplished and assign actions to Forum-EC
7	T0+6 months	Status of actions assigned by the previous Session of the Forum. Make adjustments as necessary
8	T0+6 months	Chairperson communicating to the Forum on recent outcomes, and plans for the next Session

ANNEX I

TERMS OF REFERENCE OF THE ARGOS JOINT TARIFF AGREEMENT (JTA)

The JTA provides for an international mechanism to provide for cost-effective location and data processing of data collected through the Argos system. The JTA is functioning through stakeholders whose roles are mainly to negotiate the Argos service level and tariff, and ensure appropriate coordination amongst Argos users in order to represent their collective interests with regard to Argos tariff and requirements. Stakeholders include:

i. Representatives of Country (ROCs) representing a country or a group of countries from responsible government organizations using Argos;
ii. Responsible Organizations (ROs) representing an agreed set of Argos user programmes;
iii. Representatives of Users Groups (RUGs);
iv. Representatives of the Argos satellite system operator and service provider;
v. Representatives of the Argos Operations Committee (OPSCOM);
vi. Representatives of the WMO and IOC Secretariats.

The JTA shall:

1. be responsible for negotiating on a yearly basis fair, cost-effective, and simple terms and conditions of the global agreement covering Argos user charges that are applicable to Argos programmes funded by national governments of WMO and IOC Members/Member states and/or other JTA approved organizations;

2. review requirements from Argos user groups and make proposals for inclusion of specific developments in the Argos development programme taking into account their potential impact on the Argos tariff;

3. approve the role of the ROCs;

4. elect an Executive Committee, chaired by the JTA Chairperson, and including the vice-Chairperson, and stakeholder representatives;

5. review and agree on its operating principles;

6. report, through the Chairperson, to the Argos Operations Committee (OPSCOM) and submit its recommendations regarding Argos tariff and required Argos system developments for agreement.

Decisions shall be agreed unanimously by the JTA. If decisions cannot be agreed unanimously, they will be deferred to the Executive Committee for further discussion and decision.

ANNEX J

EXAMPLES OF SATELLITE CAPABILITY CRITERIA TO BE CONSIDERED BY THE FORUM

Below are examples of satellite data telecommunication system capability requirements that the Forum may wish to consider:

- Global and regional coverage; specifically polar regions and third pole;
- Network services and data access technology;
- Data transmitter technology, including radio-frequencies, interface programming, and electric power consumption;
- Data transmission rates;
- Data transmission quality;
- Real-time capability and data timeliness;
- Location capability;
- One-way vs. two-way data communication;
- Ground segment data processing, quality control, and distribution requirements;
- Data collection, and ground segment data processing pricing;
- Reliability;
- Future developments / maintaining current system;
- Size;
- Bandwidth;
- Etc.

In particular, the Forum may wish to develop and maintain an up to date matrix of the compatibility between the proposed capabilities of the different systems and the user requirements.

ANNEX V

UPDATED WORKPLAN LEADING TO THE FORMAL ESTABLISHMENT OF THE FORUM

Step	***Action***	***Date / Deadline***	***By***
1	Approach Co-sponsors in the view to agree on the draft Terms of Reference for the Forum; and plan/organize an preparatory workshop for the establishment of the informal Forum.	Done	IOC, WMO Secretariats
2	Approach operators of satellite data telecommunication systems and platform transmitter terminal, identify contact points, and discuss/negotiate the level of their contributions/participation	Done	Secretariats[1]
3	Approach users of satellite data telecommunication, inform them about the Forum, and seek their participation in the Forum and the *ad hoc* [informal] Forum workshop	Done	Secretariats
4	Setup an organizing committee of the *ad hoc* [informal] Forum workshop with Terms of Reference and membership (see draft below)	Done	Preparatory workshop
5	Negotiate with potential hosts, and propose a venue for the *ad hoc* [informal] Forum workshop	Done	Organizing Committee
6	Inform the joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) about developments regarding the Forum, and seek further guidance	Done	Secretariats of WMO and IOC
7	Issue invitation letters for the *ad hoc* [informal] Forum workshop	Done	Secretariats
8	Inform the WMO Commission for Basic Systems (CBS) Implementation Coordination Team on Integrated Observing Systems (ICT IOS) about developments regarding the Forum, and seek further guidance	Done	Secretariats
9	Inform the Implementation Coordination Team on Information Systems and Services (ICT-ISS) about developments regarding the Forum, and seek further guidance	Done	Secretariats
10	Coordinate documentation plan with contributors	Done	Secretariats
11	Inform the CBS about developments regarding the Forum, and seek further guidance	Done	WMO Secretariat
12	Propose agenda and documentation plan for the *ad hoc* [informal] Forum workshop	Done	Organizing Committee
13	Issue invitation letters for the *ad hoc* [informal] Forum workshop	Done	Secretariats
14	Seek documents from contributors to the documentation plan	Done	Secretariats
15	the *ad hoc* [informal] Forum workshop is tasked to: • Review current satellite data telecommunication issues, • Identify areas where progress/proposals can be made • Review and adjust as needed the draft Terms of Reference of the Forum, • Review the proposed operating principles of the Forum, including Terms of Reference of the Forum's Executive Committee • Elect an Interim Executive Committee for the Forum, Refine the workplan for formal adoption of the Forum by the Executive Bodies of the co-sponsor Organizations	Done	Organizing Committee and the Secretariats
16	Interim Executive Committee to investigate widening the scope of the Satcom Forum (e.g. with WWF, Movebank, Bio-Logging)	ASAP	Interim Executive Committee
17	Review draft Terms of Reference of the Satcom Forum, and provide comments to the interim Executive Committee	31 Oct. 2013	*Ad hoc* Satcom Forum participants
18	Review the draft Operating Principles of the Satcom Forum, and provide comments to the Interim Executive Committee	31 Oct. 2013	*Ad hoc* Satcom Forum participants
19	Update the workplan on the basis of the *ad hoc* Satcom Forum outcome	31 Oct. 2013	Interim Executive Committee
20	Submit draft Terms of Reference of the Satcom Forum to CBS	15 Nov.	WMO Secretariat

1: Secretariats of WMO, IOC

	Management Group	2013	
21	Submit draft Terms of Reference of the Satcom Forum to the GOOS Steering Committee (GSC) for approval	15/11/2013	IOC Secretariat
22	Report on the Satcom establishment process to the sixty-sixth Session of the WMO Executive Council (EC-66) for further guidance	Mar. 2014	CBS Management Group
23	Satcom1 participants at 5th International Bio-Logging Science Symposium (22-26 September 2014, Strasbourg, France) to promote formation of a group at this event to represent the collective interests of the marine animal tracking community with regard to Satcom (Bernie McConnell to lead, assisted by Kim Holland and Melinda Holland)	Sept. 2014	Bernie McConnell
24	CBS Extraordinary Session in 2014 to review the proposed Terms of Reference for the Satcom Forum, and propose a WMO coordination mechanism under CBS	Sep. 2014	CBS Ext (2014)
25	Initiate Pilot Project to explore the use of social media and internet forums to support the activities of the Satcom Forum, and optimize communication	2014	Andy Sybrandy
26	Plan for the first meeting of the Forum	2014	Interim Executive Committee, and the Secretariats
27	Report of the CBS Extraordinary Session in 2014 approved by WMO Congress	Mid-2015	WMO Congress
28	First official meeting of the Forum	2015	Interim Executive Committee, and the Secretariats
29	to discuss the issue with the SOT in the view to propose a fair long term tariff scheme solution regarding the use of the Inmarsat system for the collection of ship-based observations	2015	Interim Executive Committee
30	To address the issues outlined in paragraph 3.3 of the *ad hoc* Satcom Forum (Paris, Oct. 2013) final report in order to demonstrate that the Forum could make a positive difference.	2015	Interim Executive Committee
31	JCOMM-5 invited to co-sponsor the Satcom Forum, and endorse its Terms of Reference if needed	2017	JCOMM

ANNEX VI

BACKGROUND INFORMATION REGARDING THE SATCOM FORUM INITIATIVE

Preliminary note: This proposal is open to all satellite data telecommunication systems used for the collection of environment data from remote platform to serve the needs of WMO, and IOC applications, e.g. DCP (EUMETSAT, NOAA/NESDIS, JMA,…), Inmarsat, Iridium, Argos, etc.

1 INTRODUCTION

The WMO Sixteenth Congress (Cg-XVI, Geneva, Switzerland, 16 May – 3 June 2011) supported the establishment of an International Forum of Users of Satellite Data Telecommunication Systems (Forum) covering a wide user basis, and to address remote data communication requirements - including tariff negotiations as needed - for automatic environment observing systems coordinated through WMO and partner organizations such as IOC.

The historical background leading to this decision is provided in Appendix A.

2 HISTORICAL BACKGROUND

The Argos Joint Tariff Agreement (JTA) was established in 1981 (WMO EC-XXXIII) to be an effective, constructive and cooperative organizing and negotiating mechanism contributing significantly to the stability of the Argos data collection and location system and its globally expanded applications. In February 1984 (IOC EC-XVII) the Intergovernmental Oceanographic Commission of UNESCO (IOC) agreed to co-sponsor the JTA with the WMO. The objective of this cooperative effort was to provide fair, cost-effective and simple procedures for users of the system. Programmes eligible for the preferential tariff under this agreement were limited to those funded by the government and/or non-profit agencies. Issues such as user requirements, improvements of the space-based Argos platform, and surface-based system data processing capabilities are also discussed through the JTA.

Since its establishment in 1985, the WMO-IOC Data Buoy Cooperation Panel (DBCP) has been closely associated to the JTA and has been influential in promoting the WMO and IOC requirements for buoy data collection, location, data processing, and distribution onto the Global Telecommunication System (GTS) of the WMO. Thanks to the DBCP action, the following Argos related activities could be achieved in the best interest of DBCP users:

(i) Development of a dedicated data processing system of Argos collected data for their conversion into geo-physical units, automatic quality control, encoding into appropriate WMO codes, and insertion onto the GTS;
(ii) Implementation of a global network of regional Argos receiving stations in order to improve data timeliness;
(iii) Argos system improvements that take into account DBCP requirements for higher data rate telecommunication, and downlink capability (including an DBCP Argos-3 Pilot Project);
(iv) Automatic collection of instrument/platform metadata by the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) *in situ* Observing Programme Support Centre (JCOMMOPS); and
(v) Publication of DBCP Technical Documents on the use of the Argos system (DBCP TD No. 3) and related GTS data processing and quality control (DBCP TD No. 2).

However, in recent years, with the advent of new satellite data telecommunication systems that better address user requirements in a cost effective way, the Argos system is no longer in a *de facto* monopolistic situation for the collection and location of drifting buoy data. Pilot activities have also been initiated by JCOMM to evaluate the use of other systems such as Iridium. Looking at integration aspects, this new situation has lead the JCOMM Pilot Project for the WMO Integrated Global Observing System (WIGOS) to promote the establishment of an international Forum of users of satellite data telecommunication systems, with a wide user base reaching out beyond the operators of

ocean observing systems, to address tariff negotiations, user requirements, and make recommendations on deficiencies and gaps related to the use of such systems. Through this type of Forum, it is expected to reduce satellite data telecommunication costs for the transmission of observations from observational platforms to data processing centres on land, and better address user requirements for high temporal and vertical resolution data, and improved timelines.

This issue was presented to the fifth Session of the WMO Commission for Basic Systems (CBS) Expert Team on Requirements and Implementation of Automatic Weather Stations (ET-AWS) at its fifth Session, Geneva, 22-25 June 2010. ET-AWS considered the needs of member countries for communication of real-time data from Automatic Weather Stations (AWS), recognised the existing JCOMM arrangement in negotiating Tariff Agreements with Argos, and noted the recommendation from the JCOMM Pilot Project for WIGOS to work towards establishing an international Forum of users of satellite data telecommunication systems. ET-AWS also recognized that there would be benefit in having a strong user base covering multiple applications to address system deficiencies, negotiate tariff and potential improvements of the rendered services with the operators of satellite data telecommunication systems.

The issue was further discussed at the sixth Session of the CBS Implementation/Coordination Team on the Integrated Observing System (ICT/IOS), Geneva, Switzerland, 28 June – 2 July 2010, and the extraordinary session of the CBS, Namibia, 17-24 November 2010, which lead to specific recommendations made to the WMO Congress.

3 PROPOSAL

WMO Congress decisions

Cg-XVI requested the WMO Secretariat to approach the partner organizations, and coordinate with the Argos Joint Tariff Agreement (JTA) with the view to establish such a Forum during the next intersessional period.

Cg-XVI emphasized that such a Forum should not only consider tariff negotiations but should take a very broad view of available technologies, options and prices as well as cooperative mechanisms through the Data Collection Platform (DCP) services of meteorological satellites.

In particular, there was concern during Cg-XVI that data from many Antarctic stations funded by research agencies are not available in real-time and, therefore, are not available to NWP systems. Cg-XVI noted that the high communication cost involved in using Iridium satellites is also a limiting factor. Cg-XVI requested the Executive Council, and the Secretary-General, in collaboration with the Commission for Basic Systems (CBS) and the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) to investigate possible ways to reduce such costs through an international Forum of users of satellite data telecommunication systems. It was also recognized that the WMO Information System (WIS) would provide a suitable environment for collection and dissemination of data from research observing stations.

Governance

It should be noted that, once established the Forum shall report to the executive bodies of the co-sponsor Organizations through mechanisms defined by each Organization.

WMO Governance

Regarding the WMO side of the governance, it was proposed to place the Forum under the responsibility of the CBS, who shall coordinate closely on related issues with JCOMM.

The Forum will be reporting to the WMO Executive Council through the CBS.

The twelfth session of the CBS Management Group (CBS-MG-XII) considered the proposed road map

leading to the establishment of the International Forum of Users of Satellite Data Telecommunication Systems. It endorsed the Preliminary Draft Terms of Reference (Appendix A, doc 6.1) for a WMO-IOC-FAO International Forum of Users of Satellite Data Telecommunication Systems and requested the Open Programme Area Group on Information Systems and Services (OPAG-ISS) to take the responsibility for the establishment of the Forum and coordinate closely this activity with the Open Programme Area Group on Integrated Observing Systems (OPAG-IOS).

IOC Governance

The Forum governance by the Intergovernmental Oceanographic Commission (IOC) of UNESCO is still to be discussed with this International Organization.

Proposed workplan

CBS-MG-XII reviewed and endorsed the proposed workplan leading in principle to the formal adoption of the Forum in 2013 (Appendix A, doc 6.4). To realize this, the Secretariats of the co-sponsor Organizations will work together in the view to set up an organizing committee, refine the draft terms of reference for the Forum, and organize an *ad hoc* workshop in late 2012. The *ad hoc* workshop will be tasked to:

- Propose operating principles, including Terms of Reference of the Forum's Executive Committee
- Adjust the draft Terms of Reference proposed by the Secretariats,
- Elect an Interim Executive Committee,
- Review current satellite data telecommunication issues,
- Identify areas where progress/proposals can be made
- Refine the workplan for formal adoption of the Forum by the Executive Bodies of the co-sponsor Organizations

4 CONCLUSIONS

The ad hoc Satcom Forum was invited to take note of this proposal, make recommendations as appropriate regarding the governance, and proposed workplan.

ANNEX VII

TERMS OF REFERENCE AND MEMBERSHIP OF THE INTERIM EXECTUVE COMMITTEE FOR THE ESTABLISHMENT OF THE SATCOM FORUM

The Interim Executive Committee for the Satcom Forum shall:

- Drive the workplan leading to the establishment of the Satcom Forum by the co-sponsoring organization;
- Submit the Terms of Reference of the Satcom Forum to the CBS Management Group and the GOOS Steering Committee;
- Once the Terms of Reference are adopted, act as Interim Executive Committee of the Satcom Forum until the first formal Satcom Forum event
- Negotiate with potential hosts, and propose a venue for the next Satcom Forum event
- Investigate establishment of a trust fund, seek potential contributors, and propose initial budget for supporting the Forum's activities
- Propose agenda and documentation plan for the next Satcom Forum event
- Organize the session of the next Satcom Forum event

The membership of the Organizing committee includes:

- Chair, David Meldrum (UK)
- Johan Stander (EC-PORS)
- Sean Burns (CGMS Secretariat)
- Eric Locklear (USA)
- Mariuxi Chavez (Spain)
- Bill Woodward (USA)
- Wolfgang Marxer (Germany)
- Andy Sybrandy (USA)
- Paul Hill (Canada)
- Tom Gross (IOC Secretariat)
- Etienne Charpentier (WMO Secretariat)

ANNEX VIII

USEFUL SATCOM CRITERIA AND DRAFT METRICS

The following is a list of criteria which may be described in tables published by the Satcom Forum describing the specifications of satellite operators or requirements of users.

- Transmission Frequency - Determines size and type of antenna
- Type of service (packet or streaming) - Some platforms perform better when using packet systems.
- Packet size and repetition rate, or streaming data rates - Care should be taken to understand actual data rates
- Timeliness: Getting data onto GTS not as automatic with Iridium.
- Availability, are satellites available. Not a problem with geostationary satellites if you are within view of a satellite and not in the polar regions. Not a problem with big LEO systems.
- Performance in different environments, such as extreme temperatures, rough oceans.
- Power Consumption - This is very important on some platforms.
- Inherent Positions - Positions calculated inherently through the signal transmitted by platforms without the need for a GPS receiver can reduce power consumption significantly
- Long Term Viability of Satellite System - Users and manufacturers both need long term stability in order to optimize planning of instrument production and deployment.
- Availability - Not simply telemetry coverage, but including regional governmental restrictions and frequency interference.
- Technical Support.

EXAMPLE OF FORMAT IN WHICH WMO AND IOC REQUIREMENTS COULD BE PROVIDED

Details by platform type								Usable satellite systems					
	No in fleet	Obs size (kbyte)	Obs frequency (day^{-1})	Platform annual data demand ($Mbyte.yr^{-1}$)	Fleet annual data demand ($Mbyte.yr^{-1}$)	Data timeliness (hr)	Data cost as % of lifetime cost	GEO		Big LEO			LEO
								GMS	Inmarsat	Iridium	Globalstar	Orbcomm	Argos
Argo	3000	1 – 10	0.1	0.05 – 0.5	110 – 1100	24				x			x
AWS	200+	1 – 10	24	10 –100	2000 – 20000	0.5		x	x	x	x	x	x
Polar AWS	300+	1	8 – 24	3 –10	900 – 3000	0.5				x			x
Drifting buoy	1500	0.1 – 1	24	1	1500	0.5				x	x	x	x

ANNEX IX

SATCOM REQUIREMENTS FOR AUTOMATIC WEATHER STATIONS (AWS)

(Information provided by Francesco Sabatini, Italy)

1 Remote data transmission is an important feature which adds more complexity to the AWS system. In particular it requires a careful evaluation in terms of power (normally it is the part of the system that drains the most current, especially during data transmission), and cost of (i) the hardware (modem, antenna, improved power supply…), (ii) data transmission (i.e. future sustainability), and (iii) routine checks towards provider for GSM/GPRS or satellite services, i.e. available credit on the SIM for each contract (each station + base station); tariffs, comparison of the expected cost to the invoices received.

2 After the site of observation has been precisely identified, a specific selection of the telemetry option can be based upon the following:

- Presence of an affordable phone landline at the site of installation
- GSM/GPRS/CDMA service coverage at both the site of observation and at the base station
- Radio frequency availability and license restrictions. Distance of the observation sites from the base station. (Signal repeaters required?)

3 Normally the satellite option chosen is the one to overcome the disadvantages of the other systems. Coverage of the service as stated by the providers is normally affordable. It can be more complex and/or expensive with respect to the other telemetry options (unless it is possible to access a Meteosat platform as a recognized National Meteorological Service).

4 More, as reported by Mike Prior-Jones of the British Antarctic Survey, in some cases geostationary satellite over the equator (i.e. INSAT) could pose connection problems in mountainous areas or steep valleys of the Asian countries, because it may be impossible to receive the signal as the mountains are in the way. LEO networks (i.e. Iridium) being polar-orbiting systems and so the satellites pass overhead, eliminating the problem.

5 Iridium terminals are also likely to be considerably cheaper than VSAT/INSAT terminals for small remote installations like weather stations. VSAT systems like INSAT provide much higher bandwidth than Iridium does, so are better suited to applications that require a high volume of data.

Challenges

6. In ET-AWS meeting of 2010 Rodica Nitu of Environment Canada reported that “The transition from manual to automated observation of atmospheric parameters represents an opportunity and a significant challenge for the applications using meteorological, climatological, etc data. While an AWS is capable of consistent and reproducible measurements in time and space, the implementation of the measurement techniques is yet to deliver all observations approaching those of a human observer”. In this context telemetry option is of primary importance to receive timely observations and addressing the first level of quality control check on the data. Further challenges are:

- Identifying the suitable data communication system
- Importance of filling gaps of observations (i.e. from remote areas)
- Satellite telemetry for Remote AWS (RAWS) but not only (i.e. as a backup system for road management and early warning systems for extreme events such as snow, heavy rainfall, landslide, etc.) to overcome local GPRS or GSM failure

Actors

7. The installation or the rehabilitation plans of the meteorological and/or the hydrological observations networks, are normally brought forward by local NMHS’s often supported by International Organizations (World Bank, WMO, FAO, GIZ...) in cooperation with Universities, Research Institutes, specific consultants and AWS manufacturers

Local or international data transmission providers (or their representatives) complete this composite list of actors in setting up the whole system, which can be based on CDMA (i.e. Nepal), GPRS (i.e. India), 4G (i.e. Haiti), Satellite (i.e. Canada, Australia, Afghanistan, Iraq)

Hardware

8. The remote modem is normally connected and controlled by the data-logger. Transparent data protocol is recommended in order to allow AWS manufactures to easily program their own systems (firmware). Availability of public application notes and clear examples may help this activities. Low power drain, fast handshaking with the satellite and robustness to operate in harsh environments are features required for deployment at RAWS.

Data transmission system

9. Normally low data rate and low bytes amount are normally exchanged between RAWS and the base unit; timeliness may have a lower priority at synoptic stations whilst it is a feature of a primary importance on applications like flooding alert, water management, advanced agricultural meteorology, road management.

10. In WMO ET-AWS 2010 it was agreed to “collaborate in the development of WMO requirements for satellite communication of data, and should include other interested parties, e.g. FAO and IOC. ET-AWS acknowledged that while there is a strong demand in the JCOMM community to address such requirements because all ocean observing platforms rely on satellite data telecommunication, the demand also exists for land based systems operating from remote areas, and from regions where ground based telecommunication infrastructures are not necessarily well developed (e.g. RA-I). There is also a growing number of satellite data telecommunication system operators, some of which not being anymore in a monopolistic situation for specific types of observing platforms (e.g. Argos for drifters, Inmarsat for VOS), and others now offering high bandwidth, better timeliness, and/or lower transmission costs (e.g. Iridium). At the same time, there is an increasing demand for the transmission of higher resolution data, better timeliness, and downlink capability”.

11. In several applications even if GSM/GPRS or CDMA service is available at the given site we have to pay attention to their level of maintenance and to the expected repair time interval in case of failure (i.e. flooding, lightning, remote sites not accessible, etc). In tis case both the installation and running costs vs its reliability is the key point. .

12. In such case satellite telemetry may play the role of a backup system to overcome temporary failures or cell phone service unavailability.

Requirements

13. It may be incorrect to ask for a generic reduction of the satellite data transmission services without considering the specific applications. The transmission frequency and the amount of bytes transmitted, are normally the key factors influencing the running costs. It may be more appropriate to talk about a cost effective hardware/service procurement, making an agreement with the providers on the basis of a flexible subscription fee related to the effective use. Some AWS's require few connections per day or at least once per day (heart-beaten), or they are equipped with a primary telemetry unit (i.e. GPRS) being the satellite unit the backup system which transmit data only in specific events.

14. Important requirements are also the power drain by the satellite device, the availability of application notes about the hardware / firmware configuration, the training of the users.

References

- Karl Monnik, WMO ET-AWS (Satcom meeting 2012)

- Satcom final report 2012
- Rodica Nitu, WMO ET-AWS 2010
- Feedback (Somalia, Nepal, Canada, Australia, Afghnistan)

ANNEX X

RECOMMENDATIONS OF THE AD HOC SATCOM FORUM

The ad hoc International Forum of Users of Satellite Data Telecommunication Systems (Satcom Forum, Paris, France, 3-4 October 2013) made the following recommendations:

(1) Recommendations regarding the use of the Inmarsat satellite data telecommunication system:

(i) Inmarsat is used for moored data buoys and tsunami buoys for the transmission of data terminal to terminal and terminal to server. For many countries including India, Inmarsat is a Government approved satellite telecommunication system and is critical for data transfer applications. All buoy systems have been developed with suitable hardware and software capability and the meeting stressed that Inmarsat should continue services of SAT C transmitter which is suitable for buoy applications, and thus Inmarsat may appreciate this societal need. This technology is well accepted and proven and hence should be retained and not withdrawn;

(ii) Inmarsat charges vary between Land Earth Station (LES) and there would be value in establishing a common tariff arrangement among all LES operators / Service providers;

(iii) Efforts should be made to prioritize data transmission according to applications, and give high priority to disaster risk reduction applications so that tsunami buoys would transmit their data as quickly as possible. Inmarsat can propose specific serial numbers, and the LES should ensure transfer within 3 minutes of the data required for tsunami early warning;

(iv) As there are many Government approved satellite communication, Inmarsat should not withdraw SAT C unless an alternative plan is made available for the scientific community;

(v) On technological improvisation, transceiver manufacturers could be asked to provide Inmarsat transceiver to have additional USB based connectivity port to interface with desktop PC / Laptop PC, since PCs with serial ports are becoming obsolete;

(vi) Inmarsat LES provides a very good service and are available for support. However at times, when faced with specific issues, a working mechanism with Inmarsat HQ/LES and Buoy operators could be developed to address transmission issues faced by Buoy operators;

(vii) Inmarsat can consider providing data transfer as free a service because they are linked to societal application as weather services are being provided to Ships. Moored buoy data would also be made available to the global community in GTS.

(2) For operational systems (and in particular for disaster risk reduction purposes), any GPRS/GSM telemetry solution should be supported by a backup Satcom system, and Satcom service providers need to recognize their importance in this regard and not impose punitive fixed charges for a backup service;

(3) A certification process should be established for companies providing GTS data distribution service on the basis of environmental data collected via satellite;

(4) To develop guiding materials with inclusion of synthetic description of the capabilities of the relevant Satcom systems, using metrics to be agreed upon;

(5) To establish a mechanism to allow for a useful dialogue to take place between the users and the Satcom service providers in particular for (i) informing Satcom providers about the user requirements; and (ii) informing users about the Satcom capabilities. Appropriate metrics should be developed for both aspects;

(6) In order to facilitate communication between Satcom users, Satcom service providers, and equipment manufacturers, explore the use of (i) conferences and expositions where users

would make scientific and technical presentation, and vendors would be offered table to display their equipments; (ii) social media (explore existing sites, and define #hashtags), and (iii) Internet forums like Wikipedia;

(7) Investigate whether tariff for low data rate applications could be negotiated with the Satcom service providers;

(8) To consider placing the Satcom Forum not only under the umbrella of the CBS, but also of JCOMM, so that the Satcom Forum becomes a joint JCOMM-CBS body;

(9) To widen the scope of the Forum as much as possible in terms of the user communities represented, and to approach organizations such as the World Wildlife Fund (WWF[31]), Movebank[32], and Bio-Logging[33] in the view to invite them to join the Forum as co-sponsors;

(10) To analyse six months of traffic from Argos JTA platforms by platform class in the view to highlight actual use of the system and to do a comparison with the Argos charges paid by the users of each class.

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31 http://www.wwf.org/
32 https://www.movebank.org/
33 http://bls5.sciencesconf.org/

ANNEX XI

COMPARISON OF PERFORMANCE FOR THE VARIOUS TRANSMISSION OPTIONS FOR SEA LEVEL STATIONS

(based on studies done by Hernandez and van Hoorne (both VLIZ, personal communication))

	GTS	Internet (FTP/Webservice)	BGAN
Transmit interval (min)	5 .. 15 (or +)	1 .. 60	5
AVG delay (min)	11	11-12	1-5
Ratio expected/arrived (%)	~100%	<< 80%	~100%
Access	Restricted/ WMO	Easy	Transmission = expensive
Format standardization	some	none	good
(Dis)advantages	- format decoding?	- lots of communication errors HTTP/FTP/timeout/..	+ trigger (no batch script)

ACRONYMS

AIS	Automatic Identification System
AnTON	Antarctic Observing Network
(R)AWS	(Remote) Automatic Weather Station
BGC	Biogeochemical
BUFR	Binary Universal Form for the Representation of meteorological data (FM 94)
CBS	WMO Commission for Basic Systems
CDMA	Code Division Multiple Access
Cg	Congress
CGMS	Coordination Group for Meteorological Satellites
CMA	China Meteorological Administration
CNES	Centre National D'Etudes Spatiales (France)- French Space Agency
CSD	Circuit Switched Data
CTD	Conductivity Temperature and Depth
D.C.	Developing Countries
DCP	Data Collection Platform
DCS	Data Collection System
DBCP	Data Buoy Cooperation Panel
DCP	Data Collection Platform
DHM	Department of Hydro-Meteorology of Nepal
CNR	Consiglio Nazionale delle Ricerche (Italy)
ET-SBO	CBS Expert Team on Surface-Based Observations
E-SURFMAR	EIG EUMETNET Surface Marine Operational Service
EUMETNET	Economic Interest Grouping (EIG) of European National Meteorological Services
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EC	WMO Executive Council
EC	Executive Committee
EC-PORS	WMO Executive Council Working Group on Polar Observations Research and Services
F.A.O.	Food and Agricultural Organization of the United Nations
GCOS	WMO-IOC-UNEP-ICSU Global Climate Observation System
GDP	Global Drifter Programme
GEO	Geostationary orbiting satellite
GFCS	Global Framework for Climate Services
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GLOSS	Global Sea Level Observing System
GMDSS	Global Maritime Distress and Safety System (of IMO)
GNSS	Global Navigation Satellite System
GOOS	IOC-WMO-UNEP-ICSU Global Ocean Observing System
GOS	Global Observing System
GPRS	General packet radio service
GRT	Gross Register Tonnage
GSC	GOOS Steering Committee
GSM	Global System for Mobile Communication
GTOS	Global Terrestrial Observation System
GTS	WWW Global Telecommunication System
HF	High Frequency
HKH-HYCOS	Hindu-Kush Himalaya Regional Flood Information System (HKH-HYCOS)
HRDCP	High Rate DCP
IBIMET	CNR Istituto di Biometeorologia (Italy)
ICIMOD	International Centre for Integrated Mountain Development

ICSU	International Council for Science
IOC	Intergovernmental Oceanographic Commission of UNESCO
IPAB	WCRP-SCAR International Programme for Antarctic Buoys
ISRO	Indian Space Research Organization
ITU	International Telecommunication Union
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS	JCOMM *in situ* Observations Programme Support Centre
JMA	Japan Meteorological Agency
JTA	Argos Joint Tariff Agreement
LEO	Low Earth Orbit satellite
MG	Management Group
NMHS	National Meteorological and Hydrological Service
NMS	National Meteorological Sercice
NOAA	National Oceanic and Atmospheric Administration (USA)
OPSCOM	Argos Operations Committee
RUDICS	Iridium Router-Based Unrestricted Digital Internetworking Connectivity Solutions
SAC	Special Access Code
SAT-C	Inmarsat C http://www.inmarsat.com/services/maritime-safety/inmarsat-c
Satcom	Satellite Data Telecommunication
Satcom Forum	International Forum of Users of Satellite Data Telecommunication Systems
S-AWS	Shipborne AWS
SAWS	South African Weather Service
SBD	Iridium Short Burst Data
SCAR	Scientific Committee on Antarctic Research
SIO	Scripps Institution of Oceanography (USA)
SLA	Service Level Agreements
SMS	Short Message Service (GSM)
SOT	JCOMM Ship Observations Team
SSB	Single Sideband Modulation
TT-Satcom	SOT Task Team on Satellite Communications
UHF	Ultra High Frequency
UK	United Kingdom
UMTS	Universal Mobile Telecommunications System
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
VAM	Value Added Manufacturer
VAR	Value Added Reseller
VOS	Voluntary Observing Ships
VSAT	Very Small Aperture Terminal
WCRP	WMO-IOC ICSU World Climate Research Programme
WMO	World Meteorological Organization
WHYCOS	World Hydrological Cycle Observing System
WIGOS WIS WMO WRC WWW	WMO. Integrated Global Observing System WMO Information System World Meteorological Organization World Radiocommunications Conference WMO World Weather Watch

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