REPORT BY THE TASK TEAM ON SATELLITE COMMUNICATION SYSTEMS

(report submitted by Sarah North, Chairperson, Task Team on Satellite Communication Systems)

Background & Introduction

1. The Task Team was originally established, at the first session of the Ship Observations Team (SOT-I Goa, February-March 2002); in response to concerns raised at JCOMM-I (Akureyri, June 2001) regarding the acceptance of Special Access Code 41 weather observations by some Inmarsat Land Earth Stations.

2. The Team's original remit was to consider how to address the disparity in Inmarsat costs, which are borne only by those National Meteorological Services that host LES and accept Code 41 messages, ideally with a view to developing a more equitable form of cost sharing

3. At SOT-II (London, July – August 2003), it was recognized that there was a risk that National Met Services faced with significant costs might decide to impose restrictions on the volume of Code 41 data that they are prepared to pay for, and this could have a consequential impact on the level of real time data availability.

4. Accordingly, the Task Team proposed several ways to address the problem, whilst maintaining the Code 41 principle that the costs should not have to be borne by the ship owners or managers. In particular, it was considered that some form of global cost-sharing scheme, financed through a single common fund presented the best approach. The fund could possibly be administered by WMO or by a single national service on behalf of all.

5. Proposals made by the team were subsequently referred to the JCOMM Management Committee (MAN-III, Geneva, March 2004) and thereafter brought to the attention of the WMO Executive Council (EC-LVI June 2004). However, the Council considered that the problem might best be addressed on a regional basis, and referred the issue back to SOT for further information before taking any decisions.

6. As a consequence of the Council's advice, the Task Team revisited the issue and proposed an alternative approach whereby an Accounting Authority could be assigned to oversee the payment of Code 41 satcom costs and act as the billing intermediary between the LES service providers and the NMS's that operate code 41 VOS. Whilst this approach was considered in detail at SOT-III (Brest, March 2005), it was generally considered that there were too many issues that would need to be resolved if it were to have any chance of success, and decided against pursuing an Accounting Authority solution.

7. Although the problem of fairly distributing VOS transmission costs was unresolved, the Task Team reported on several new developments at SOT IV (Geneva 2007) that were helping to reduce the burden of transmission costs borne by certain National Meteorological Services. In particular it was noted that:

   - The E-SURFMAR programme had established contractual arrangements with its member National Met Services to increasingly, compensate them, subject to budget provisions, for their VOS communication costs. This compensation had helped, to some extent, to alleviate the unfair burden borne by its members that host Inmarsat LES i.e. France, Netherlands, Greece and UK. Furthermore the compensation takes into account Inmarsat costs borne by European LES continues that are generated by both E-SURFMAR and non-E-SURFMAR ships.

   - The E-SURFMAR programme team had also developed technical innovations to reduce Inmarsat transmission costs arising from both manned VOS and Automatic Weather systems. For manned VOS E-SURFMAR Programme team had successfully developed a "half compressed" system of transmitting weather messages via Inmarsat which reduced the size of the message from five blocks to only two, resulting in a corresponding reduction in the transmission costs i.e. ~0.32 €* per message (i.e. assuming two blocks of 32 bytes), compared

with approximately 0.80 €* for a standard VOS message. A facility to send messages in half-compressed format is included in the latest version of the TurboWin electronic logbook. However, because the 'half compressed' message system requires the use of new Special Access Codes (e.g. SAC 412 if sent via Aussaguel LES), and dedicated software to uncompress the messages, only a small number of ships have adopted this system *(and only one ship was still using it at January 2009)*

- Recognising the increasing costs arising from the use of Automatic Weather Stations sending hourly data, Météo France had developed new compression software to enable messages from BATOS AWS systems to be sent via the Inmarsat-C Data Reporting Service. Because this new compression software resulted in a significant reduction in transmission costs (~ 0.145 €* per report) it was being rolled out to all BATOS ships. BATOS AWS messages are sent to the LES (currently only France-Telecom/Aussaguel and Stratos/Burum may receive the data) and are then routed by email to Météo-France for processing and insertion on the GTS.

- The E-ASAP programme had been active in addressing the need to reimburse the cost of ASAP TEMP messages sent via Inmarsat. TEMP code messages are comprised of four parts, and are significantly larger than SHIP code messages, so the transmission costs involved are significantly larger than standard VOS messages. Because the majority of these messages were historically sent via Goonhilly LES, the costs had traditionally been borne by the Met Office. At the time, arrangements were therefore made for participating E-ASAP countries to reimburse the Met Office for these costs. However, the transmission problems experienced following the closure of Goonhilly resulted in the discontinuation of this arrangement,and introduction of a new E-ASAP Satcom transmission system to email the TEMP messages via Inmarsat.

- Bilateral arrangements had also been established to reimburse costs e.g. between the German Weather Service, Deutscher Wetterdienst (DWD) and those NMSs who pay the additional communications costs caused by the closure of Raisting LES, and the consequential re-routing of German VOS messages via Burum and Goonhilly LES.

- With the increased use of Shipborne AWS systems, there was a notable move towards the use of alternative satellite transmission systems, in order to reduce costs. In particular, the Iridium satellite system not only offered global satellite coverage but substantial cost savings if the Short Burst Data transmission system is used. . Moreover, transmission delays, such as those associated with Argos transmissions used by MINOS AWS systems, were avoided and the system could provide two-way communication. Noting that the Iridium system was being evaluated under the DBCP's Drifter Iridium Pilot Project, it was decided at SOT IV to establish a new Iridium Task Team under SOT.

  [Note - Typical costs for an iridium message from the BAROS iridium AWS systems are currently ~0.07 €* per message (including monthly fees and assuming 6000 reports per year). Additional charges are incurred if the message length extends beyond the maximum allowed 32 bytes size for an Inmarsat C report e.g. if the Baros message exceeds its 30 Byte block size Vizada would, for instance, make a further charge for the second 30-byte block, while other providers charge by the addition bytes used.]

- A growing number of VOS were now willing to absorb the costs of sending their weather observations via email rather than using the traditional Code 41 systems. In addition, almost all the manually reporting offshore installations recruited by the Met Office in the North Sea had migrated to the use of email communications and many government service vessels and Antarctic survey vessels were now using email to send their observations.

8. Having considered the above issues and developments it was decided at SOT IV to re-establish the Task Team with a modification to its name and Terms of Reference as shown at *Annex 1*. The Teams report on the tasks assigned to them is in *Annex 2*.

ANNEX 1

TASK TEAM ON SATELLITE COMMUNICATION SYSTEMS

Tasks:

1. Evaluate the operational and cost-effective use of satellite data telecommunication systems for the real-time collection of VOS data in support of the World Weather Watch, GOOS, and GCOS;

2. Work closely with the Task Team on SOT Iridium and the DBCP Iridium Pilot Project;

3. Continue to monitor the cost implications of Inmarsat satellite communications sent by Code 41

4. Review all relevant JCOMM Publications to make sure they are kept up to date and comply with Quality Management terminology;

5. Report to the next SOT Session on any relevant issues/proposals

Members:

- Sarah North (TT Chairperson, United Kingdom)
- Frits Koek (the Netherlands)
- Robert Luke (USA)
- Derrick Snowden (USA)
- Pierre Blouch (France and E-SURFMAR)
- Toshifumi Fujimoto (Japan)
- Michael Myrsilidis (Greece)
- Representatives of countries where LES
- accepting Code 41 are located
- A representative of RA III

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ANNEX 2

REPORT ON THE TASKS ASSIGNED TO THE TASK TEAM ON SATELLITE COMMUNICATION SYSTEMS

Task 1 - Evaluate the operational and cost-effective use of satellite data telecommunication systems for the real-time collection of VOS data in support of the World Weather Watch, GOOS, and GCOS;

In addition to the use of Inmarsat satellite communications, which is required by the SOLAS Convention for most ocean going merchant ships, and which has been traditionally used for manually reporting VOS, a variety of different satellite systems are now available. As reported at SOT IV, these primarily include Iridium, Argos and Meteosat, which are increasingly being used in connection with shipborne AWS and databuoy systems.

Considerable work has been undertaken since SOT IV by the E-SURFMAR Programme to evaluate the relative merits of different satellite communication systems. This work will help to guide the work of the E-SURFMAR Task Team on AWS, which is aiming to develop a suitable specification for ship borne AWS systems for use on European VOS. A spreadsheet produced by E-SURFMAR comparing the relative cost advantages and limitations of Inmarsat, Iridium, and Meteosat transmission systems proposed for Automatic Weather Stations is in *Annex 3*. To provide a more accurate comparison of the operating costs of each system the spreadsheet also takes into account the amortization of relevant transmitter costs over 5 years.

It will be noted from this spreadsheet that the Short Burst Data (SBD) transmission costs associated with the Iridium system currently offer notable savings when compared to other systems. Additionally, Iridium is increasingly replacing Argos as the preferred method of transmitting drifting buoy messages. Iridium, with two-way communication ability and global coverage, is also now beginning to be used for a number of different shipborne AWS systems. In particular, it is used for the simple BAROS AWS systems that are being fitted to the majority of the upper air E-ASAP ships to assist with data targeting exercises, and is being considered as a replacement for the more complex BATOS AWS systems that currently use Inmarsat. Other shipborne AWS systems being tested with Iridium transmitters include the MetPod AWS and the Viasala MAWS systems and, in addition, Iridium is increasingly being employed on moored buoys that contribute to the E-SURFMAR programme. The iridium message is typically received as an email attachment that can be sent to a number of mailboxes.

Argos continues to be used as the transmission system for a number of MINOS simple AWS systems. The advantages of the Argos system are the low cost of the transmitters and the low power consumption. However, this is counterbalanced by the fact that transmissions depend on the location of the polar orbiting satellites relative to the ground receiving stations, which can result in significant transmission time delays. For this reason it is anticipated that there will be only very limited use of Argos for shipborne AWS in the coming years. Service Argos who prepares the FM-13 SHIP messages for insertion on the GTS (through Météo-France or NOAA) processes raw data from the NOAA satellites that host Argos systems.

Meteosat DCP’s continue to be used on a number of MILOS AWS systems, such as those fitted on German VOS, and on moored buoy AWS systems. The messages are received at Darmstadt and then sent onto the GTS. Whilst this system has the notable advantage that it is free of charge for EUMETSAT members, the transmitters are very expensive and the system is subject to allocated time slots. Users must also manage the integrity of the data to reduce transmission errors, and ongoing availability of suitable analogue and digital DCPs could be a problem. It is also unclear whether the use of DCP's is suitable for round the world ships when data would need to be sent via Meteosat, GEOS and GMES. Many moored buoys operated by the Met Office have now been fitted with dual

Meteosat and iridium transmission systems

With respect to Inmarsat, it will be noted from the spreadsheet at *Annex 3* that the use of data compression can result in significant cost savings. This has already been demonstrated for ships fitted with BATOS AWS systems that are sending their observations using the Inmarsat Data Reporting Service. The messages are emailed on by the Land Earth Stations to the processing centre(s). Decoding software is then used to prepare the FM-13 SHIP (or FM-96 BUFR) reports for insertion on the GTS.

There are several other systems that could potentially be used by VOS or SOOP ships, including Globalstar (which was tested on E-ASAP ships, but discontinued, as it did not offer a full global coverage) and Orbcomm. However, the team has not addressed the merits of these systems in this report.

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Another factor that will have a bearing on transmission costs in the coming years is the migration, away from alphanumeric WMO code formats such as FM13-SHIP to new binary WMO formats such as FM96-BUFR, which will allow for the reporting of additional parameters and associated metadata. However, the use of BUFR is primarily for the international exchange of data between national Meteorological Services, and is not considered a requirement for the real time transmission of observed data from ships. Accordingly, it is anticipated that the growing use of shipborne AWS systems is likely to give rise to a variety of proprietary transmission formats, the relative merits and cost benefits of which will need to be investigated by the Team in the coming years

In considering this Task, the team noted that the remit only made mention of VOS data and did not directly include SOOP data. SOT is invited to agree that this task should be broadened to clearly include the real time collection of satellite data in support of SOOP. *[Action]*

Task 2 - Work closely with the Task Team on SOT Iridium and the DBCP Iridium Pilot Project;

Several members of the Team have experience with iridium communication systems and been in contact with the SOT and DBCP iridium teams. Following the successful use of Iridium for transmitting short burst data from drifting buoys, Météo France in particular have been investigating and developing its use for both simple and complex shipborne AWS systems i.e. Baros and Batos systems respectively.

Twelve Baros stations reporting only hourly pressure measurements have already been built since the SOT IV meeting. A first prototype Baros system was installed by Météo France on a trawler from October 2007 to August 2008 and reported 4690 observations before being removed when the trawler was sold. By mid-February 2009, four Baros AWS were in operation on E-ASAP ships and eight others were ready to be installed. The data format is 15-byte long, and includes the observation time, the ship's heading and speed, the GPS latitude and longitude, the sea level pressure and its tendency over the past three hours. Data timeliness is excellent with the observation being received as an email only a couple of minutes after transmission. The data is then processed (FM13-SHIP and FM94-BUFR code) and then inserted onto the GTS (FM13-SHIP only for the moment).

Météo-France is also investigating interfacing an Iridium SBD modem in place of an Inmarsat-C one. The data format will be the same as that used for Inmarsat-C Data Reporting (32 bytes) allowing it to report a complete FM13-SHIP data set. Although the length of binary reports was limited to these 32 bytes with Inmarsat, the limitation will be higher with Iridium SBD, allowing the possibility of adding extra parameters to the message (e.g. wind gust, salinity, CO2 pressure, irradiances) Although communication costs are already low with the Inmarsat-C data reporting service (~0.15 € per report) they will be half as much again with Iridium i.e. provided that only one 30 byte block of data is needed for the message.

The Met Office have installed iridium deck drifters on two vessels (a research ship and a ferry) reporting pressure only. These are essentially identical to SVP-B drifting buoys, but with the drogues removed and the sea temperature readings disabled from going onto the GTS. Data quality is good although it is understood that if a GPS position fix is not made the previous position is kept for the observation. Although this is acceptable for a drifting buoy, it is not for a ship, which moves more quickly. (Note - New Iridium drifting buoys report the time of the last GPS fix, which could possibly be used to filter the GTS data transmission in the case of deck drifters put on board a ship). The Met Office is also testing a Vaisala MAWS automatic weather station fitted with Iridium, prior to putting it on a suitable ship.

Task 3 - Continue to monitor the cost implications of Inmarsat satellite communications sent by Code 41

As reported at SOT IV Goonhilly LES was effectively closed in November 2006 and the Inmarsat C services were transferred to Burum LES in the Netherlands. This followed the take over of Xantic (the company that previously operated Burum) by Stratos.

Although this transition was supposed to be seamless, it resulted in serious data transmission losses, message header format issues, and significant data delays. It also impacted on the issuance of SafetyNet broadcasts and warnings. The problem was caused by the inability of Burum LES to re-route the received observations back to the Met Office by the same telex routes as had previously been used. Following meetings with representatives from Burum LES, these problems where mostly resolved and data timeliness has now improved

However this change had a notable impact on the timeliness and availability of upper air TEMP code data from E-ASAP ships causing the E-ASAP Programme team to instruct its participating ships to switch their satcom configurations to use alternative Inmarsat LES (such as Aussaguel LES). However, in the last couple of years all the E-ASAP ships, which previously sent their messages via Goonhilly LES using code 41, have transferred to the use of a dedicated new E-ASAP email system whereby the TEMP messages are mailed direct to DWD, who currently manage the programme. This has resulted in a marked drop in the cost of Code 41 transmissions via Goonhilly.

Although Goonhilly has effectively closed, the Goonhilly ID numbers have been continued by Stratos, and the Met Office continues to bear the costs of VOS observations. In effect, Goonhilly is therefore now a 'virtual' LES in that all VOS traffic is now routed to Burum.

The problems experienced with the closure of Goonhilly highlighted the need to be able to ensure continuity of Inmarsat data traffic (both SHIP and TEMP) in order to meet E-SURFMAR and E-ASAP objectives, as well as the wider global forecasting and climate objectives. To ensure that such data losses are not experienced in future it was suggested at SOT IV that suitable emergency back-up arrangements may be needed, whereby data can be transferred to another LES/Supplier.*[Action]* It was further suggested that there was a need to have a clear mechanism to keep LES ID numbers up to date with ownership of the list clearly assigned to ensure that any changes are promulgated swiftly to VOS focal points and thence to observing ships.*[Action]* Unfortunately no progress was made on either of these points, and SOT is invited to reconsider them.

Since SOT IV, a number of further changes to the Code 41 list have arisen. Firstly, Vizada Satellite Communications, the primary provider of satellite communications for the U.S. notified their intention to make changes to their listed ID series in order to expedite their data routing systems. Consequently, all weather observations previously transmitted to the x01 series ID would be directed to the upgraded x04 series IDs. Although traffic from the x01 series IDs will continue to be processed, Vizada advised that transmission delays were increasingly likely and that it was therefore, imperative that ships should switch to using the X04 ID Series, i.e. switching from ID codes 001, 101, 201 and 301 to the following codes;

Operator	Service		AOR-W	AOR-E	POR	IOR
VIZADA	**C**	**004**		**104**	**204**	**304**
VIZADA	**C (Amver/SEAS)**	**004**		**104**	**204**	**304**

[Note - According to Vizada ships observers should follow the instructions provided by the mobile terminal manufacturer to change LES IDs for Ship-Shore calls- although there will be a few different solutions for how this is accomplished, depending on the terminal manufacturer. LES IDs x01 and x04 are selectable in all ocean regions and there are, no manufacturers that limit the selection to strictly x01. No 'bulletin board' changes are therefore required to support the changes.].

These changes to Vizada operated LES not only affect the US based LES (i.e. Southbury and Santa Paula) but also the Norwegian hosted LES (Eik). It is understood that NOAA will continue to collect the charges for all messages sent to Santa Paula and Southbury, and presumably also for Eik. (However, several VOS operators advise their VOS to avoid using this LES due to previous billing problems). Because many non US operated VOS also send their observations via US based LES it is therefore incumbent on individual VOS operators to make the changes known to their VOS fleets *[Action – VOS Operators]*. The way in which Vizada promulgated the change highlights the need for responsibility for the code 41 list to be clearly assigned. *[Action]*

Contact was also made with Vizada to clarify whether the LES operated by France Telecom provided global coverage and consequently whether ID numbers 021 (AOR-W) and 221 (POR) could be added to the list. Although Vizada subsequently confirmed that it was also possible to send code 41 messages via these ID numbers it remains to be confirmed whether Météo France, as the host LES country national met service will be willing to pay the costs associated with messages sent via IDs 021 and 221.

The fact that code 41 observations are now routed globally from all Inmarsat satellite footprints now brings into question the principle laid down in WMO guidance that weather reports should be sent to the nearest LES. Clearly, this is not happening nowadays and can be complicated by the fact that some ships may be instructed by their shipping companies to use only prescribed LES suppliers. Also, because the majority of LES that accept Code 41 observations are located in the Northern hemisphere it can be difficult to be sure which LES is the nearest. However, recent changes to the TurboWin program (Version 4.5 beta) to recommend the LES to send observations to could help in this respect. A map showing the distribution of Code 41 LES recommended in the TurboWin program is attached at *Annex 5*.

In this respect, it is also recalled that Arvi LES that imposes geographic limitations (e.g. based upon Metarea) on the areas from which they will accept Code 41 observations (e.g. Arvi).presumably to limit the costs incurred.

Confirmation has also recently been received from Stratos that ID X02 series supports SAC 41 in all four ocean regions and consequently that LESID numbers 302 (for the IOR region) and 202 (for the POR region) could be added to the list as stations that accept, or relay, Code 41 messages. Although these messages are now actually handled by Burum rather than Goonhilly it is believed that the costs associated with messages sent to ID 302 and 202 would still be collected by the Met Office. Accordingly, to avoid confusion it is suggested that these LES should be listed as Goonhilly/Burum in the LES list.

Because of company mergers in recent years, it should be noted that there are now essentially only two main providers of Code 41 LES stations. These two providers are Stratos (which acquired Xantic in February 2006 and adds to the previous mergers of BT, KPN, Telstra and Teleglobe) and Apax Partners (which bought out France Telecom in July 2006, purchased Telenor Satellite Services in October 2006, and incorporated them under the Vizada brand in 2007). Conglomerating LES services

in this way, and reducing the overall number of Code 41 LES, inevitably adds to the unfairness of the Code 41 reverse charging system. Introducing new ID number series also introduces new risks of increased charges being incurred by a smaller number of national meteorological services

A revised LES list to reflect the above-mentioned changes is attached in *Annex 4* for consideration and agreement at SOTV *[Action].* Changes made since SOT IV are indicated in red. Once this list has been agreed it is recommended that a new column should be added to the list to clarify which national met services are incurring the costs,

The Task Team originally undertook an initial review of Inmarsat costs borne by National met services whose countries host LES in 2003. Given the significant changes that have taken place since then, as outlined above, SOT is invited to instruct the Task Team to undertake a further review to determine the actual costs currently being faced by individual members in order to help guide future decisions about reducing the Inmarsat cost burden *[Action]*

In considering this Task members may wish to note that there Resolution A707 (19) issued by the International Maritime Organisation's Assembly in 1991 recommended '*… that States make every effort, consistent with domestic laws and policies, to arrange that meteorological reports, ship position reports and medical advice and assistance messages …. Shall be free of charge to shipping'*

Task 4 - Review all relevant JCOMM Publications to make sure they are kept up to date and comply with Quality Management terminology;

The Task Team recommends that the Code 41 list in WMO Publication 9 Volume D should be revised to reflect the updated list of LES that accept Code 41 messages at *Annex 4*. Details should be promulgated by WMO to all VOS operating countries listed WMO Publication No 47 *[Action]*

Details of the Code 41 list maintained on the WMO website (http://www.wmo.int/pages/prog/amp/mmop/inmarsat_les.html) should also be updated *[Action]*

A review of relevant GTS bulletins for ship observations listed in WMO Volume C1 (Catalogue of Meteorological Bulletins) may also be needed – see Task 5 below *[Action]*

Task 5 - Report to the next SOT Session on any relevant issues/proposals

The following issues have arisen since SOT IV, which are relevant to the work of the Task Team…

1. **GTS Bulletins for Inmarsat Code 41 observations**

It recently became known that if non-standard hour observations are sent to certain LES, or are sent from certain geographical areas, there is a possibility that they will not be inserted on the GTS and, consequently, the cost of the observations will have been wasted.

Initially it was discovered that observations sent to Burum LES from a research ship operating in Antarctica below 60 deg South weren't being put into a bulletin for transfer on the GTS. Following contact with the Dutch met service (KNMI) this situation has now been resolved and bulletins are now issued

Following further investigation it also became apparent that certain countries that host LES accepting Code 41 observations might not be putting observations sent at intermediate or non-standard hours onto the GTS. This appears to be borne out by examination of WMO Volume C1 (Catalogue of Meteorological Bulletins) which lists the following bulletins

Australia - Perth : ABRF, ADRM, APRF, APRM, AMMC, AMRF, ASRF
Non standard hour bulletins not issued

Japan - Yamaguchi : RJTD
Non standard hour bulletins issued

Singapore - Sentosa : WSSS
Non standard hour bulletins and intermediate hour bulletins not issued

Arvi - India :
No Information available

Thermopylae - Greece : LGAT
Non standard hour bulletins not issued

Aussaguel - France : LFPW, LFVW
Non standard hour bulletins issued

Southbury and Santa Paula - USA : KBIX, KGWC, KWBC, KWAL, KNHC,
Non standard hour bulletins issued

Station 12 Burum - Netherlands : EHDB
Non standard hour bulletins not issued outside North Atlantic

Goonhilly - United Kingdom : EGRR
Non standard hour bulletins issued

It therefore appears that non-standard hour observations sent to Perth, Sentosa, Thermopylae and Burum LES may not always be circulating on the GTS (although in the case of Perth it is understood that the non-standard hour observations may be sent with later collectives). Given the value of these observations in real time, and the fact that SOLAS requires ships to undertake more frequent observations when in the vicinity of tropical cyclones, it is suggested that the WMO Secretariat should invite members to check the accuracy of their entries in WMO Volume C1 to ensure that all ship observations are circulated on the GTS irrespective of the hour that they are sent or the geographical area they are sent from *[Action]*

2. AIS

Although, the AIS systems carried by VOS are not presently capable of transmitting weather data, recent developments within the IMOs correspondence group on AIS, appear to have accepted that weather data should be included in one of the proposed future binary message formats [this issue will be considered separately by the VOS Panel]

In a separate but related development, space-based initiatives to extend AIS vessel tracking capability are currently being investigated by a number of countries. In particular, in 2004 the US Coast Guard established a contract with Orbcomm to develop and build the capability to receive process and forward AIS signals from space via an AIS receiver onboard their communications satellites. .At the start of 2009 Orbcomm's constellation of more than 30 spacecraft included six recently-launched satellites carrying AIS receivers, making it the first commercial provider of globally collected AIS data from space. (Lloyd's Register – Fairplay has signed a global distribution agreement with ORBCOMM to allow it to distribute information obtained from ORBCOMM's AIS equipped satellite constellation).

3. Coding and Transmission errors

As reported at SOT IV there are a substantial number of observations received by Goonhilly LES that are rejected for a variety of coding errors e.g. BBXX or call sign missing, empty transmissions with no data, use of O (i.e. the letter O) instead of 0 (i.e. the digit zero), incorrect code group lengths etc. Whilst these errors represent wasted communications costs, their number has reduced since SOT IV, possibly due to the quality control checks in e-logbooks like TurboWin and increased use of AWS systems. Details of such transmission errors arising from Goonhilly LES continue to be circulated by the Met Office to VOS operators via the JCOMMOPS mailing lists, so that remedial action can be taken. It is proposed that the SOT invites other National Met Services that host LES toconsider circulating similar coding/transmission error lists *[Action]*

4. Broadband/email

The number of manually reporting VOS sending their weather observations direct by email, rather than via Code 41, has continued to grow since SOT IV, thereby helping to reduce the burden of transmission costs faced by meteorological services. This trend is expected to continue in the coming years as broadband communication systems become more widely available on merchant ships. These systems will also allow the use of web based electronic logbook software such as that currently being developed for the TurboWin program

SOT is invited to advise VOS operators, whenever possible, to encourage their manually reporting VOS to consider moving to the use of email to send their weather reports in lieu of using Inmarsat Code 41 (but subject to individual ship-owners being willing to absorb the costs) *[Action]*

5. Masking of ship's call signs

The current trials of call sign masking methods will also have potential implications for determining Inmarsat satellite communication costs. If call signs were masked by securely held, but unique, generic identifiers, it would still be possible to assign individual ship communications costs back to the originating VOS operating countries. This will be necessary for programmes like E-SURFMAR, where participating countries are compensated for the communication costs incurred by their VOS (and for costs incurred by non European VOS that are paid by E-SURFMAR members)

Where the non-unique identifiers such as ‘SHIP’ disguise ships identities it will be more difficult to correctly, assign the costs associated with individual ships, unless the Inmarsat numbers of all the ships that use a particular LES are known. The use of ‘SHIP’ on European VOS would make it extremely difficult for the E-SURFMAR program to arrange compensation for its member countries.

ANNEX 3

ADVANTAGES AND DRAWBACKS OF SOME COMMUNICATION SYSTEMS

FOR AUTOMATED WEATHER STATIONS

Caution: *indicative costs given below (in Euros) only are provided for comparison purposes and exclude Value Added Tax. They cannot therefore be guaranteed and should only be considered as indicative costs*

	Inmarsat C		**Meteosat DCP**		**Iridium SBD**	
Type	GEO		GEO		LEO	
Coverage	Limited to 70N-70S		Limited to 60N-60S		Yes	
Transmitter + antenna cost	2,200 €		5,500 €		850 €	
Timeslots	No		Yes		No	
Risk to have a mask during transmission	Yes		Yes		Weak	
Transmission integrity	Ensured by the system		To be managed by the user ??		Ensured by the system	
Data format	Text (***)	Binary (DR)	Text	Binary	Text (***)	Binary
Data processing	Required for BUFR	Required	Required for BUFR	Required	Required for BUFR	Required
In use	Yes	Yes	Yes	??	??	Yes
Operating (*) cost/report	0.39 €	0.12 €	0 €	0 €	0.13 €	0.06 €
Total (**) cost/report	**0.46 €**	0.19 €	0.18 €	0.18 €	0.16 €	**0.09 €**

(*) Monthly fees included if any
(**) Assuming an amortization over 5 years and 6,000 reports per year.
(***) for Inmarsat C text and Iridium text messages, the table assumes only three 32-byte blocks (96 characters maximum) per report. Reports from AWS systems that contain no visual observations will require less than 96 characters.

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ANNEX 4

PROPOSED REVISIONS TO THE CODE 41 LIST

ATLANTIC OCEAN REGION-EAST (AOR-E)		
Name of station	**Country**	**ID number**
Aussaguel	France	121
Goonhilly/Burum	United Kingdom	102
Southbury	USA	104
Burum	Netherlands	112
Thermopylae	Greece	120
ATLANTIC OCEAN REGION-WEST (AOR-W)		
Name of station	**Country**	**ID number**
Goonhilly/Burum	United Kingdom	002
Southbury	USA	004
Burum	Netherlands	012
Aussaguel	France	021
INDIAN OCEAN REGION (IOR)		
Name of station	**Country**	**ID number**
Arvi	India	
Aussaguel	France	321
Eik (Oslo)	USA	304
Sentosa	Singapore	328
Burum	Netherlands	312
Thermopylae	Greece	305
Yamaguchi	Japan	303
Goonhilly/Burum	United Kingdom	302
PACIFIC OCEAN REGION (POR)		
Name of station	**Country**	**ID number**
Santa Paula	USA	204
Sentosa	Singapore	210
Burum	Netherlands	212
Yamaguchi	Japan	203
Goonhilly/Burum	United Kingdom	202
Aussaguel	France	221

Note 1: Arvi will accept code 41 reports from within Metarea VIII (N) only.
Note 2: Ships previously reporting through Perth (renamed to Station 12) must use SAC 1241 when sending weather reports through POR/212 or IOR/312.
Note 3: Vizada Satellite Communications, the primary provider of satellite communications for the U.S. VOS program has recently upgraded their system to expedite communication traffic flow. As with most technological advances, some older systems become less productive. In order to ensure expedited routing, all communication normally transmitted to any x01 series ID should be directed to the upgraded x04 series IDs. While the x01 series IDs will continue to process any communication traffic received, transmission delays will become more and more likely. Therefore, it is imperative that everyone start switching their INMARSAT addresses over to the X04 Series, i.e. switching from codes AOR-E/101, AOR-W/001, and POR/201 to AOR-E/104, AOR-W/004, and POR/204 respectively.
Note 4 As the Inmarsat Access Control and Signalling Equipment (ACSE) previously located in Goonhilly Land Earth Station has now been physically relocated to Burum, this service is now effectively operated from Burum. However, the ID Numbers associated with Goonhilly (i.e. the X02 series) remain in use.

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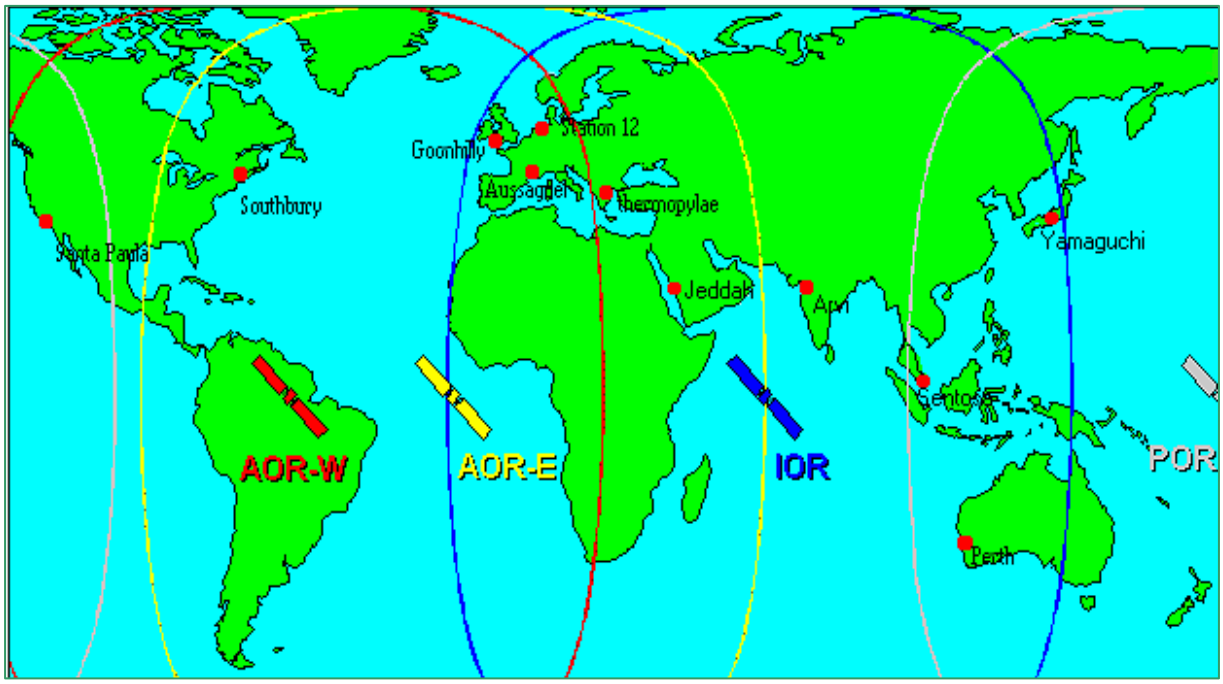
ANNEX 5

DISTRIBUTION OF RECOMENDED CODE 41 LES WITH INMARSAT SATELLITE FOOTPRINTS
(From TurboWin Program)



[Note - Norwegian LES Eik is not shown on the above map]

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