World Meteorological Organization
Organisation météorologique mondiale

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Our ref.: OBS/SAT/CGMS

GENEVA, 23 July 2012

Annexes: 2 (available in English only)

Subject: Survey on Current and Planned Use of L-Band and X-Band Direct Readout Services from Polar-Orbiting Satellite Systems

Action required: Respond directly online no later than **5 September 2012**

Dear Sir/Madam,

The purpose of this letter is to draw your attention to an evolution of direct readout systems that will affect future generations of polar orbiting satellites, and to seek your feedback on this matter requiring careful consideration by all WMO Members who are using or planning to use such direct readout systems.

Most operational meteorological satellites in polar-orbit have been transmitting data to the ground in real-time in the 1675-1710 MHz band, which is the part of the L-Band for which the International Telecommunications Union (ITU) has given a primary allocation to space-to-Earth transmission from meteorological satellites. A great advantage of this band is its limited attenuation by rain, which enables its use in all weather conditions, an essential requirement for operational meteorological data.

Several satellite operators are now considering using the X-Band (around 8 GHz) for direct readout from future generations of polar-orbiting systems. The main reason is that advances in remote-sensing technology result in high-resolution instruments that will generate one order of magnitude more data than a decade ago, and such high data rates cannot be accommodated in lower frequency transmissions. Furthermore, progress in radio-communication techniques renders X-Band receiving equipment more affordable than it used to be. Within the X-Band, the 7750-7900 MHz band has been given, by the ITU, a primary allocation to space-to-Earth data transmission from polar-orbiting meteorological satellites.

For users, the consequence of direct readout services being available in X–Band, in comparison to the L-Band, can be summarized as follows:

- Access to higher data rate services (order of magnitude 100 Mb/s instead of 10 Mb/s), which is necessary for full data access at full resolution;

- Need to use a higher-class antenna and receiving chain;

To: Permanent Representatives (or Directors of Meteorological or Hydrometeorological Services) of Members of WMO (PR-6656)

cc: Hydrological Advisers to Permanent Representatives)
CGMS Secretariat (EUMETSAT), Darmstadt) (for information)

- Higher sensitivity to rain, requiring appropriate margins in the link budget, especially for inter-tropical latitudes;

- Higher risk of interfering sources: the X-Band is used by many other telecommunication applications, and the feasibility to operate an X-Band receiving site without interference has to be checked on a case by case basis for each site. To avoid interference issues, it is essential to immediately register the receiving site and frequency with the national radio-frequency regulator for the intended operation.

Bearing in mind the respective advantages and limitations of these two frequency bands for satellite data transmission, the current WMO requirement foresees two parallel direct broadcast services:

- A high data rate stream, that can be in X-band, containing full resolution data needed for NWP, Nowcasting and other real-time applications;

- A low data rate stream, in L-Band, containing a subset of data (e.g. selected channels, lossy compressed data). This low data rate stream would secure the possibility to receive data in all atmospheric conditions, with less exposure to potential interference sources, and with a lower-class antenna similar to the ones used for current L-Band Direct Readout services.

The combination of these two services is expected to satisfy the user needs for efficiency, robustness and affordability. However, maintaining two different services in parallel is a design constraint for future satellite systems. Therefore, in order to re-assess this requirement, the Coordination Group for Meteorological Satellites (CGMS) has invited WMO to enquire with its Members their position on this matter, and to invite their feedback. For this purpose, a short online survey has been prepared, which includes nine questions. A copy of these questions is provided in Annex I, and some background information is provided in Annex II.

I would be grateful for receiving your responses to this short survey, using preferably the online version: http://www.surveymonkey.com/s/wmolbandxbandsurvey2012. Your responses will be analyzed and reported back to satellite operators at the next meeting of CGMS in November 2012. Please do not hesitate to consult the Secretariat (jlafeuille@wmo.int or sbojinski@wmo.int) if you need further clarification.

Your response on this important satellite data dissemination issue is expected by no later than **5 September 2012**.

Thank you in advance for your cooperation.

Yours faithfully,

(J. Lengoasa)
for the Secretary-General

WORLD METEOROLOGICAL ORGANIZATION

OBS/SAT/CGMS, ANNEX I

Survey on Current and Planned Use of L-Band and X-Band Direct Readout Services from Polar-Orbiting Satellite Systems

You are invited to provide your responses on line at:
http://www.surveymonkey.com/s/wmolbandxbandsurvey2012
(If you have multiple receiving stations, please complete this survey for each receiving station individually)

1. Please indicate your member country or territory

2. What is the location of your receiving station?

Station name	Latitude (N/S)	Longitude (E/W)

3. Are you receiving or planning to receive a direct readout service from polar-orbiting satellites in L-Band at this station?

Satellite series	Currently operating	Planning to operate
NOAA/POES	YES/NO	YES/NO
METOP	YES/NO	YES/NO
FY-3	YES/NO	YES/NO
Meteor-M	YES/NO	YES/NO
JPSS/LRD		YES/NO
Other L-Band service		

4. If you are receiving in L-band, did you experience any transmission losses due to weather conditions?

Transmission losses
No significant loss
Some losses
Severe losses

5. Are you receiving or planning to receive a direct readout service from polar-orbiting satellites in X-Band at this station?

Satellite series	Currently operating	Planning to operate
Aqua/Terra	YES/NO	YES/NO
Suomi-NPP	YES/NO	YES/NO
FY-3/MPT	YES/NO	YES/NO
JPSS/HRD		YES/NO
Other X-Band service		

6. If you are receiving in X-band, did you experience any transmission losses due to weather conditions?

Transmission losses
No significant loss
Some losses
Severe losses

7. Did you notify this receiving station to your national radio-frequency regulatory administration?
   If yes, please indicate which services and frequencies you notified to the regulatory administration

8. In the event that full resolution data of future polar-orbiting systems would be transmitted in X-band, do you have a need for additional transmission, in L-band, of a subset of the data stream (low data rate)? For which reason (back-up, atmospheric conditions, regulatory context, interference, affordability of X-Band equipment, etc.)?

Need of L-Band low data rate service in addition to X-Band high data rate service
Not needed
Needed for back-up purposes
Needed for weather resilience purposes
Needed for interference purposes
Needed because it is more affordable
Needed for other reason

9. In the event where you could not rely on an X-Band receiving equipment for any reason (atmospheric, regulatory, interference, affordability....), and no L-Band service would be available, do you think that alternative ways would meet your operational needs (e.g. Internet , "RARS" data retransmission by EUMETCast, CMACast or GEONetCast, etc.)?

Possibility to use alternative means
No alternative available
Could use retransmission from neighbouring X-Band stations
Could use the Internet
Other:

OBS/SAT/CGMS, ANNEX II

BACKGROUND INFORMATION FOR THE SURVEY

Direct readout (or Direct Broadcast)

The polar-orbiting meteorological satellites that have been operated over the past four decades and until now, such as the NOAA/POES, Metop, FY-3, Meteor-M series and the recently launched S-NPP satellite, all include a "Direct readout" capability, also called "Direct broadcast". This enables users located anywhere on the globe to receive data in real time from the spacecraft when it passes in visibility of the user receiving station. For polar-orbiting satellites, this direct readout functionality is the only way to collect the data in real-time, without waiting for them to be stored aboard the spacecraft, downloaded to the main data acquisition station, processed and redistributed. These direct readout services normally follow the LRPT/AHRPT dissemination standard[1] adopted by the Coordination Group for Meteorological Satellites (CGMS).

L-Band

The term L-Band generally designates the 1-2 GHz frequency range. Within the L-Band, the1675-1710 MHz frequency band has been allocated primarily to meteorological activities, including meteorological satellites and radiosondes. The lower part of the band (1675-1695 MHz) is mainly used by geostationary satellites, the upper part (1695-1710 MHz) by polar-orbiting satellites.

With the exception of S-NPP which was launched in November 2011 by the United States, all polar-orbiting meteorological satellites perform direct broadcast in the1695-1710 MHz band. Some of these satellites include an additional dissemination capability either at a lower frequency (135 MHz), or at a higher frequency band (X-Band).

X-Band

The term X-Band generally designates the 7 to 11 GHz frequency range in communications engineering (Note: in the radar context, it often designates the 8 to 12 GHz range). Within the X-Band, three bands have been allocated to space-to-Earth transmissions from meteorological or environmental satellites:

- 7450-7550 MHz for geostationary satellites (e.g. Elektro-L for raw data);
- 7750-7900 MHz for non-geostationary meteorological satellites (e.g. S-NPP);
- 8025-8400 MHz for Earth exploration satellites (e.g. Aqua 8160 MHz).

Weather resilience

The X-Band is known to be exposed to attenuation by liquid water in the atmosphere. Investigations suggest that the attenuation can be significant in some areas, e.g. in equatorial regions. (See: Shoewu, O and Edek, F.O, Microwave signal attenuation at 7.2GHz in Rain and Harmattan Weather, AJSIR, 2011).

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[1] LRPT/AHRPT Global Specification, CGMS-04 (http://www.cgms-info.org/docs/publications-and-reference-documents/2011/01/22/pdf_cgms_04.pdf)

Notification process to radio-communication administrations

Given the need to protect as far as possible a receiving site from the future implementation of neighbouring interfering sources, it is strongly recommended to register each receiving site with the relevant national radio-frequency authority. This process should be initiated preferably at the very early planning stage of the receiving station, or as soon as possible thereafter. The registration implies to notify the exact location of the station, the frequencies at which it will operate, and the particular services it will support.

It is noted that on 28 June 2012, the sixty-fourth session of the Executive Council adopted a resolution urging Members *"To register adequately with their national radiocommunication administrations all terrestrial and space radiocommunication stations/systems and radio-frequencies used for meteorological and related environmental operations and research".*

RARS

The Regional ATOVS Retransmission Service (RARS) is a data distribution scheme used for near-real-time dissemination of sounding data from polar-orbiting satellites, mainly for the benefit of global NWP centres. (See: http://www.wmo.int/pages/prog/sat/rars_en.php). Data are received by a network of Direct Readout stations distributed around the globe, processed in a coordinated fashion, and made available to the global community via the Global Telecommunications System or other means such as EUMETCast or GeoNetCast (see below).

RARS does not replace Direct Readout capabilities: it leverages the use of Direct Readout stations in sharing the data, making this data available to users located beyond the visibility area of the satellite. The RARS scheme is a trade-off between, on one hand, the real-time acquisition by local Direct Readout stations and, on the other hand, the delayed access to global data stored aboard the satellite.

Geonetcast and other DVB-S retransmission services

WMO encourages the use of integrated data dissemination capabilities for satellite and non-satellite data and products, using Digital Video Broadcast by Satellite (DVB-S) standard or its evolution (DVD-S2), such as EUMETCast(EUMETSAT), CMACast (China), MITRA (Russian Federation), GEONETCast-America (United States).

Most of the existing services are operated either in Ku-Band (around 12-15 GHz) or in C-Band (around 4 GHz), the C-Band being preferred at low latitudes because it is less disturbed than the Ku-Band by atmospheric liquid water.

These services involve a retransmission from a ground station via a telecommunication satellite; they are therefore particularly relevant for geostationary data, which are generally pre-processed on the ground before dissemination, and for derived products. By design, however, such a retransmission service does not provide a real-time capability like the Direct Readout to access polar-orbiting satellite data.
