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WMO WP-18
Prepared by WMO
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DISSEMINATION OF SATELLITE IMAGES VIA SATELLITE

(*Submitted by the WMO*)

Summary and purpose of document

This document presents a review and recommendations for the direct broadcast from meteorological satellites conducted by the second and third sessions of the CBS OPAG IOS Expert Team on Satellite Systems Utilization and Products.

ACTION PROPOSED:

CGMS may wish to comment on the recommendations concerning the future of the direct broadcast service from meteorological satellites.

DISCUSSION

1. The second session of the CBS OPAG IOS Expert Team on Satellite Systems Utilization and Products met in Melbourne, Australia, 25 – 29 October 1999. It discussed the future of direct broadcast from meteorological satellites in general. In view of the rapid technological advances now occurring and expected to accelerate in the future, the second session felt it appropriate that a review of the concept of direct broadcast from satellite systems comprising the space-based subsystem of the Global Observing System be conducted. In view of its overall mandate to improve satellite system utilization, the Expert Team Meeting suggested that the OPAG IOS Chairman bring to the attention of CBS and the CBS Advisory Working Group the need to review the concept of direct broadcast from satellite systems comprising the space-based subsystem of the Global Observing System. Such a review should be conducted in concert with the OPAG ISS (Open Programme Area Group on Information Systems and Services) and CGMS satellite operators. The Commission for Basic Systems will be informed in November 2000 of the Expert Team discussions concerning the future of direct broadcast from meteorological satellites by the OPAG IOS Chairman.

2. The third session of the CBS OPAG IOS Expert Team on Satellite Systems Utilization and Products met in Lannion, France, 3-7 July 2000. It reviewed the concept of direct broadcast from the space-based Global Observing System paying particular attention to advantages, limitations and challenges. It took into consideration rapid technological advances, in particular telecommunications, now occurring and expected to accelerate in the future.

3. The third session recalled that the Direct Broadcast Service (DBS) was a broadcast service available from most of the meteorological satellites operated by members of the Coordination Group for Meteorological Satellites (CGMS). Such broadcasts allowed the transmission of satellite sensor data and products in real or near real-time to user reception stations located within the broadcast field of view of the satellite.

4. The third session briefly reviewed the history of the DBS. The DBS was initiated by USA polar orbiting satellites in December 1963, when TIROS-8 included images from a vidicon TV camera in the satellite's Automatic Picture Transmission (APT). In December 1971, the Russian METEOR series of polar orbiting satellites provided an APT service and the first Chinese FY-1 series of polar orbiting satellites provided APT services in 1988 and 1990-1991. The APT scheme has been used with little change to this day and world-wide there were now over 3,100 registered user stations (plus several thousand unregistered home-made or kit-assembly stations) in over 150 countries. APT is a VHF analogue transmission from polar-orbiting satellites in which visible and infrared images are transmitted using one of several standard frequencies between 137.3 and 137.95 MHz.

5. The third session recalled that in 1977, a new digital data transmission scheme was introduced to allow the broadcast of larger amounts of data provided by the AVHRR instrument on board the TIROS and later NOAA satellites. This broadcast became the High Resolution Picture Transmission (HRPT) which, also, has been continuously used for the relay of digital higher resolution image data from several polar orbiting meteorological satellites. There were now some 580 registered HRPT user stations in around 70 countries receiving data from NOAA and FY-1 satellites. HRPT is a digital transmission using either 1698.0, 1707.0 or 1702.5 (back-up) MHz.

6. In 1974, the USA's SMS-1 geostationary satellite started the Weather Facsimile (WEFAX) service. Subsequently, a continuing series of GOES satellites have provided the WEFAX service to this day. The WEFAX service provided processed satellite imagery through an analogue transmission scheme compatible with that of APT. Currently, there are globally over 4600 registered WEFAX user stations (again with many 1000s more, unregistered, using home-made or kit-assembly stations), in over 160 countries. By informal agreement of the satellite operators, WEFAX is provided globally at 1691.0 MHz.

7. High resolution digital image data from the Visible and Infrared Spin-Scan Radiometer that was stretched in time to allow acceptable broadcast data rates (S-VISSR) has also been broadcast by the GOES satellites since the early 1970s. Although originally designed for internal use by NOAA, S-

VISSR has been made available for all users. It has also been adopted by some other satellite operators. With the introduction of the three-axis stabilized GOES-8 in 1994, the USA replaced the S-VISSR transmission scheme (Mode AAA) by GOES-Variable (GVAR), to increase flexibility in the transmission of multi-spectral imagery and sounding data.

8. The European Meteosat satellites started digital High Resolution Image (HRI) and WEFAX services in 1977. S-VISSR and WEFAX services have been provided since 1977 by the Japanese GMS satellites and by the People's Republic of China FY-2 satellites since 1997. Additionally, in 1990, the later series of operational Meteosat satellites started the Meteorological Data Distribution (MDD) broadcast service. This service was primarily designed to disseminate meteorological data and forecast information to NHMS in the African region to complement the GTS.

9. To date, down-link frequencies, modulation schemes and data formats used by the satellite operators for the dissemination of high resolution digital data from the geostationary meteorological satellites have varied according to national needs and no attempt has been made so far to standardize frequencies or data formats. Even so, globally there are currently around 900 user stations capable of receiving this type of broadcast in around 80 countries.

10. The third session noted the rapid increase in the number of user stations over recent years and the following table that summarized the global number of registered user stations by type (source: WMO) as of May 2000:

APT	HRPT	WEFAX	HR	Total
3131	584	4647	898	9260

11. The third session recalled that CGMS had agreed that standardization of direct broadcasts in the future was highly desirable to facilitate the acquisition of data by the various user communities. The session stressed that for LEO satellite data, in particular, such a harmonization of standards was absolutely necessary. However, the session was pleased to note that there already existed general agreement by members of CGMS to adopt global standards for some near-term satellite broadcasts. As an example, analogue APT will become digital LRPT and analogue WEFAX will become digital LRIT.

12. The third session then reviewed the present launch and transition plans of the satellite operators for their geostationary and polar-orbiting satellites. It expressed great concern due to the proliferation of proposed new formats and frequencies and apparent lack of a coherent transition strategy. It was strongly of the opinion that WMO Members would be able to better utilize satellite data if the satellite systems used common formats, provided for low-cost receiving stations and long lead-times in any transition of service.

13. The third session also noted that different policies in different parts of the world resulted in different implementations of the DBS. Some data were encrypted and could only be used if the receiving facility was equipped with a decryption key unit. For example, Meteosat HRI image data were encrypted with the exception of the 6-hourly data; GOES data or NOAA polar orbiting satellite data were not encrypted while future NPOESS data would have encryption capability. The Meteosat MDD service was encrypted but freely available to NMHS.

14. The third session noted that despite the various differences in service outlined above, it was of the opinion that the DBS concept had provided WMO Members with the following valuable advantages over the last three decades:

- data were available in real-time, or near-real-time;

- users could receive data relevant to their part of the globe regardless of their local telecommunication infrastructure. Thus, the DBS supported utilization of satellite information even at remote or mobile sites. In many cases up to now, the DBS had been the only possibility to distribute satellite image data to the users in a timely fashion.

15. The third session stressed the need to keep users fully informed about current broadcasts and the future plans of all the satellites making up the space-based component of the Global Observing System, using mechanisms such as the WMO Satellite Activities Web pages. The session considered that in addition to broadcast types, more information should be made available about the content of such broadcasts.

16. The third session also reviewed the latest dissemination plans for the future geostationary satellite, MTSAT-1R, planned to be flown by the Japan Meteorological Agency (JMA) in 2003 and the future broadcast plans of the Russia Federation. Concerning MTSAT, the session agreed that the broadcast information should be included in the new technical document describing the new LRPT/LRIT services. The session was pleased to note the continuation of service of GMS-5 until 2003 and that there would be a period between 2003 and 2005 when there would be the parallel broadcast of WEFAX and LRIT from MTSAT-1R. Similar transitions, over different periods, were planned for the changes from the high resolution S-VISSR broadcast, through HiRID, dual HiRID/HRIT and finally HRIT.

17. Concerning the Russian Federation direct broadcast proposal, the session noted with interest the intention to use back-up transponders flown on other earth observation or communications satellites to support the collection and broadcast of DCP information and the Russian Federation's plans to make use of the alternative allocation at 8 GHz for the broadcast of information from space to ground in the 8-10 year time period.

18. The third session recalled that in March 1999 a questionnaire had been distributed in order to assess the actual use of satellite data and products by WMO Members. The evaluation of the questionnaire was performed by the Expert Team. Results and conclusions from the WMO Member responses to the questionnaire have been published in WMO Technical Document WMO/TD No. 94 (SAT-23) entitled "Status of the Availability and Use of Satellite Data and Products by WMO Members". The information in the Technical Document allowed further assessment of the present concept of DBS from the users' perspective.

19. In particular, the session noted from the responses given in the questionnaire that:

- The GTS was generally used for the reception of quantitative products extracted from satellite data at specialized centres and satellite image data were received from the DBS;

- The Meteosat Meteorological Data Distribution (MDD) System was typically used in RA I in addition to the GTS. The answers to the questionnaire provided by RA I Members often emphasized the importance of MDD for their duties and the need for continuing such a service;

- The number of NMHS reporting data availability problems was relatively high. On average, 50 percent or more of WMO Members who returned the questionnaire reported some data availability problems either due to lack of satellite data receiving equipment or to maintenance or communication line problems.

- To date, data availability was clearly linked to affordability of the user station, the cost of its operation and of its maintenance.

20. The session also noted the potential Internet provided for distribution of meteorological data as a complement to DBS, as well as for schools and amateurs, or as the main data source for training centres (within the VL concept) or for scientific users to access recently archived data and the ongoing activities by satellite operators to already provide subsets of satellite data to their users via the Internet. The session was well aware of current shortcoming in the Internet system, but was generally of the opinion that an effective Internet system for data exchange could be expected globally in the coming years. The session also agreed that the developments in this area should be kept under constant review.

21. The third session also considered new developments in telecommunication technology as related to satellite data dissemination including: the use of digital packaged transmissions, VSAT technology and emerging standards for digital video broadcast (DVB). The session noted with some concern that radical changes in communications technology were taking place over a period of time far shorter than the life cycle of a meteorological satellite system. The session considered that, wherever possible, advantage should be taken of such progress to improve access to data by the users.

22. The third session then considered several possible evolution paths for the DBS. It noted that user requirements were being developed, sophisticated instrument payloads were being proposed and designed to take advantage of developing technology and alternative data dissemination schemes were being considered. These alternatives included: the use of data relay between satellite systems; the use of commercially provided higher data rate services; and the use of services such as the Internet. Commercially provided services could be more reliable, as they may have greater potential for system redundancy. Furthermore, in the case of the geostationary satellites solely dedicated to meteorology or climate monitoring, not including the broadcast capability could simplify the design of the satellite, could reduce development costs, relax the need for very accurate station keeping, and thereby possibly extend the lifetime of the satellite. Additionally, the use of commercially provided broadcast services could facilitate the global development of low cost standard classes of user stations with smaller antennas with less stringent requirements for pointing accuracy and for a significant reduction in the need for specific training as concerns the operation and maintenance of the equipment. Relying on higher bandwidth telecommunication systems offers the potential of improving the overall timeliness, however, the session noted that an important point to consider with such broadcasts would be the telecommunication coverage. In order to ensure coverage within a region similar to that currently available from the meteorological satellite broadcasts, use of more than one telecommunications system may be required. The session stressed, however, that to make any commercial proposal viable, the cost to the user of the telecommunication service should not offset these advantages, also bearing in mind the timeliness and coverage requirements.

23. The third session considered that any implementation of such a possible evolution would be a long-term objective and could be considered selectively in the following categories of satellite data flows:

- A gradual implementation of near-real-time satellite data available through high bandwidth telecommunication means as a complement to the DBS: for example, GEO imagery from “foreign” satellites, satellite products derived from GEO and/or LEO satellites, global data from polar-orbiting satellites;
- With the start of operations of future generation of meteorological satellites, a full set of real-time GEO data disseminated by normal telecommunication satellites, or other means as a replacement to the DBS assuming it offers more cost-efficient solution with the same timeliness and coverage performance as dissemination by the meteorological spacecraft itself.

24. The session also considered that real-time direct broadcast from LEO spacecraft will continue to be received through tracking L-band antennae, for reasons of timeliness, as long as no equivalent service can be provided via a telecommunication satellite constellation. Such a change was only expected to occur in the long term (10-15 years).

25. The session stressed that any change to the broadcast concept would need long periods of notice for the users and long transition periods, which should be compatible with the lifecycle of receiving equipment and of relevant satellite series.

26. The third session also agreed that there was a requirement for system studies and demonstration before the impact of such major changes in broadcast system on the users could be assessed in more detail and recommended that this topic be added to the future work plan of the Expert Team.

27. The third session noted that new dissemination concepts could offer many opportunities for the wider distribution of satellite imagery and derived products from both GEO and LEO satellites on a more global scale and include both operational and R & D satellites.

28. The third session also noted that many aspects involved in this issue (e.g., observation, telecommunications, training, resources) would require coordination with other relevant OPAG working groups.

29. In conclusion, the third session agreed that direct broadcast service onboard meteorological satellites be complemented and supplemented by alternative telecommunications services with the ultimate goal for a smooth and orderly transition to the full use of alternative telecommunications service for broadcast service starting with the future generation of satellites.

30. The Commission for Basic Systems, at its twelfth session in November 2000, will review recommendations from the third session of the Expert Team Meeting. In particular, it will review the direct broadcasting concept that so far very successfully and efficiently served the meteorological user community and the proposed preliminary guidance for future telecommunication alternatives, noting certain shortcomings in the current receiving concept and the enormous increase in data through the next decade. The Commission could agreed that direct broadcast service onboard meteorological satellites should be complemented and supplemented by alternative telecommunications services with the ultimate goal for a smooth and orderly transition to the full use of alternative telecommunications service for broadcast service starting with the future generation of satellites.