CGMS-XXXI EUM-WP-12
Prepared by EUMETSAT
Agenda Item: V/2
Discussed in WG V

PROPOSAL FOR AN OVERALL STRATEGY FOR CONVERGENCE OF PLANNED ADMS

The paper presents
- Status of EUMETSAT activities regarding Alternative Dissemination Methods
- Plans for evolution of the EUMETCast system
- Elements for consideration in a strategy for convergence of ADMs

PROPOSAL FOR AN OVERALL STRATEGY FOR CONVERGENCE OF PLANNED ADMS

1 INTRODUCTION

This document discusses the perspective for the future of Alternative Dissemination Methods to provide multi-mission, multi-sourced dissemination infrastructure for meteorological operational systems. Such an infrastructure has been developed by EUMETSAT since 2002 principally around the dissemination requirements of EUMETSAT satellite programmes. Recently, requirements have emerged to provide Member State and WMO operational services via EUMETCast (DWDSAT, RETIM-Afrique, Basic Meteorological Data for RA VI).

Throughout the document, 'direct dissemination' is used to refer to the MSG and MTP dissemination baseline of dissemination via the communications payload of the MSG and MTP spacecraft.

2 BACKGROUND

Since its inception in 2002 to disseminate EUMETSAT ATOVS Retransmission System (EARS) data to Users, and later in 2002 to disseminate Meteosat-6 Rapid Scanning Service data, EUMETCast has evolved into a multi-mission meteorological data dissemination system supplying operational services as shown below:

Service	Description	Ku-band	C-band
EARS	NOAA polar-orbiter ATOVS retransmission service	x	
RSS	Meteosat-6 rapid scanning service	x	
MSG-1 HRIT	Full resolution SEVIRI data	x	x
MSG-1 LRIT	Low resolution SEVIRI data, DCP, MDD, FSDS, Met Products	x	x
DWDSAT	DWD-sourced observation and forecast data	x	

Fig 1 – Operational Services on EUMETCast

In addition to the services above, proposals are currently under consideration by delegate bodies to add the Meteosat-5 Indian Ocean Data Coverage (IODC) service, Meteo France's RETIM-Afrique and a basic meteorological data dissemination (MDD-like) service for RA VI to EUMETCast.

3 EUMETCAST SYSTEM CONFIGURATION AND COVERAGE

3.1 Ku-band EUMETCast Configuration

The diagram below shows the Ku-band EUMETCast configuration, including the interface to the DWD for the DWDSAT products.

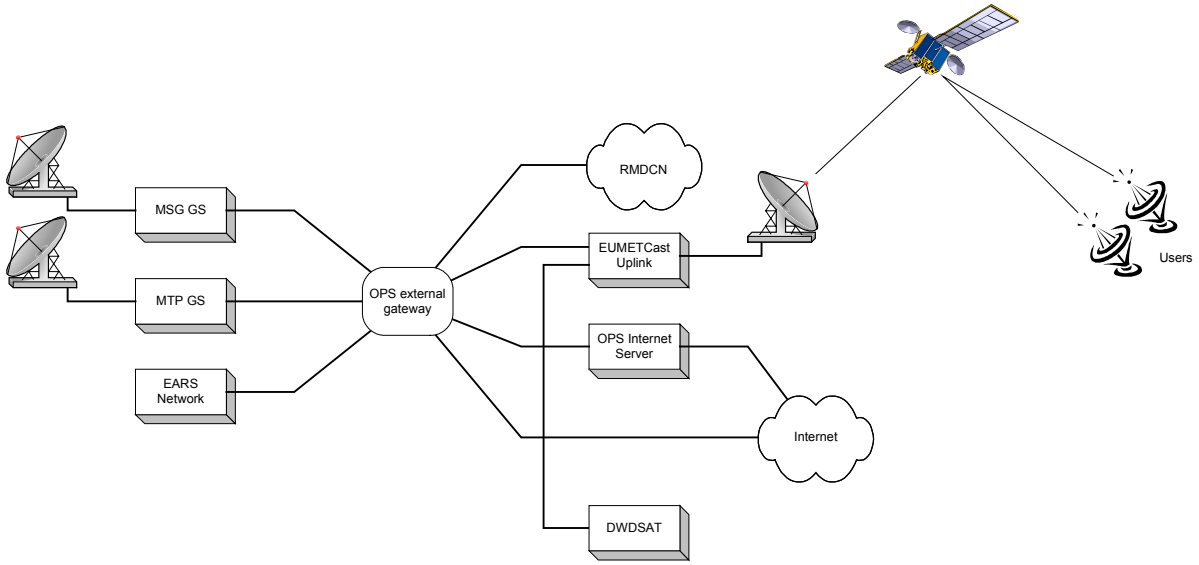

Figure 1 Ku-band EUMETCast Configuration

3.2 C-band EUMETCast Configuration

The diagram below shows the C-band EUMETCast configuration.

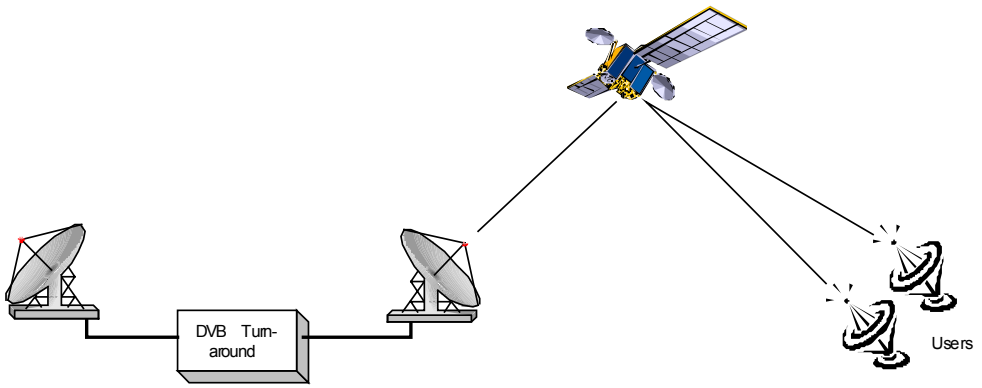

Figure 2 C-band EUMETCast Configuration

3.3 C-Band EUMETCast Dissemination

Telespazio is the service provider of the EUMETCast C-Band dissemination. The system configuration for this service utilises a "turnaround" of the EUMETCast Europe Ku-Band multicast: At DVB level, the data packets are received in Fucino, re-uplinked to a transponder of the Spacecraft Atlantic Bird-3, to be received with a suitable reception station. Such a reception station requires a C-Band front-end (antenna, feed and LNB), but can use the same type of DVB PC H/W and S/W as for Ku-Band reception.

The C-Band service has been established primarily for African Users in the framework of the PUMA project, but due to the footprint of Atlantic Bird 3, European Users can also benefit from this service (see coverage area in the figure below).

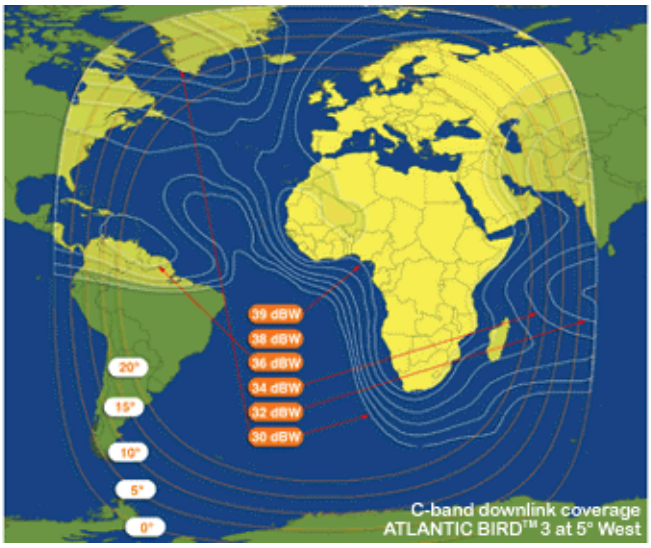

Figure 3 C-band Downlink Coverage

EUMETSAT has started a trial service on 1st of August, for a duration of 3 months, in which the C-band uplink system will be upgraded and performance monitored. C-Band reception by trial users is scheduled to start in September/October. Operational readiness of the C-Band system is scheduled for 1st of November.

4 SEQUENCE OF EVENTS

The sequence of events relevant to the EUMETCast MSG-1 Image Dissemination Service is listed in the following.

4.1 Historical Events

- 30/04/03 Start of Dissemination Trial (HRIT channel, each second repeat cycle);
- 14/05/03 Support of all repeat cycles (4 per hour) in the HRIT channel;
- 02/06/03 Demonstration of C-Band Service by provider (2 weeks);
- 28/06/07 Ku-band Uplink System (T-Systems) upgraded to full redundancy;
- 01/07/03 Distribution of the tq®TELLICAST client software by EUMETSAT;
- 07/07/03 Start of LRIT dissemination (SEVIRI channels and service messages);
- 14/07/03 Addition of MDD to the LRIT schedule;
- 29/07/03 Addition of Foreign Satellite Data to the LRIT schedule;
- 01/08/03 Start of Dissemination Trial in C-Band (provider only);
- 01/08/03 Start of DWDSAT trial.

4.2 Planned Events

- September Introduction of eToken encryption scheme;
- September/October Start of Dissemination Trial in C-Band (Reception Stations);
- October Progressive inclusion of MET products in LRIT;
- October Addition of DCP messages and bulletins to the LRIT schedule;
- November Addition of IODC (MET-5) data to the LRIT schedule.

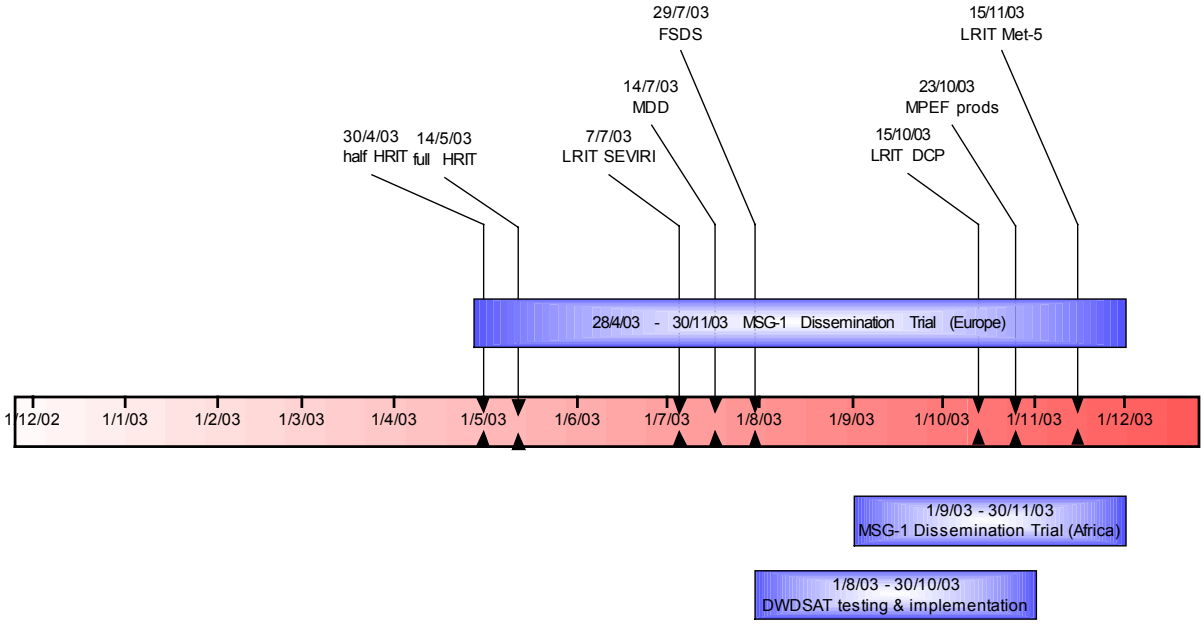

Figure 4 EUMETCast schedule

5 ALTERNATIVE DISSEMINATION ISSUES

5.1 Data Access Scheme

Reception of data whose access is restricted in accordance with the EUMETSAT Data Policy will be controlled using the Tellicast encryption scheme. This system uses the Aladdin eToken PRO key unit, which will be programmed and distributed by EUMETSAT.

This EUMETCast Key Unit (EKU) is functionally similar to the originally foreseen MSG Station Key Unit (SKU) – but is physically smaller and uses a more commonly available interface (USB). The EKU can be used on either Ku or C band EUMETCast reception stations.

In addition to the EKU, users will require a unique username and user key. Users operating multiple EUMETCast reception stations will require an EKU for each station.

Access to the following services is restricted by the EUMETSAT data policy:

- HRIT SEVIRI (quarter-hourly, half-hourly, hourly and 3-hourly transmissions);
- LRIT SEVIRI (half-hourly, hourly and 3-hourly transmissions);
- Rapid Scanning Service (10 minute real-time service);
- Meteorological Data Dissemination (MDD).

All other services comprising the essential data set will be unrestricted and access will be via a generic username and user key.

5.2 EUMETCast Service Availability

The availability of the EUMETCast Service is measured as the ratio of successfully received reference files to transmitted reference files. The figures for received files are established on a dedicated reference reception station. Non-availability of the uplink system is additionally counted in the availability statistics. The required/contractual availability figure is 99.5 %, measured on a monthly basis. The figures achieved from November 2002 until May 2003 are presented in the graph below.

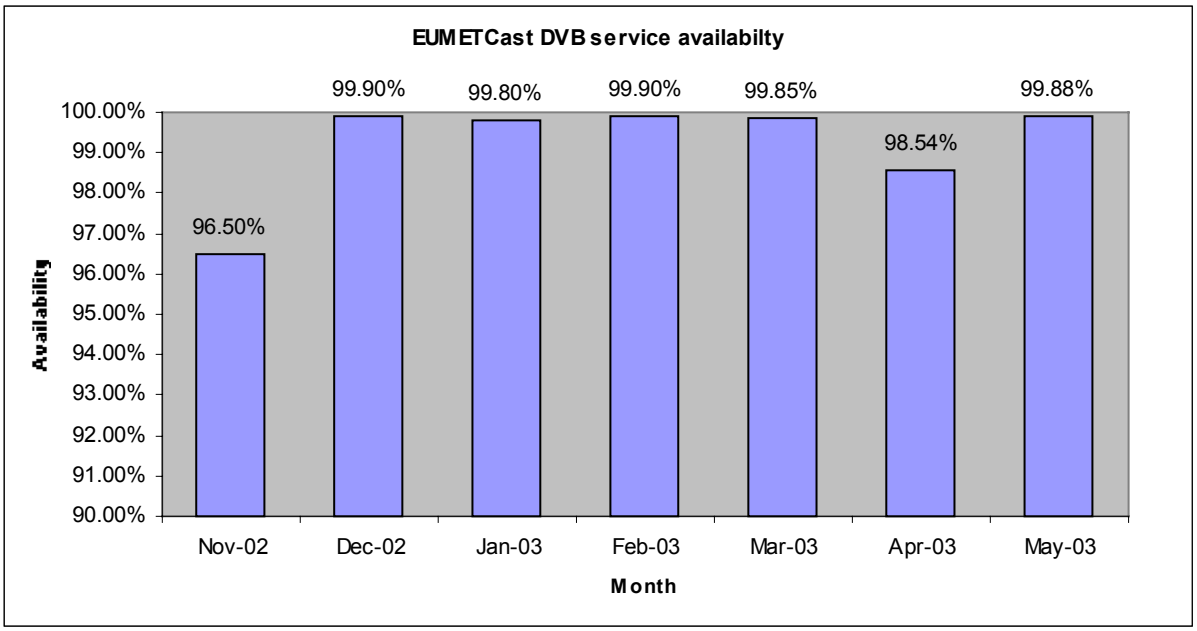

Figure 5 EUMETCast Service Availability

5.3 EUMETCast User Status

The growth of EUMETCast User registration figures up to end of September 2003 is depicted in the table and figure below (covering also the EARS and RSS service and the number of reception stations).

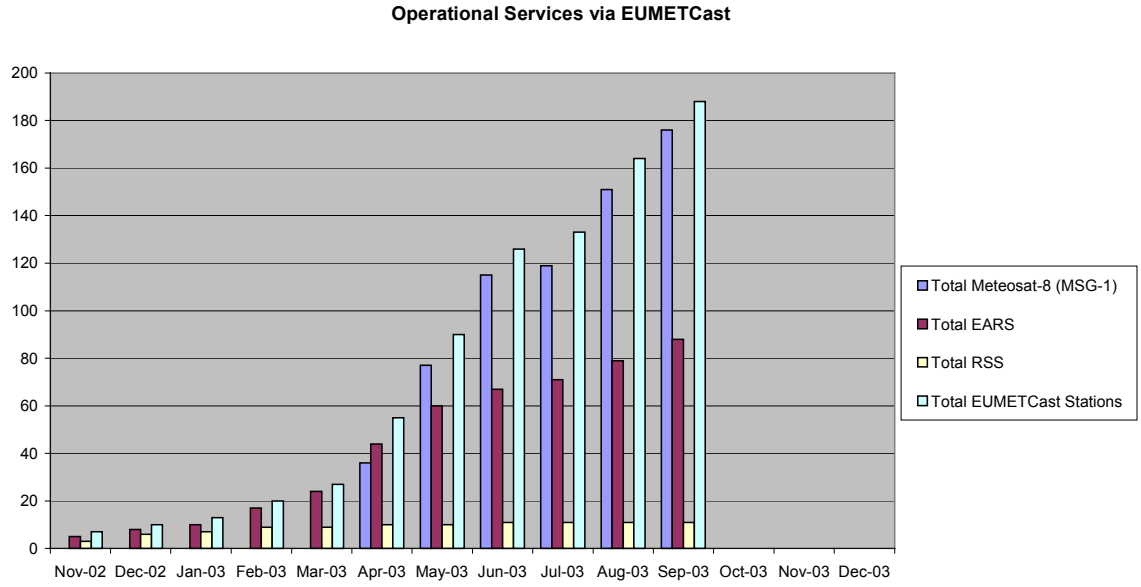

Figure 6 Total Number of Users per Operational Service via EUMETCast

5.4 MSG Product Dissemination Timeliness using EUMETCast

So far, limited studies have taken place addressing the timeliness of the delivery of MSG data using EUMETCast. These studies have addressed only the timeliness of the HRIT segment file delivery, and have been based on the MSG ground segment configuration currently supporting EUMETCast dissemination. The result of these studies is that for the majority of segment files, the timeliness is in the range of 4 – 7 minutes. This figure represents the full end-to-end timeliness – from acquisition of the SEVIRI level 0 data to availability of the SEVIRI level 1.5 HRIT segment file on the EUMETCast reception station.

Further measurement campaigns of the timeliness of HRIT files, and the other MSG streams on EUMETCast are planned for later in MSG-1 Commissioning.

5.5 DWDSAT

Endorsed by the 53rd EUMETSAT Council, the DWDSAT service (DWD's FAX-E follow-on) is being integrated into EUMETCast. The required additional bandwidth of 256 Kbps (Ku-band) has been provided on 1st of August 2003, and the uplink system at Usingen has been configured with an interface to the DWDSAT data, provided by a dedicated line from DWD at Offenbach to the Ku-band EUMETCast uplink system.

6 TECHNICAL DOCUMENTATION

A general description of the EUMETCast System and the procedure for gaining access to information disseminated via it is provided in the document EUM TD 15 "EUMETCast, EUMETSAT's Data Distribution System".

7 EVOLUTION OF EUMETCAST

The catalyst for the development of EUMETCast into a multi-sourced, multi-mission environmental data distribution was the addition of MSG operational services to EUMETCast. This necessitated a significant increase in EUMETCast bandwidth and geographic reach, which in turn triggered the development of a critical mass in terms of the potential take-up of EUMETCast in the meteorological User community.

8 DISCUSSION

8.1 Overall Approach

Whilst EUMETCast was upgraded to disseminate MSG HRIT and LRIT at short notice in response to the Solid-State Power Amplifier (SSPA) situation on MSG-1, it should be recognised that, for the remaining operational services disseminated by EUMETCast, there is no easily foreseeable alternative to EUMETCast. In terms of coverage, the Ku-band coverage

is sufficient for EARS, RSS, DWDSAT and the MDD-like service for RA VI, with the C-band coverage being required for IODC and RETIM-Afrique (if approved). So, an element of continuity is inherent in the current approach to EUMETCast, independent of whether MSG dissemination forms part of the EUMETCast baseline or not.

Of course, less bandwidth would be required in the absence of MSG HRIT/LRIT, but lower bandwidth EUMETCast service provision of similar geographic coverage will be required for the lifetime of these services.

However, with the increasing penetration of EUMETCast in the User Community it is already now clear, the Alternative Dissemination is not alternative anymore, but is part of the baseline.

8.2 Spacecraft Useful Lifetime

For all Meteosat spacecraft (MTP and MSG), one of the most significant factors affecting useful spacecraft lifetime is the on-board fuel reserve for attitude and orbit control. The biggest consumer of fuel by far, once in geostationary orbit, are manoeuvres concerned with controlling spacecraft orbital inclination.

When there is sufficient on-board fuel reserve for inclination control, the inclination is maintained below 0.7° for MTP, and 1° for MSG. The fundamental constraint here is keeping the spacecraft in the beamwidth of User stations with fixed-pointing antennas. For MTP, no inclination-related constraint has been found in image processing, thus allowing continued production of meteorological products, and exploitation by the Users.

Once the fuel reserve is below the limit where inclination control can be performed, the inclination is allowed to drift, with the remaining fuel reserve being used for attitude and longitude control. This is as part of the end-of-life fuel optimisation strategy and is currently being applied to Meteosats 5 and 6.

The advantage of using a dissemination scheme such as EUMETCast for MSG dissemination is the significant extension of nominal spacecraft operations in this end-of-life fuel optimisation strategy phase. A useful lifetime extension of around 3 – 5 years can be expected in the case of the MTP spacecraft. For MSG, an extension of useful lifetime, based on the use of Alternative Dissemination mechanism, of 2 years is already part of the MSG-4 Programme Extension bringing the operational lifetime of MSG up to the end of 2018.

8.3 MSG SSPA Retrofit

Independent of whether MSG dissemination forms part of the EUMETCast baseline or not, the SSPA retrofit is required to secure reliable SEVIRI, GERB and DCP data acquisition capability. In the case of MSG-1, SSPA-A is used to downlink SEVIRI and GERB in a reduced output power, non-nominal thermal configuration. DCPs are not acquired as per the recommendations of the Inquiry Board.

8.4 Coverage

EUMETCast coverage currently consists of the Ku-band beam from HotBird 6 covering Europe, and the C-band beam of AtlanticBird 3, whose coverage chart can be seen in figure 2. Additional EUMETCast coverage can be obtained by procuring bandwidth on a satellite with a beam covering the required area. It should be noted that in addition to coverage, the characteristics of the satellite and the selected beam also impact the User station requirements in terms of antenna diameter and RF front-end performance.

The MSG direct dissemination coverage is shown below:

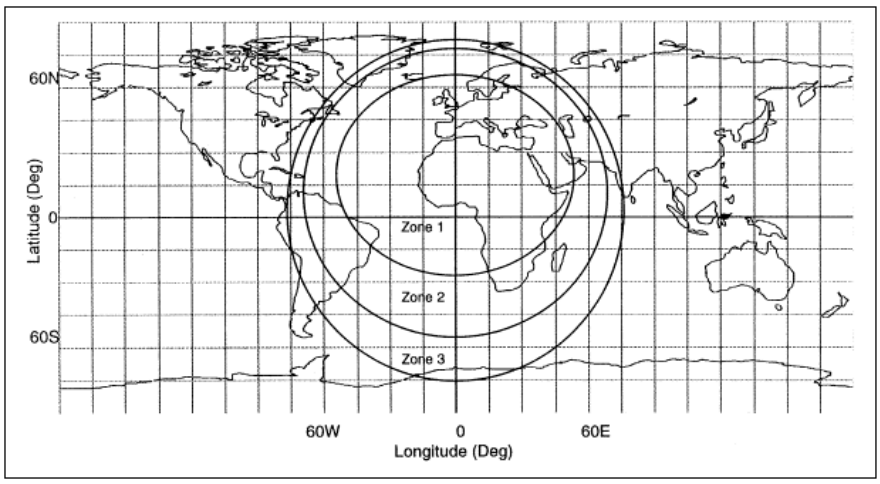

figure 3 – MSG direct dissemination coverage

'Global' coverage similar to the MSG direct dissemination footprint is not easily commercially available, with what little commercial capacity there is – in C-band - being fully utilised by existing customers. So, in order to meet as far as possible the MSG Zone 3 coverage (see fig. 3) as described in the MSG EURD using EUMETCast, it would be necessary to add a satellite beam covering the South American continent. The footprint of such a beam from Atlantic Bird 1is shown in figure 4.

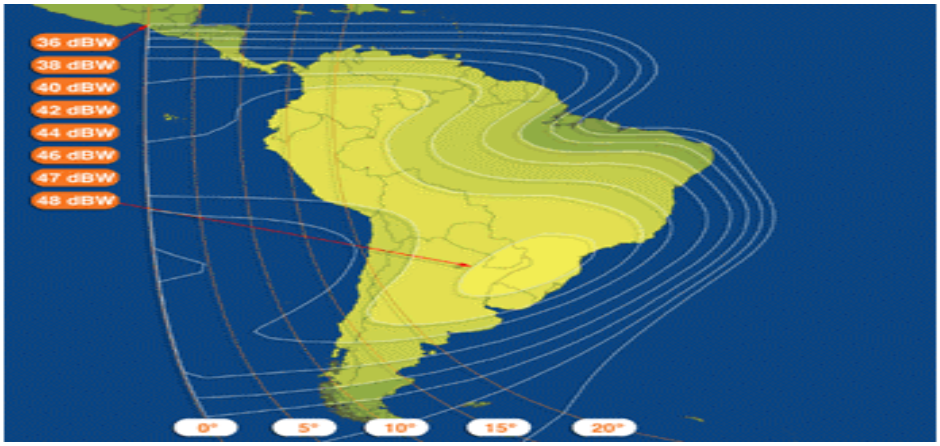

figure 4 – South American Ku-band beam from Atlantic Bird 1

The current Ku and C-band coverage beams that make up EUMETCast overlap in the European area. Although this was not part of the requirements when procuring the C-band service – it does have the beneficial effect of offering European Users a choice between Ku and C-band EUMETCast services. It is planned to maintain this configuration as it effectively offers an enhanced level of redundancy for European Users, and to study possible configurations to enhance this level of redundancy.

MSG direct dissemination could then be used to complement EUMETCast, either as a backup capacity, or to provide additional services such as a basic global service.

8.5 Data Formats

The formats used for distribution of MSG image data on EUMETCast are the LRIT/HRIT dissemination formats as per the original MSG baseline. For the meteorological products, BUFR and GRIB2 are being used. The data formats use for Alternative Dissemination should be considered and consolidated on a global scale

8.6 Definition of Data requirements

For the services responding to data needs of EUMETSAT member states, the data requirements are defined by the EUMETSAT Delegate Bodies.

For MDD the Data Requirements are defined jointly by EUMETSAT and the Working Group on Planning and Implementation of the World Weather Watch in RA I. For the proposed BMD service a similar arrangement would be established with RA VI.

8.7 Encryption and Access Control

The EUMETCast multicast uses encryption to control User access to the multicast data. The encryption features provided by EUMETCast's multicast system (Tellique's Tellicast) are quite sophisticated, allowing the full implementation of EUMETSAT's MTP and MSG data policy.

It should also be noted that some of the services provided by EUMETCast, such as MDD and DWDSAT and RETIM-Afrique, have their own data policy which is independent of EUMETSAT's data policy. These services have been fully integrated into EUMETCast, using features already available in the EUMETCast multicast to control User access to the operational services.

9 FINANCIAL ASPECTS

Using the current costs of the various elements of EUMETCast as a guide, the likely costs of operating EUMETCast in the future can be inferred. This leads to a consolidated multicast

cost of 65 KEUR/month for the current bandwidth level and geographic coverage – which leads to an total annual bandwidth cost of 780 KEUR for C-band and Ku-band.

The EUMETCast system and the MSG data service are funded by EUMETSAT. Deutscher Wetterdienst funds the DWDSAT service. For the proposed Basic Meteorological Data distribution service for RA VI, the funding is under discussion.

10 FUTURE EVOLUTION OF EUMETCAST

10.1 Operational Services

In the future, additional EUMETSAT-sourced operational services which are candidates for provision via EUMETCast are:

- Meteosat-7 dissemination as the spacecraft enters the end-of-life fuel optimisation strategy phase;
- Second MSG operational service (e.g. rapid scanning);
- ASCAT retransmission service;
- JASON-2 operational service;
- Higher-frequency data from other Geostationary satellites.

For non-EUMETSAT-sourced operational services, it is difficult to judge what the level of demand in this area is, and whether the level of demand experienced so far is 'the tip of the iceberg' or a fuller representation of the long-term level of demand. Certainly, the infrastructure offered so far seems to bring significant cost-benefit to the Meteorological Services concerned.

Also to be noted is the impact of WMO initiatives in this area, such as the implementation of the FWIS (Future WMO Information Systems) concept, and the implications for EUMETSAT in supporting these initiatives. An example of this is the proposal to provide an MDD-like service for WMO Regional Association VI. This proposal would entail the provision of a data dissemination channel on EUMETCast, responding to data requirements co-ordinated by the WMO RA VI member states.

11 USER COMMUNITY

With the extensive use of industry standards in the implementation of EUMETCast, the cost of entry into the high-performance meteorological reception system marketplace has been drastically reduced. Additionally, the flexibility of the EUMETCast implementation allows the addition of operational services without significant overall system impact.

With suitable tuning of the disseminated products available, and the associated elements of EUMETSAT's data policy, this could lead to a considerable broadening of the User Community:

a) amongst those for whom centralisation of the infrastructure required to receive different operational services brings significant advantage, and;

b) amongst groups traditionally excluded by the cost and sophistication of L-band bespoke meteorological data reception systems.

12 ITEMS FOR CONSIDERATION

For a developing a global "system" for alternative dissemination, a number of issues need to be addressed. These are proposed here as a starting point of discussion.

- Frequency bands
  - C-band vs Ku-band
- Communication standards
  - Standard DVB protocols for physical layer
  - TCP/IP as standard for transport layer
  - ftp as standard for application layer
- Data format standards
  - WMO formats vs HRIT/LRIT vs others
- Data policy aspects
  - Standard encryption mechanisms
- User station standards
  - Operating systems
- Acquisition of data
  - Provision of non-satellite data from WMO community
  - Retransmission services for locally acquired satellite data
- Global data exchange
  - Mechanisms for real-time data exchange between operators
  - DVB-turnaround or file-transfers
  - Data policy aspects of global exchange
- User requirements
  - Mechanisms for consolidation of data requirements within WMO regions
  - How are user communities outside meteorology addressed?
- Funding from users
  - WMO trust funds
  - User licenses
  - GNI-based contributions from WMO member states
- Coverage
  - Reflection of global coverage of co-ordinated GEO satellites
  - Issue of continental-only coverage of Telecom satellites
  - Possible other solutions for oceans
- Role of CGMS partners