

TD 15 - EUMETCast - EUMETSAT's Broadcast System for Environmental Data

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Change Record

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1 INTRODUCTION

EUMETCast is a multi-service dissemination system based on multicast technology. It uses commercial telecommunication geostationary satellites using DVB standards and research networks to multi-cast files (data and products) to a wide user community.

‘EUMETCast Satellite’ is EUMETSAT’s primary near real-time dissemination system – it is based on standard Digital Video Broadcast (DVB) technology, using Ku-Band capacity on commercial telecommunication geostationary satellites to deliver operational environmental services to a wide user community in Europe. EUMETCast also delivers operational services to users in the Middle East and Africa using C-Band. EUMETCast is the EUMETSAT contribution to GEONETCast, which is a global network of satellite-based data dissemination systems providing environmental data to a world-wide user community.

Like EUMETCast Satellite, ‘EUMETCast Terrestrial’ is a “push” multi-casting system for near real-time data dissemination that uses high-bandwidth terrestrial networks rather than satellite transponders. EUMETCast Terrestrial currently relies on the infrastructure provided by GEANT and providers of national research networks (NRENs) within and outside Europe. EUMETCast Terrestrial is accessible only to those users having authorised access to research networks.

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2 EUMETCAST SERVICES

2.1 System Overview

Within the current EUMETCast configuration, the multicast system for file distribution is based on the client/server software package TelliCast. The server is implemented at the EUMETSAT HQ in Darmstadt, and the clients installed on the individual EUMETCast Reception Stations.

Files are encoded into a multicast stream on the EUMETCast Platform. The multicast stream is then transported to the user via two main networks: EUMETCast Satellite and EUMETCast Terrestrial.

On EUMETCast Satellite the multicast is transferred via a dedicated communications line from EUMETSAT to the uplink facility. There the multicast is encoded into a DVB signal and transmitted to a geostationary communications satellite for broadcast to user receiving stations. Each receiving station decodes the signal and recreates the original multicast stream.

On EUMETCast Terrestrial the multicast is transferred via a multicast-enabled dedicated network, currently using research networks, to the user. Users must be eligible to connect to the national research networks and the research network must be included in the EUMETCast Terrestrial network.

The EUMETCast Client stations decode the multicast back into files according to the subscription of the user.

EUMETCast Terrestrial is currently a demonstration service and is being evaluated for its potential to work as a back-up to the EUMETCast Satellite service.

The key features of EUMETCast are:

- Secure delivery of data, allowing multicasts to be targeted to a specific user or group of users, thus supporting any required distribution/access data policy;
- Handling of any file format, allowing the dissemination of a broad range of products;
- No limitations to file sizes;
- Use of DVB turnarounds allowing the easy extension of geographical coverage
- One-stop-shop delivery mechanism allowing users to receive many data streams via one Reception Station
- An installed user-base of over 4000 Reception Stations
- Use of off-the-shelf, commercially-available DVB reception equipment
- Use of high-bandwidth managed global terrestrial networks
- Highly scalable system architecture

The diagram below shows the architecture of the EUMETCast System, comprising the EUMETCast Satellite and EUMETCast Terrestrial Services.

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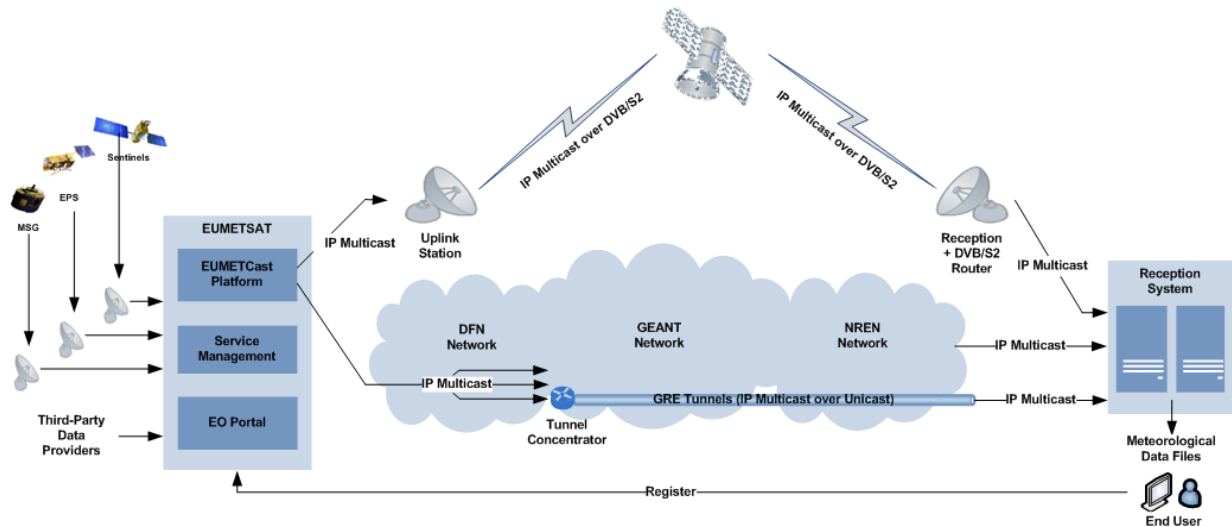


Figure 1: EUMETCast System Model

The dissemination of multicast data through terrestrial networks – instead of uplinking to satellites, is an end-to-end terrestrial dissemination. The emphasis is on achieving a best possible synergy between the two components and, in particular, as regards providing a harmonised interface to the end-user – irrespectively if the data was disseminated via satellite or terrestrial networks.

For both EUMETCast components the client software subscribes to the multicast channels that contain their desired data & products. Once subscribed, the files are in the case of EUMETCast terrestrial routed through terrestrial networks in a single transmission. For use cases in which the same data has to be sent to multiple users simultaneously, multicast allows to set up a highly-scalable dissemination system without the burden of duplicating the data volume for each new user as it would be the case in traditional one-to-one concepts.

A single reception station can receive any combination of the provided services. Data whose access is controlled will be encrypted using a combination of EUMETCast Key Unit and the EUMETCast Client Software. The decryption at the user station will be carried out by using an USB eToken decryption scheme.

2.2 EUMETCast Satellite

EUMETSAT operates two EUMETCast Satellite broadcasts: EUMETCast Europe in Ku-band via EUTELSAT 10A and EUMETCast Africa in C-band via EUTELSAT 8W. The geographic coverage of a DVB downlink is determined by the characteristics of the spacecraft and its associated antenna beams.

The diagram below shows the high-level architecture of the EUMETCast Satellite Services, comprising EUMETCast Europe and EUMETCast Africa.

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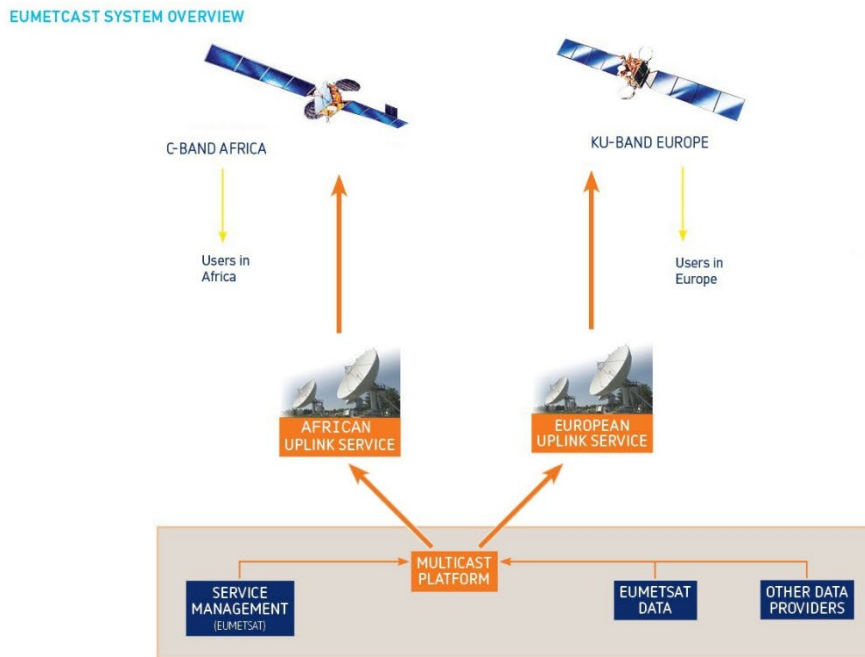


Figure 2: EUMETCast Satellite System Overview

2.2.1 EUMETCast Europe

EUMETCast Europe is operated using the DVB-S2 standard. The following table shows the transponder parameters.

Ku-band Transponder EUTELSAT 10A (10° E), Europe		
Parameter	Transponder 1	Transponder 2
Name	EUTELSAT 10A	EUTELSAT 10A
Transponder	C4	C10
Downlink Frequency	11262.500 MHz	11387.500 MHz
L-band Frequency, for LOF=9750 MHz	1512.5 MHz	1637.5 MHz
Symbol Rate	33000 kS/s	33000 kS/s
Polarisation	Horizontal	Horizontal
Roll-Off	5%	5%
Transmission Standard	DVB-S2, VCM mode	DVB-S2, CCM mode
MODCOD 1 — Basic Service	8PSK3/5 MPE transport stream (TS) ISI=1 max 55 Mbps info bit rate (TS level) max 50 Mbps IP data rate	No Basic service

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MODCOD 2 — High Volume Service	16APSK2/3 MPE transport stream (TS) ISI=1 max 85 Mbps info bit rate (TS level) max 77 Mbps IP data rate	16APSK2/3 MPE transport stream (TS) ISI=1 max 85 Mbps info bit rate (TS level) max 77 Mbps IP data rate
Remarks	The same ISI value will be used for the Basic Service and High Volume Service. This allows the simultaneous reception of both services with one DVB receiver. If the receiver supports the full data rate, there is only one DVB receiver needed for a full single transponder.	

Table 1: EUMETCast Europe Downlink Parameters

2.2.1.1 EUMETCast Europe Backup Satellite

In case of an unrecoverable failure of EUTELSAT 10A the EUMETCast Services will be continued on EUTELSAT HB13 in the 13° East orbital position. The downlink parameters are listed in Table 2. Should the downlink parameters be changed (e.g. for a different transponder) you can find the latest values on the EUMETCast webpages under the following URL:

<https://eumetsatspace.atlassian.net/wiki/spaces/DSEC/pages/736362573/EUMETCast+Europe+Backup+Satellite>

Ku-band Transponder EUTELSAT HB13 (13° E), Europe		
Parameter	Transponder 1	Transponder 2
Name	EUTELSAT HB13	EUTELSAT HB13
Transponder	13C 6	13C 8
Down Link Frequency	11316.72 MHz	11355.08 MHz
L-band Frequency (LNB LOF=9750MHz)	1566.72 MHz	1605.08 MHz
Symbol Rate	29995 kS/s	29995 kS/s
Polarisation	Vertical	Vertical
Roll-Off	5%	5%
Transmission Standard	DVB-S2, VCM mode	DVB-S2, CCM mode
MODCOD 1 — Basic Service	8PSK3/5 MPE TS, ISI=1	No Basic service
MODCOD 2 — High Volume Service	16APSK3/4 MPE TS, ISI=1	16APSK3/4 MPE TS, ISI=1

Table 2: Downlink parameters for EUMETCast Europe Backup Satellite

The backup satellite will be used only in a case of emergency, i.e. when the prime satellite E10A cannot provide the service due to a permanent failure. In this case, EUMETSAT will inform the users (via our User Notification Service: <https://uns.eumetsat.int/>) that EUMETCast Europe is provided by HB13 and users will then need to reconfigure their antennas and receivers for the transponders 6 and 8 on HB13.

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It is recommended that users prepare their reception systems for the backup satellite and transponders, in order to keep the interruption to a minimum, should the backup satellite be activated. There are two choices available for the out-door equipment:

1. Set up a separate reception chain for HB13. Follow section 4.2.2 to point the antenna.
2. Set up a multi-feed solution according to section 4.2.2.2.

Spare DVB receivers can also be prepared:

- Configure the first receiver for E10A, transponder 1 (C4)
- Change Downlink frequency, or L-band frequency to 13C 6 (see Table 2)
- Change Symbol rate to 29.995 MSps or select “Auto”

- Configure the second receiver for E10A, transponder 2 (C10)
- Change Downlink frequency, or L-band frequency to 13C 8 (see Table 2)
- Change Symbol rate to 29.995 MSps or select “Auto”

The spare receivers can be left in cold standby (off), warm standby (on, but disconnected), or even hot standby (traffic connected to the operational network). If in hot standby, reception will automatically start in case of a backup activation.

All other users will have to adjust their existing antennas once they are informed that HB13 is activated:

- Change Downlink (or L-band) frequency for transponder 1 to 13C 6 (see Table 2)
- Change Symbol rate to 29.995 MSps or select “Auto”

- Change Downlink (or L-band) frequency for transponder 2 to 13C 8 (see Table 2)
- Change Symbol rate to 29.995 MSps or select “Auto”

- Repoint the existing antenna to HB13 (azimuth first)
- Optimise pointing by maximising link margin, EsNo or C/N

2.2.1.2 Basic Service and High Volume Service Concept

The achievable data rates for satellite-broadcast systems depend on the reception antenna sizes — larger antenna sizes can support higher data rates. This is done by the proper selection of the so-called MODCODs (MODulation and CODing).

EUMETSAT is providing two services via DVB-S2:

Basic Service: This is the continuation of the former EUMETCast Europe DVB-S Service. The selected MODCOD for the Basic Service will provide the same availability as the former DVB-S service for most of the users, assuming the existing antennas are being used. Due to the slightly different footprint in some areas, slightly larger antennas might be needed. For more details on antenna sizes, see the Satellite Footprint section below. The DVB reception device must be compatible with the Basic Service. For further information see section 3.2, ‘DVB DEVICES’.

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High Volume Service: The selected MODCOD for the High Volume Service is optimized for higher data rates — roughly a factor 1.5 over the Basic Service. Users wanting to receive data from this service with an availability of 99.98% (average over a year) will need larger antenna sizes compared to the Basic Service — roughly a factor 1.8 of what is required for the Basic Service. Depending on the antenna size used and the geographic location users keeping the Basic Service antenna sizes might still be able to receive the High Volume Service, but at a reduced availability, e.g. they will have less rain margin. For more details on antenna sizes see the Satellite footprint and recommended antenna sizes section below.

The first transponder capacity is shared between the Basic Service and High Volume Service. It is not planned to expand the Basic Service beyond one transponder. Therefore, all additional transponders will only carry High Volume Services.

2.2.1.3 DVB-S2 VCM and CCM

The DVB-S2 specification introduces a concept known as Variable Coding and Modulation (VCM). The introduction of VCM allows support for multiple MODCODs within the same carrier. This means that both the High Volume and the Basic Services, described above, can be transmitted simultaneously on the same carrier without interfering with each other.

Users with small antennas can receive the Basic Service, and users with large antennas can receive both services. This functionality becomes important when the High Volume Service is introduced. It provides a seamless implementation of the new service that will be transparent to users. It also provides the capability to change the DVB configuration (MODCOD) on-the-fly without an impact on the reception equipment.

Therefore, VCM is a key function to provide flexibility in order to efficiently use the available satellite transponder resources. The only requirement is that receiving equipment must be compatible with VCM.

VCM will only be used when more than one service is operated at a transponder, i.e. on transponder 1. On all additional transponders the CCM mode (Constant Coding and Modulation) will be used which is less demanding on the DVB device specification.

2.2.1.4 Satellite footprint and recommended antenna sizes

The footprint below in Figure 3 illustrates the general coverage of EUTELSAT 10A. The required antenna sizes depend on reception station location, the EIRP, the typical weather patterns and the selected DVB-S2 parameters (e.g. MODCOD, Symbol Rate).

The Basic Service can be received with the currently installed antennas in most areas within the footprint. For the High Volume Service, larger antennas are required, but with clear sky conditions, even the Basic Service antennas might be usable.

For recommended antenna sizes, please see Appendix B, 'Antenna Size recommendation'. The plots show the yearly availability, taking into account typical weather patterns for standard antenna sizes. Professional users should aim for 99.98% availability and find the recommended antenna size from the plots.

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For locations not covered by the plots, or in case of questions, please contact our User Service Helpdesk at ops@eumetsat.int.

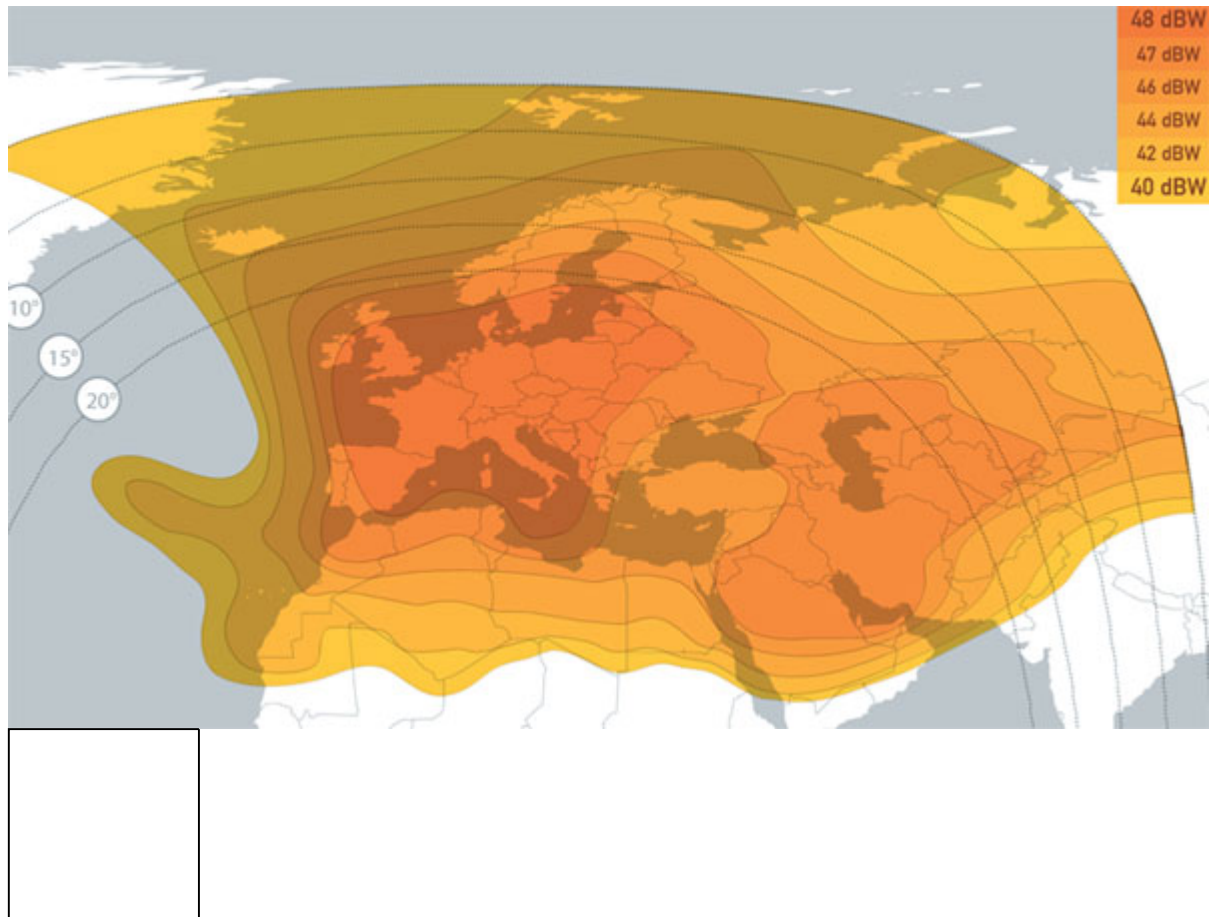


Figure 3: EUTELSAT 10A Satellite Coverage

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2.2.2 EUMETCast Africa

EUMETCast Africa is operated using the DVB-S2 standard in C-band. Table 3 shows the transponder parameters.

C-band Transponder EUTELSAT™ 8 WEST B (8° W)	
Parameter	Value
Name	EUTELSAT™ 8 WEST B
Transponder	C04
Down Link Frequency	3848.2525 MHz
Symbol Rate	9.892 MS/s
DVB-S2 MODCOD	4PSK (QPSK) 3/4
Polarisation	Circular Left Hand

Table 3: EUMETCast Africa Downlink Parameters

2.2.2.1 Satellite footprint and recommended antenna sizes

The footprint below in Figure 4 illustrates the general coverage of EUTELSAT 8W. The required antenna sizes depend on reception station location, the EIRP, the typical weather patterns and the selected DVB-S2 parameters (e.g. MODCOD, Symbol Rate).

For recommended antenna sizes see Appendix C, ‘Antenna Size recommendation’. The plots show the yearly availability taking into account typical weather patterns for standard antenna sizes. Professional users should aim for 99.98% availability and find the recommended antenna size from the plots.

For locations not covered by the plots, or in case of questions, please contact our User Service Helpdesk at ops@eumetsat.int.

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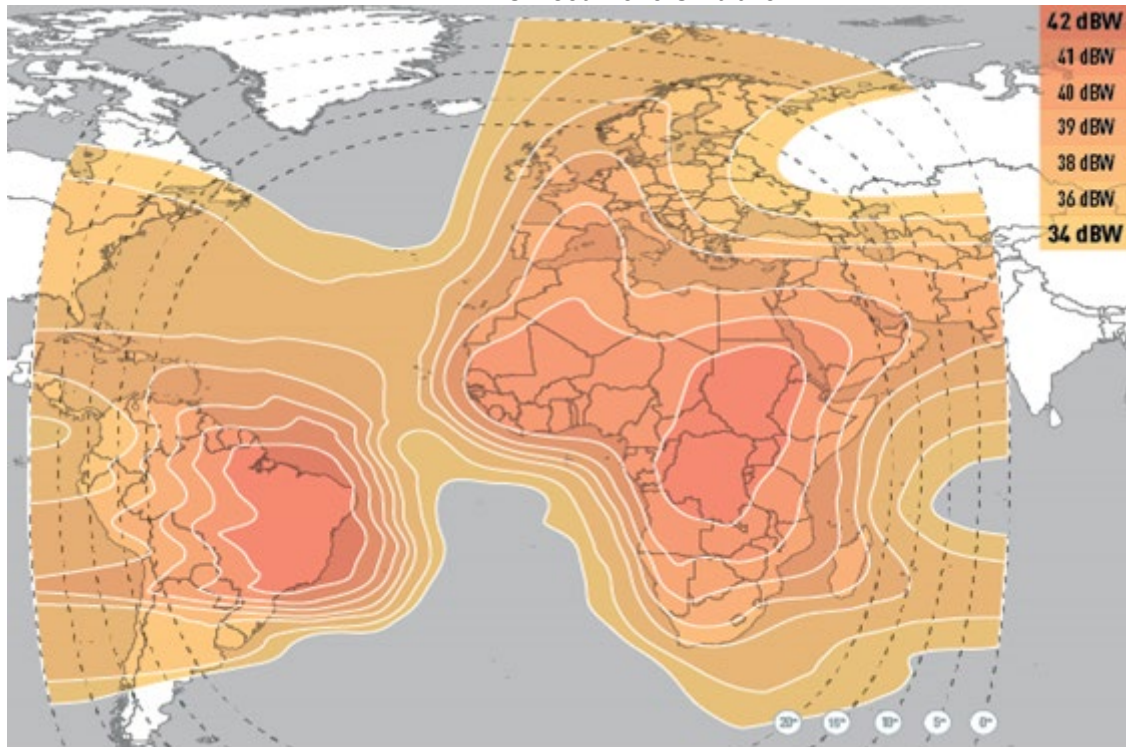


Figure 4: EUTELSAT 8 West B Coverage

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2.3 EUMETCast Terrestrial

The dissemination of multicast data through terrestrial networks – instead of uplinking to satellites - currently relies on the infrastructure provided by GEANT and providers of national research networks (NRENs) globally, GEANT network in Europe and the global connectivity of GEANT to other continents. The worldwide connectivity offers the possibility to an extensive geographical reach of the EUMETCast terrestrial service.

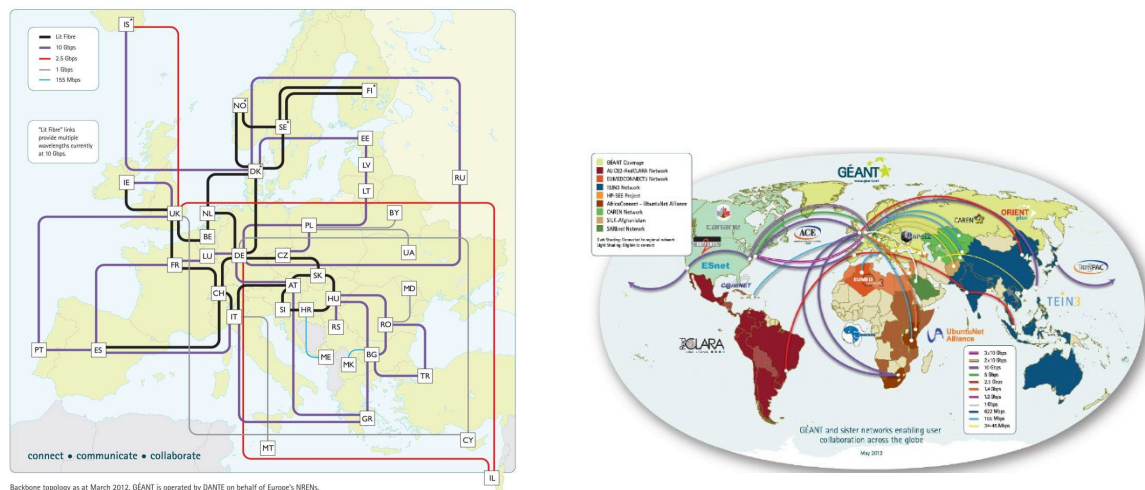


Figure 5: (Left) The European Network connectivity of GEANT ¹, (Right) GEANT Global connectivity

The overall principle for EUMETCast Terrestrial is to have a single data source where files are encoded into a multicast stream and then transported to the user via a multicast-enabled dedicated network based on Source-Specific Multicast (SSM) service model.

2.4 EUMETCast Data Services

EUMETCast supports the dissemination of EUMETSAT and third party environmental data streams and products. The list of available products varies according to the EUMETCast broadcast. The most comprehensive list of products is available via the EUMETCast-Europe service.

For an up-to-date list and description of the individual products/data streams available on each EUMETCast broadcast, consult the Product Navigator <http://navigator.eumetsat.int> or contact the User Service Helpdesk (see Section 6.2).

Please note that access to some services is allowed in accordance with EUMETSAT Data Policy, or the data policy of the individual data provider.

2.4.1 Data Formatting and file naming conventions

The data is made available on the reception station as files organised and formatted according to the reception format specification. No changes are performed in the reception station.

¹ The topology and network map of the GEANT project and its interconnections is available at http://www.geant.net/Media_Centre/Media_Library/Pages/Maps.aspx.

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The format of data files provided on EUMETCast is in accordance with the specification for each individual service and is determined by the data provider concerned. For more information on the file names and formats, consult the Product Navigator <http://navigator.eumetsat.int/>.

2.4.2 Data Volume

The data volume per file varies according to the individual product or data file. For the comprehensive list of a data volumes per EUMETCast channel consult the EUMETCast web pages, or refer to the Product Navigator for information on individual product volumes.

2.4.3 Archiving

By default, files received are kept in the selected target directory indefinitely. It is recommended to implement an automatic housekeeping mechanism to keep only the files for a configurable amount of time on the local disks.

2.4.4 Reporting

The station, via the TelliCast client, maintains a full log of the file reception history. This includes the time of reception for each individual file. The level of reporting is configurable.

2.4.5 Timeliness

All files are available and accessible on the reception station within a few seconds of the reception of the last DVB packet. However, partially received files are not made available and are deleted. The timeliness is determined by the settings on the EUMETCast Platform and controlled by EUMETSAT. A correctly-configured reception station will not add any significant delay to the availability of the received files.

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3 EUMETCAST RECEPTION STATION RECOMMENDATIONS

3.1 PC Hardware Specification

This section can serve only as best-practice advice. Station manufacturers should test and select the hardware components to make sure all elements are compatible.

Minimum recommended requirements are:

- **2.8 GHz Pentium IV type or better CPU (dual/quad core recommended)**
Although also < 1GHz CPUs work in some environments, it is recommended to use state of the art CPUs, in order to provide margin for system administration and other parallel tasks.
- **8 GByte RAM**
Although the minimum RAM requirement is much lower, the performance of the reception and storage to disk depends very much on the RAM size that is available for disk caching. State of the art systems with 8 GB RAM haven been proven to receive all services of 1 full transponder up to 70 Mbps without losses.
(see also section 4.4.1 below)
- **Storage**
The exact requirement depends on the volume of data to be stored. The storage size should be large enough to hold the maximum data volume that is expected under worst case assumptions, i.e. max incoming data rate, longest housekeeping period, longest retention period of the data. For example, max data volume for 22.5 Mbps is 220 GB per day, for 34 Mbps it is 340 GB per day. Please note that separate target directories can be specified per EUMETCast channel, allowing the use of multiple disks. It is recommended to use SSD drives as primary data storage location used by the TelliCast client software.
(see also section 4.4.1 below)
- **Fast and Reliable Disk Interface, e.g. SATA, SCSI, SAS**
A **non-blocking I/O** to disk(s) is of utmost importance, to be ensured by use of suitable/reliable hardware and up to date drivers. Using network drives as primary storage location is not recommended, but is possible if carefully designed, and a non-blocking I/O can be achieved under operating conditions.
- **RAM-Disks**
As an alternative to using hard-disks as target directories for received data, for high availability systems the usage of ram-disks is an alternative. The ram-disk size should be large enough to hold the maximum data volume that is expected under worst-case assumptions, i.e. max incoming data rate, longest housekeeping period, longest retention period of the data. Please note that separate target directories can be specified per EUMETCast channel, allowing the use of multiple ram-disks. Ram-disks should be set up as static ram-disks with fixed size allocations.
(see also section 4.4.1 below)

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- **PCI Bus**
If an internal DVB card is used: Please make sure that the PCI bus (PCI, PCIe, etc.) is compatible with the DVB card specification.
- **100/1000 Base Ethernet Card**
This interface is needed if data must be transferred to other computers, or as interface if a DVB Receiver/Router is used. It is strongly recommended to use dedicated network interfaces for incoming multicast traffic, and not use those for other (unicast) traffic. The network speed must match the incoming multicast data rate.
(see also section 4.4.1 below)
- **USB Port 2.0**
This interface is **mandatory** for connection of the EUMETCast Key Unit (EKU). Furthermore, additional USB ports might be needed to connect USB DVB reception devices and other peripheral devices.

3.2 DVB DEVICES

This section provides an overview of various types of DVB devices and the generic requirements. For the DVB-S services (EUMETCast Africa until mid-2018) generally any DVB device supporting IP reception (e.g. satellite over internet) should be working. Please note that also EUMETCast Africa will be migrated to e DVB-S2 Service in 2018.

For EUMETCast Europe and the future Africa DVB-S2 service, please check the most up-to-date list of compatible devices on the EUMETSAT website.

In terms of interface there are three types of devices:

- **Internal DVB Cards:**
 - These are usually PCI (5V or 3V) or PCIe devices. Please make sure the PCI/PCIe specification (exact version number) matches the computer interface
- **DVB Router Receiver:**
 - DVB Router Receivers are standalone boxes sending the received DVB multicast data onto a LAN that connects to the PC via a network card.
- **USB DVB Receiver:**
 - These boxes are connected to the PC via an USB link with the same functionality as an internal DVB Reception Card. At the minimum USB 2.0 should be supported.

A frequently updated list of compatible reception devices is maintained on:

<https://eumetsatspace.atlassian.net/wiki/spaces/DSEC/pages/742260752/Devices>

3.2.1 Generic Requirements for EUMETCast Europe

The generic requirements for the EUMETCast Europe DVB-S2 service reception devices are:

- Standard: DVB-S2.

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- Symbol Rate: up to 33 MSps 16APSK, and 45 MSps for QPSK/8PSK.
- Support for QPSK, 8PSK & 16APSK including all defined FEC codes for these modulations.
- Support for VCM, Multiple Transport Streams, Multi-Protocol encapsulation (MPE).
- Support for a minimum of 6 PIDs for the Basic Service and a minimum of 2 PIDs for the High Volume Service. Not more than 8 PIDs will be used on one transponder.
- Support for minimum two MPE transport streams using the same ISI
- Users may need to procure/install/configure an additional network adapter in the host system if using a LAN DVB router.
- A maximum output IP bandwidth of 50Mbit/s for the Basic Service and up to 80Mbit/s for the High Volume Service must be supported.

Please note that all devices need to fulfil the full specification as outlined above. Hence devices that just state "DVB-S2/MPE/VCM compliant" might not necessarily be suitable.

3.2.2 Generic Requirements for EUMETCast Africa

In 2018 EUMETCast Africa will switch to the DVB-S2 standard. It is recommended to use only DVB-S2 compliant devices for EUMETCast Africa. The generic requirements for the future EUMETCast DVB-S2 service reception devices are:

- Standard: DVB-S2
- Symbol Rate: up to 45 MSps.
- Support for QPSK/8PSK including all defined FEC codes for these modulations.
- Support for a minimum of 6 PIDs
- Support for one MPE transport stream
- A maximum output IP bandwidth of 80Mbit/s.

3.3 Operating System Specification

The TelliCast client software is only available for Intel x86 based platforms.

Several Operating Systems have been tested by EUMETSAT, focusing on compatibility/performance with selected DVB PCI cards. The following combinations have been verified as performing satisfactorily:

- Windows 7, 32 and 64 bit
- Windows 8, 32 and 64 bit
- Windows 10, 32 and 64 bit
- Linux kernel 2.6.28 and higher, with the DVB S2 devices that are supported by the built-in kernel drivers. Both 32-bit and 64-bit systems are supported.
- All of the above listed operating systems with a DVB Router Receiver connected via the network interface
- NTFS file system on Windows OS and ext2 (or higher) files system on Linux OS – recommended for maximum performance

Other combinations of Operating System and DVB PCI/USB devices may function adequately, but have not been tested by EUMETSAT.

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The following linux distributions have been verified as performing satisfactorily with the Safenet ECU software and Tellicast versions 2.14.5 and later:

- Centos 6.10, 32/64 bit Kernel 2.6.32
- Centos 7.6, 64 bit Kernel 3.10.0
- Scientific Linux Release 6.1, 64 bit Kernel 2.6.32
- openSUSE 15.0, 64 bit Kernel 4.12.14
- Ubuntu 16.04, 32/64 bit Kernel 4.4.0
- Ubuntu 18.04, 64 bit Kernel 4.15.0

Older Linux distributions may not be supported any more by the latest ECU hardware and software.

3.4 EUMETCast Terrestrial – Last-Hop Router and Reception Station

EUMETCast Terrestrial demonstration service is based on SSM Multicast service mode. This requires the last-hop router to support PIM-SSM. The communication protocol between the reception station and the adjacent router is IGMPv3, hence it must be supported on the adjacent router and on the receiver's operating system.



Figure 6: EUMETCast Terrestrial end-to-end system overview

3.5 EUMETCast Software

In the EUMETCast up-link system, all processing steps between the reception of the data files for dissemination and the provision of an IP stream to an IP/DVB gateway are performed by the TelliCast Server software. Consequently, the counterpart of this software, the TelliCast Client software is mandatory on the EUMETCast Reception Stations, with a licence required for each station. Hence the following software items (including supporting software) need to be installed and configured:

- The TelliCast Client Software (information about the latest version see EUMETSAT's web site), available for both MS Windows and Linux systems. This software supports mainly the following functionalities:
 - Decoding and error correction of the data from multicast stream into files
 - Decryption of the data based on a key code
- The appropriate driver software for your chosen DVB device (if applicable)
- Properly configured network interfaces for DVB routers (see also section 4.4.1 below)

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- The EUMETCast Key Unit Run-Time-Environment, available for both MS Windows and Linux systems
- For Linux Systems: PCSC lite, required for the EUMETCast Key Unit (EKU), the required version depends on the EKU hardware used (see installation instructions on the EUMETCast DVD)
- a modern web-browser for display of the TelliCast monitoring information

3.6 Application Software

A wide range of application software is commercially available for image viewing and data processing. These are available in the form of freeware, low-cost software packages and higher-cost advanced data/product processing software; see Appendix B for guidelines to some of this software. For detailed information, please consult reception station manufacturers.

3.7 General Note on Reception Equipment

EUMETSAT strongly recommends setting up the EUMETCast PC only as a Reception Station with an optional FTP/File Server functionality, and not to install and run other application software. Peaks in disk or bus usage could interrupt the DVB data reception and thus cause non-recoverable data losses.

Whilst the multicast system includes many features to ensure the reliable delivery of data, the Ku-Band transmission is subject to attenuation by rain. This means that heavy rain in the vicinity of the reception station may cause attenuation of the satellite signal which, in turn, could result in some loss of data.

C-Band transmission is significantly less susceptible to rainfall, but may be affected by local interference from airport radar, television transmitters and wireless networks (5G). In this case installation of a RF band-pass filter between the feed horn and the LNB has proven to reduce or even to eliminate the interference, depending on its signal strength and frequency range. In cases of strong out of band interference close to the downlink frequency a narrow band pass (single transponder) filter is required, e.g. to suppress 5G wireless signals. It shall, however, be noted, that with such a filter installed, it may take longer for the DVB card to lock onto the signal. In some instances, the cable may even have to be disconnected and reconnected several times before successful signal lock is achieved. The locking capability depends on the type of the filter, the LNB and the DVB card in use.

3.8 Purchasing Hardware and Software

The basic hardware equipment for receiving EUMETCast is readily available from many commercial suppliers. For a list of known manufacturers, consult the EUMETSAT website.

The EUMETCast Client Software and EUMETCast Key Unit are available from EUMETSAT. All subscriptions should be made via the EO Portal or addressed to the EUMETSAT User Service (please see Section 6.2 for details).

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4 EUMETCAST SETUP

This section provides some insight into the data flow at the reception side and gives recommendations for addressing the key performance issues.

Owing to the multitude of possible hardware/software combinations, EUMETSAT cannot provide individual user support for the receiving equipment set up. Users are advised to set up their stations in line with guidelines provided by EUMETSAT and to contact the individual component vendors should problems arise.

The up-to-date installation guides for DVB devices, the ECU and the TelliCast software are provided on the EUMETCast CD/DVD and on the EUMETSAT website:

<https://eumetsatspace.atlassian.net/wiki/spaces/DSEC/pages/695763106/Reception+Station+Recommendations>

4.1 PC Setup

For general PC set up support, please contact your system administrator or PC vendor.

4.2 Satellite Reception Setup

4.2.1 DVB Device Installation

Install the DVB card and driver according to the instructions in the package and connect it to the antenna. Alternatively connect the DVB router to the network interface and configure the reception parameters following the guides. All DVB installation guides are included in the EUMETCast CD/DVD and the latest versions are available for download at

ftp://ftp.eumetsat.int/pub/OPS/out/user/EUMETCast_Support/EUMETCast_Licence_cd/

4.2.2 Satellite Dish pointing and LNB alignment

Adjusting the satellite dish at regular interval for best reception is very important, even for small antennas as over time the pointing will degrade due to wind load.

For new installations you will need to find the exact elevation, azimuth and skew that gives you the optimal reception. In order to get a clear signal, you need a clear path from your dish to the satellite - no trees or buildings in the way.

There are three steps to successfully installing the satellite dish and optimising it for DVB-S2 reception.

The first step involves finding your “look angle”, the direction in which the dish needs to be pointed to receive the signal. This can be done by utilising the website

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<http://www.dishpointer.com/>² where to find the “look angle” you enter your location and the required satellite. Alternatively you can call a local technician for assistance.

The second step is aligning the satellite dish/antenna to the satellite using the azimuth and elevation angles. Use a compass or get the direction from Google maps to select the azimuth. Select the elevation by using the elevation angle scale on the mount bracket. Then use a dish pointer tool to optimise the signal. Connect the DVB device and check if you have selected the correct transponder (see transponder table in section 4.2.2.1) and that EUMETCast can be received.

The third step is optimizing your reception. We suggest a laptop is used in close proximity to the dish and your already configured DVB receiver, or alternatively remote control software, to enable you to see and optimise the reception via the instantaneous changes in levels.

Follow the DVB receiver setup guide to configure the receiver for the DVB downlink. Make sure you already receive EUMETCast data and read the link margin or EsNo or C/N (or other quality parameter) while moving the dish.

Try moving the dish in very small steps towards the East or West to find the maximum link margin and fix the azimuth. Then move it fractionally up or down to get the best link margin value. Wait until the parameters have stabilised. Repeat these steps several times. Then tighten the screws. Sometimes tightening the screws will de-point the dish again. You may have to try several times.

For the DVB-S2 reception in KU band (on EUTELSAT 10A), the 'skew' angle of the LNB is very important. The 'skew' angle represents the horizontal/vertical plane of the LNB. When a satellite dish is facing towards a satellite at due south, the plane of the LNB will be vertical (straight down). As the dish is moved around either East or West to receive other Satellites the LNB will need to be tilted (rotated), clockwise for West and counter clockwise for East (as viewed from the rear of the dish). The best way to adjust the LNB skew is to set it at zero degree and then to rotate it in very small steps both ways while keeping an eye on the link margin. Adjust for optimal link margin.

If the user's LNB supports focussing, the user should try to find the best focus point to get the higher possible link margin, moving the LNB towards the dish or away from it.

Note: If the user satellite dish is within the specification the measured clear sky link margin should be more than 4 dB for Ku band and more than 2.5 dB for C band which is sufficient to give the target availability of 99.98%.

A more comprehensive antenna pointing guide is available on the EUMETCast CD/DVD and for download at:

ftp://ftp.eumetsat.int/pub/OPS/out/user/EUMETCast_Support/EUMETCast_Licence_cd/Generic_Documentation/

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4.2.2.1 Transponder table

The following transponder table helps to identify the satellites and to optimise the reception. This table was valid at the time of writing this document.

See <https://www.lyngsat.com/>³ for latest status on active transponders

10°E	H	11262 MHz	33.0 MSymbol/s	8PSK 3/5, 16APSK 2/3	(EUMETCast)
13°E	H	11258 MHz	27.5 MSymbol/s	8PSK 3/4	locked (HB13)
13°E	V	11278 MHz	27.5 MSymbol/s	8PSK 3/4	locked (HB13)
19°E	H	11273 MHz	22.0 MSymbol/s	8PSK 2/3	locked (Astra)

4.2.2.2 KU band dual feed setup

This section describes the installation and pointing of a dual feed system, in order to be ready for reception from the EUMETCast backup transponders on HB13.

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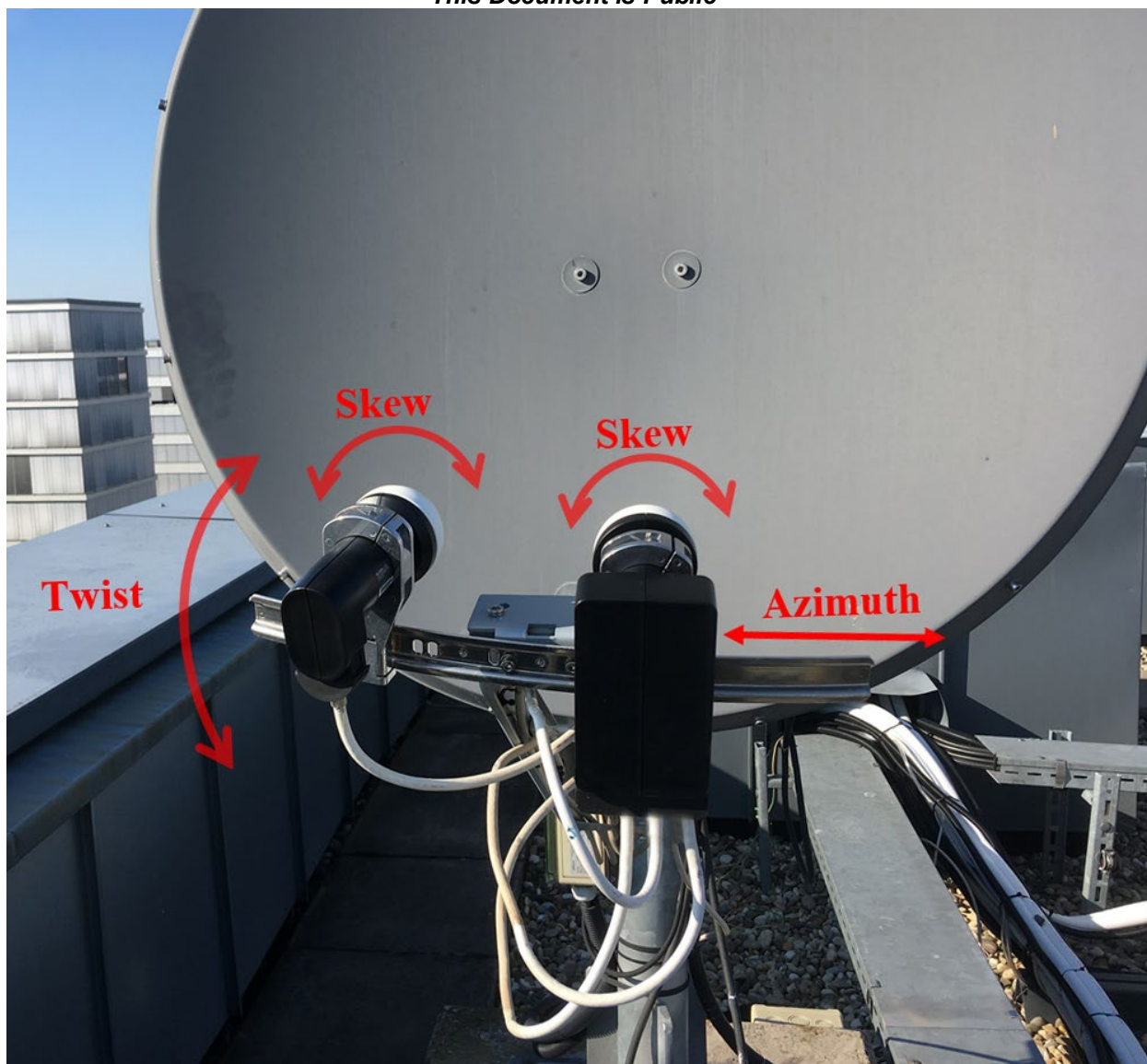


Figure 7: Dual-Feed system

Inspect the antenna if existing rails for mounting multiple LNBs exists, and if it is long enough to span the range from 10° E to 22° E, with enough margin. A curved rail is recommended, such that all LNBs point to the centre of the dish. For most of the LNB mounts there are kits available to install multiple LNBs.

Use a DVB-S2 signal analyser / satellite finder supporting ACM/VCM and the MODCODs used by EUMETCast, or a DVB router /DBV card with PC/Laptop to analyse the reception. For the optimisation in the following steps always optimise for maximum C/N or link margin or EsN0, whatever is available, for HB13 use the list of active transponders listed in section 4.2.2.1 below.

Starting from an antenna pointed to E10A with an LNB in the focus, mount the curved rail kit for the LNBs you are intending to use. In Figure 7 the standard 40mm LNB mounts are used.

- put LNB (for the E10A) in the centre of the rail, close to the original position

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reception from E10A should still work

- move azimuth of antenna towards East until you find a strong signal from E13 and fix the azimuth position
- move the LNB on the rail in East direction, until the E10A transponder is found again
- mount the second LNB and move it to the other side of the rail (west), until HB13 is found
- optimise azimuth position on the rail for both LNBs
- optimise skew angle of both LNBs

Due to different elevation of E10A and HB13, the rail must be twisted, depending on the location of the station. Twisting has more impact on HB13 due to the longer offset position, therefore start with HB13 first.

- optimise twist angle for HB13
- then optimise the elevation of the complete antenna for E10A
- repeat optimisation of elevation and twisting until the maximum for both LNBs is found

After this procedure the E10A performance should close to the original performance, and in addition reception from HB13 QPSK MODCODs should be possible.

4.2.2.3 Antenna pointing requirements

This section describes the impact of pointing errors on the link margin. The requirements for mobile reception systems are exactly the same as for fixed antenna systems.

An implicit requirement is of course that the pointing accuracy must be maintained good enough to prevent a significant degradation in the link margin.

For example:

For the Europe DVB-S2 High Volume Service an antenna size of 2.4 m is sufficient for nearly all European sea areas, and for Atlantic areas not too far from the European coast. See antenna size plots in Appendix B for more details.

The table below shows the gain loss (= link margin degradation) versus the pointing error. From this the pointing accuracy for a 2.4 m antenna should be better than 0.2°.

2.4 m antenna Ku band	
pointing error	gain loss
0.1°	0.2 dB
0.2°	0.8 dB
0.3°	1.8 dB
0.38°	2.87 dB

Table 4: gain loss versus pointing error

The degradation for other antenna sizes and in C-band can be calculated using this tool:

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http://www.satellite-calculations.com/Satellite/off_peak.htm⁴

4.2.3 LNB

The LNB is a crucial analogue component for reception of the weak satellite signals in Ku band and for delivering the down-converted L-band signal to the DVB receiver. That's why the user should check the existing LNB and decide if there is a need for it to be replaced. The LNB should also match the antenna geometry.

The noise figure of the LNB is a measurement of how much noise the LNB will add to the signal you may be intending to receive. The gain is a measure of the amplification factor. The lower the noise figure of the LNB and the higher the gain the better the LNB will be able to receive weaker signals. Although high gain LNBs might be useful to compensate losses from long antenna cables, it is more efficient to use low loss cables in this case. The cross-polar isolation is a measure of how much the signals from neighbouring transponders on the different polarisation are suppressed.

Some companies advertise the "0.1dB" noise figure specification. This is utterly meaningless. Once the noise figure is below 0.6dB right across both bands (Hi and Lo), then lowering it further would make no discernible difference to reception. With low price consumer LNBs a quality selection by specification cannot be made. It is better to just test different LNBs if the result is not satisfactory. High priced quality LNBs can give an improvement in link margin of more than 0.5 dB compared to the average consumer device.

In order to increase the link margin it is more cost effective to invest in a larger dish compared to a high priced LNB.

EUMETSAT suggests for Ku band a Universal LNB (HD Reception) which can feed the DVB-S2 receiver in the full Ku band range (10.7 to 12.75 GHz). For C band an LNB supporting the C band range with LOF of 5150 MHz and power supply via coax cable is suggested. These LOF frequencies are compatible with the EUMETSAT provided DVB devices configurations and guides.

Where a user has two or more receivers, multi output LNB (Dual or Quad LNB) can be used, each output supporting the full Ku band range. See also section 4.2.5.

4.2.4 Cabling - Connectors

It is recommended that the user checks the existing wiring and IF connectors. Be sure that the cable is in a good condition and shows no signs of damage or kinking. Ensure that the inner core and braiding are not shorted and that both have electrical continuity. If the user finds that the wiring needs replacing, EUMETSAT suggests using only high-quality cable with proper insulation. For distance less than 20 m it is recommended to use the standard 75 ohm Coaxial

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Cable Type-F RG 6/U or similar. For longer cables up to 200m a low loss coax cable type 75 ohm RG-11 should be used. Using an amplifier to compensate cable losses will not achieve the same performance compared to using shorter or low loss cables.

The user should also check that the F-connectors are fitted correctly. If the copper insulation touches the inner copper wire, or if the F-connector doesn't touch the outer braid, strong interference can occur resulting in degradation in signal quality.

4.2.5 Redundant receivers and multiple transponders

Where a user has two or more receivers which should be connected to one or more transponders there are many solutions possible:

- Using passive splitters
- Using multi-output LNBs (Dual or Quad LNB)
- Using separate dedicated antennas
- Using multi-switches and DiSEqC

The pro and cons of the different choices are briefly explained.

A minimum hardware upgrade to support 2 transponders is shown in Figure 8. A passive splitter is inserted in the antenna cable and splits the incoming IF signal (0.9 – 2.1 GHz) into multiple output ports to which the DVB receivers can be directly connected. They usually allow DC pass-through from the receivers in order to feed power to the LNB. This solution is only possible if the two (or more) transponders are operated in the same polarisation and frequency band.

As a variation of the splitter solution multi output LNB (Dual or Quad LNB) can be used. In fact the splitter function is moved to the antenna and longer cables must be used to connect the antenna to the receivers. The advantage of this solution is that each LNB output port can support the full Ku band range and different polarisation, however the correct KLNB type must be chosen.

Alternatively, if the multiple receivers are using the same frequency band and polarisation, passive splitters can be used at the input side of the receivers.

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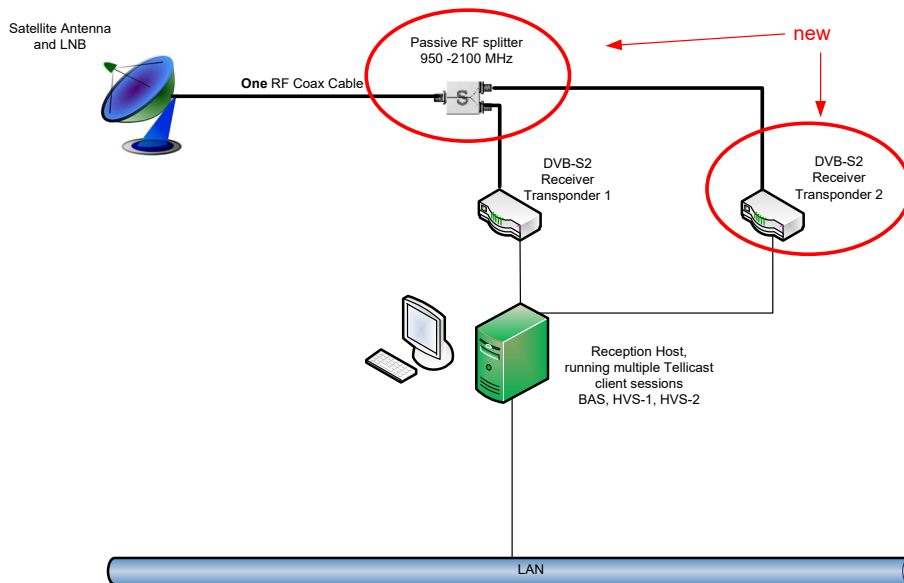


Figure 8: Minimum hardware upgrade

Figure 9 shows a variation of the splitter solution where the existing system is maintained as much as possible and the new transponder is served by separate reception PC. This solution requires a dedicated license and EKU for the second reception PC.

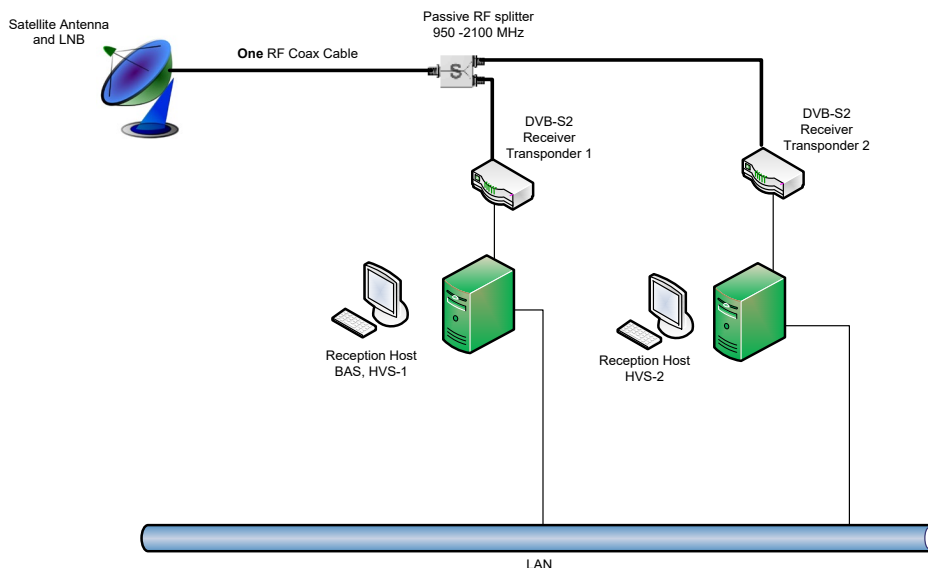


Figure 9: Hardware upgrade keeping existing system untouched

Figure 10 shows a high availability and fully redundant solution. It is a duplication of the splitter solution with the advantage that a completely separate system allows down time of one of the systems without impact on the overall reception service. Such a down time might be caused by problems or might be necessary for maintenance.

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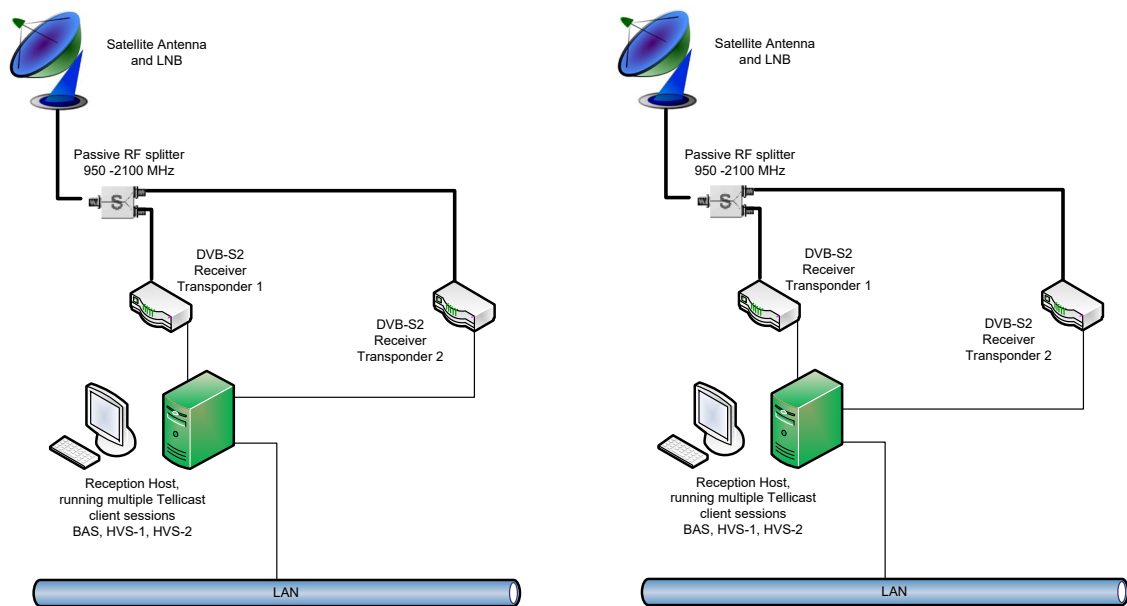


Figure 10: fully redundant reception chains (recommended)

4.3 Terrestrial Reception Setup

As an initial setup it is recommended to physically locate the reception station as close to the NREN router as possible. This direct connection will allow verifying that the reception of the EUMETSAT data via the terrestrial multicast service works conceptually. At a next step the station could then be moved inwards towards the site's own network if such desired. The reception station interfaces should not be connected via a radio link to the WAN network - either microwave or Wi-Fi.

To configure the reception of the EUMETCast Terrestrial service on the User's site it is required to:

- Verify with the National Research Network used that their network is multicast-enabled
- Establish with the NREN a Site-to-NREN SSM multicast enabled connection (next section).
- Configure IGMPv3 on the operating system of the reception station

4.3.1 Network Configuration

The EUMETCast Terrestrial service has a centrally located server at EUMETSAT. The service utilises SSM multicast in which the receivers always know in advance the multicast source and group addresses. These parameters are configured within the Tellicast configuration file.

At the network level to configure SSM multicast it is required on the router adjacent to the receiving host to enable PIM-SSM (Protocol Independent Multicast - Source-Specific Multicast).

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This specifies the range of addresses for which PIM-SSM will be used (default is 232.0.0.0/8). On the adjacent router's interface facing the receiving host it is required to be configured IGMPv3. The non-last hop routers must only run PIM-SM.

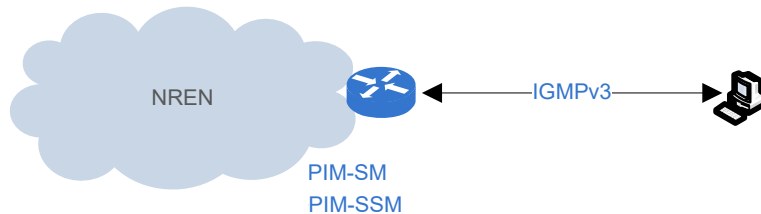


Figure 11: Multicast routing configuration

4.3.2 Troubleshooting SSM Multicast

Once the network has been configured and the EUMETCast Client Software is installed and started, follow the checklist below to verify that the connectivity can be established.

- Check that announcement channel is joined on the network interface. On the host:

```
hostname#netstat -ng
IPv6/IPv4 Group Memberships
Interface    RefCnt Group
-----
lo           1    224.0.0.1
eth0         1    224.0.0.1
eth0         1    232.223.222.1
```

- Check that version 3 of IGMP is in use. On the host:

```
hostname#tcpdump -i interface igmp
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth0, link-type LINUX_SLL (Linux cooked), capture size 65535 bytes
12:44:57.765937 IP 62.40.109.38 > igmp.mcast.net: igmp v3 report, 1 group record(s)
12:45:00.65732 IP 62.40.109.38 > igmp.mcast.net: igmp v3 report, 2 group record(s)
```

(Note: replace *interface* with the name of the interface used by the multicast)

The igmp report must indicate “v3”, otherwise enable igmp version 3 on the router interface facing the host.

- Check if the router has a multicast route for the SSM (Source,Group)=(193.17.9.3,232.223.222.1), display the content of the IP multicast routing table:

```
router#show ip mroute ssm
(193.17.9.3, 232.223.222.1), 21:13:13/00:02:51, flags: sTI
Incoming interface: FastEthernet0/0, RPF nbr 193.17.9.3
Outgoing interface list:
FastEthernet0/1, Forward/Sparse, 21:13:13/00:02:23
```

The output shall show (193.17.9.3,232.223.222.1). Otherwise please verify if PIM-SSM is configured on the router and if the NREN is multicast-enabled.

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- Check incoming multicast:

```
hostname#tcpdump -nni interface udp port 4711
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth1, link-type EN10MB (Ethernet), capture size 96 bytes
10:20:28.411230 IP 193.17.9.3.60174 > 232.223.222.223.4711: UDP, length 1442
10:20:28.431457 IP 193.17.9.3.60174 > 232.223.222.223.4711: UDP, length 1442
```

- Check the log file (cast-client*.log) and look for “Connected to announcement channel”. This shows that the SSM multicast is established.

```
MSG:2016-05-04 13:26:16.328:Connected to announcement channel 'TSL-TER-1', address 232.223.222.1:4711
(announcement channel)
```

4.4 The System Architecture and Data Flow

Figure 12 shows an overview of the EUMETCast hardware and software elements of a typical reception station, and the internal and external data flows. The functions of these elements and the data flows will be described in this section.

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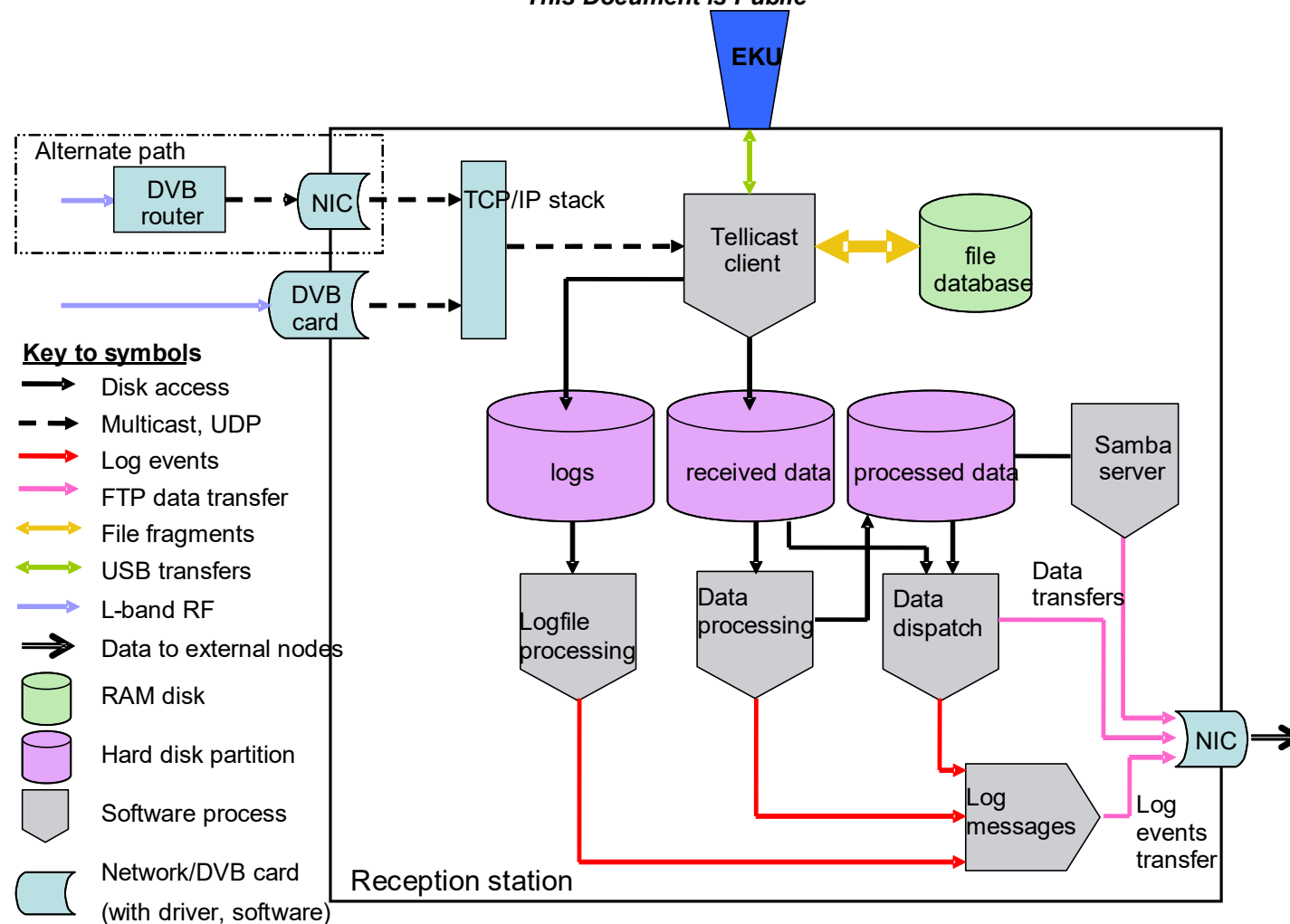


Figure 12: Reception Station Architecture

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The EUMETCast broadcast is received at the antenna/LNB front end and down-converted into an L-Band signal. The L-Band signal is routed via a co-axial cable, which acts as the input to the DVB receiver. The signal reception can be accomplished in different ways, either:

- The built-in PCI DVB card, or;
- An external USB DVB receiver
- An external DVB router and a second network interface card (NIC) in the receiving computer.

Actually, all DVB reception devices appear to the operating system in the same way: as a network interface. The DVB card driver or DVB router or firmware decodes the data and filters the IP packets according to the configured parameters, such as MODCODs and Packet Identifiers (PIDs), to select which IP multicast packets are passed through to the network interface.

The TelliCast client software interfaces to the DVB network interface via the TCP/IP stack by subscribing/un-subscribing to multicast data streams. In detail, when the TelliCast client is started, it sends a “join” message to the selected network interface specifying the Announcement Channel multicast (group) address. The network interface will forward (signal) this join message to the next network router (if there is one) and transmits any received multicast packet matching that group back to the requesting client.

The TelliCast client then gets a continuous stream of announcement data - the announcement channel is “opened”.

The TelliCast client uses its username to identify the subset of data it is configured to receive. In addition to the username, a password and an EKU (EUMETCast Key Unit) are necessary to decrypt the data. A given username works only with the matching password/EKU combination. For each transmission a data channel is opened using the same concept as above to “join” a multicast data channel. At the end of the transmission the data channel is closed with a “leave” request to the network interface.

The reception behaviour using the EUMETCast default configuration is as follows: During reception, the file fragments are immediately written to the temporary location on the disk using a temporary file name and control information is held in a database, which is resident in memory – the file database. Once a file is completely received, it is moved from the temporary to the target location on the disk and renamed to the original filename, and the timestamp of the file is set to the original time in the EUMETCast platform. It is important that the temporary location and target location are on the same file system, otherwise the move operation will not be possible (in Linux) or result in a copy operation (Windows) which takes more time and resources. The move is an “atomic” and fast operation because it consists of just a change in the file allocation table - the file itself is not touched.

Subsequent data processing, data replication, data distribution and housekeeping of files and directories are controlled by other applications.

Distribution of received and/or processed data may be accomplished in three ways. Firstly, file-distribution software may be configured to deliver – FTP push – files to remote locations via the local network. Secondly, the files may be pulled from the EUMETCast station via FTP by the end-user equipment. A standard FTP server on the station provides the interface for this functionality. Lastly, the local directories of the reception station may be mounted over the network using the Samba protocol or an equivalent network file sharing method.

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The integration of processing, file distribution and display software must be carefully done to avoid any bad impact on the reception. The following sections will give some information about the most critical elements.

4.4.1 Key Elements for Performance

The TelliCast client is real-time software that has to be able to process incoming data, access information and outgoing data at the speed of the incoming information. This makes it much different from unicast transfer protocols (ftp, etc.) where lost data will be requested and retransmitted. The salient points for the TelliCast performance are the interfaces - networking for incoming data, file system for file fragments, data and logs, and USB bus to ECU for decryption. Any bottlenecks in these interfaces will have an impact in performance

Networking: The multicast stream consists of UDP packets and is optimised for best bandwidth usage. The timing between announcement channel and the data channels is very important to achieve high efficiency on the Satellite links. That means that the active network elements including DVB receivers should not introduce jitter of more than 100 msec until the traffic reaches the TelliCast client. In terms of routing the network elements (routers or switches) between the DVB receiver or the terrestrial border router and the computer must be configured to either react very fast for join and leave requests, or must be configured to pass all multicast traffic from the DVB receiver (static routing). Any interruptions of the traffic must be avoided because of the unidirectional data flow, i.e. there is no retransmission in case of lost packets.

Special attention must be placed on

- Stable Ethernet link between network ports, avoid repeated auto negotiation or speed switches
- Multicast signalling should be static, i.e. all traffic statically routed from DVB receiver or border routers to computer(s)
- Sufficient bandwidth for multicast, i.e. use dedicated LANs or VLANs for the multicast, and avoid routing of unicast and multicast together on the same LAN
- Avoiding buffering, i.e. buffering will lead to jitter which may become unacceptable. Buffering can also occur in the tcpip stack, DVB devices, or other interfaces (PCIe, USB, etc.).
- Interrupt servicing of network interfaces by multiple CPUs or cores. Static assignment of interrupts allows better performance compared to dynamically changing assignments (see irqbalance in Linux systems). The effects can result in buffering and packet drops (overruns) in the kernel.

File System Performance: In general, all file systems must have sufficient performance to avoid blocking I/O situations in the TelliCast application. Insufficient file system performance is the top 3 of problems reported by users.

The file database contains the control information for all transmissions in progress including received and missing fragments. Since transmissions are going on in parallel on many channels and the activities are very dynamic, the access to the control information is very time critical.

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Any delay to this control information will cause dropped packages or dropped control information. In order to achieve this, it is mandatory that the file database location is in memory, as in the default configuration of the TelliCast clients.

When the file database becomes full, it will discard data and considerably slow down due to internal housekeeping operations, even when it is in memory, and therefore cause losses.

The next equally important interface is the files system for data storage. In the default configuration it contains the temporary and target location where the file fragments are written to and, after the file is complete, the data will be made available. Different locations can be configured per EUMETCast channel, however it is essential that the temp and target directory for a specific channel resides on the same file system. Recommended solutions for this files system are:

RAM disks provide the best possible performance in terms of random access and throughput. The limitation is the maximum size which depends on the operating system and the hardware. The RAM disk must always have sufficient space left to allow temporary peaks and temporary file fragments to be stored. Successfully received files must be moved as fast as possible to persistent storage system or discarded after processing. This solution makes sense on properly designed high performance systems or on integrated processing systems where the original files are not needed.

SSDs also provide much better random access and throughput performance compared to what is required by the TelliCast client. In addition, the persistent SSD storage is an order of magnitude higher and costs much lower compared to RAM. So far no IO bottleneck has been observed on SSD systems, in particular when several GB of RAM are available as file cache. As much as possible separate data disks should be used, in order to avoid impact from system and possible memory swap activities.

Spinning disks are still widely used and provide persistent storage at low cost. However, the in particular the random access performance is too low to support the full EUMETCast stream. It works only satisfactorily when a high amount of RAM is available as file cache and if a state of the art disk interface (SCSI, SAS, SATA) in connection with hard-disk cache is used. Otherwise just random read access to the data will cause reception losses.

EKU communication: The EKU uses the USB bus as its interface. Delays affecting the USB response might cause timeouts in the TelliCast client. A 10 s response delay will be interpreted as an EKU failure and the TelliCast client is restarted. If immediately after the restart another timeout occurs then the EKU is disabled and encrypted channels cannot be received. Jumps in the system time (due to non-optimal time synchronisation) can falsely indicate EKU timeouts and lead to the mentioned problems. Also the EKU itself can experience communication “hang-ups”. A soft hang-up can be recovered with a manual TelliCast restart. Therefore, it is advised to install an EKU monitor tool to perform this recovery.

The EKU can also experience a “hard hang-up”, indicated by the LED going permanently off. This state can only be recovered by a power cycle of the EKU (unplug, replug EKU, or unload reload the USB module). For this case, contact EUMETSAT Helpdesk to replace the EKU.

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CPU Performance: The CPU requirements of TelliCast are not very high. Normal state-of-the-art CPUs for Desktops are sufficient. Dual or quad core CPUs can help to distribute the most demanding software processes into different cores.

4.5 EUMETCast Client Software Description

This section aims at understanding the TelliCast client operation, various configuration options, and the interpretation of the log messages.

4.5.1 Installing EUMETCast Client Software

The EUMETCast Client Software, TelliCast, licence package is available from EUMETSAT on CD/DVD-ROM. The package includes detailed installation documentation for Linux and Windows.

Please follow the installation instructions. Then the following default directory structure will be created:

Under Windows:

```
C:\
+---EUMETSAT
|   +--- EUMETCast                Program and configuration files
|       tc-cast-client.exe
|       cast-client_bas.ini
|       cast-client_hvs-1.ini
|       cast-client_hvs-2.ini
|       cast-client_ter-1.ini
|       cast-client_afr-1.ini
|       license.ini
|       cast-client-channels_bas.ini
|       cast-client-channels_hvs-1.ini
|       cast-client-channels_hvs-2.ini
|       cast-client-channels_ter-1.ini
|       cast-client-channels_afr-1.ini
|       ... and other files
+---EUMETCast
|   +---logs                    Tellicast client log files
|   +---received                Subdirectory structure for received files
|       +---bas
|       +---hvs-1
|       +---hvs-2
|       +---ter-1
|       +---afr-1
+---tmp                        Subdirectory structure for transient files
```

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Under Linux:

```

/
+---/etc                                Program and configuration files
|   tellicast-client.cfg
|   cast-client_bas.ini
|   cast-client_hvs-1.ini
|   cast-client_hvs-2.ini
|   cast-client_ter-1.ini
|   cast-client_afr-1.ini
|   license.ini
|   cast-client-channels_bas.ini
|   cast-client-channels_hvs-1.ini
|   cast-client-channels_hvs-2.ini
|   cast-client-channels_ter-1.ini
|   cast-client-channels_afr-1.ini
|
+---init.d                               Service startup file
|   tellicast-client
|
+---usr
|   +---local
|       +---bin
|           tc-cast-client                Executable
+---home
|   +---<username>
|       +---data
|           +---eumetcast                Temporary and target directories

```

4.5.2 EUMETCast Client Configuration files

A detailed description of all configuration parameters is available from the Web interface of the TelliCast client. In this section the parameters relevant for EUMETCast are described in more detail.

cast-client_bas.ini

- contains client configuration parameters, such as:

```

[recipient]
user_name=
user_key=

```

Note: When using the Windows installer please enter user_name/user_key during the installation process, then it will be remembered when making software upgrades.

```

[shell]

```


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port=8100

The port number to access the TelliCast Web interface, i.e. <http://localhost:8100/>

Please keep this values unchanged, there are fixed assignments for each EUMETCast service

refresh=3

Can be changed to increase or decrease the refresh rate of the Web interface

[watchdog]

#error_script=error.bat

#error_script_cause_announcement=60

Can be enabled to trigger an error script (or notification) in case the announcement channel is interrupted

max_memory_usage=500000000

Will initiate a restart of the client if the memory usage is exceeded

Must be present because the default value is too low

[logging]

log_file_size=20000000

log_file_number=15

log_level=normal

Allows tailoring of the logging, in terms of file size, number of files, and content

[locations]

file_database_directory=<memory>

log_file=>>\EUMETCast\logs\recv_bas.log

license_file=C:\EUMETSAT\EUMETCast\license.ini

channels_file=C:\EUMETSAT\EUMETCast\cast-client-channels_bas.ini

The locations of the log, license and channels file. Normally automatically defined on installation

[announcement_channel]

address=224.223.222.223:4711

name=TSL Announcement Channel

Automatically set on installation

Must match the EUMETCast Announcement channel for the service.

[parameters]

interface_address=0.0.0.0

file_delivery_counter=0

file_delivery_speed=0

file_database_size=20000000

file_database_type=control

total_bandwidth=200000000

tmp_directory=\EUMETCast\tmp\bas

allow_execute=1

To enable the 'set_systemtime'-feature, the client must be running as root, or as service

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```
# then the client host system time will be synchronised with the EUMETCast server
platform
# if multiple clients are running, enable maximum one client to synchronise the time
#set_systemtime=1
The default values will work on most systems
```

cast-client-channels_bas.ini

- Allows selection of target directories for incoming files, e.g. another drive. See comments in the file for more information

```
[channel]
name=*
receive_buffer_size=8000000
Defines the kernel receive buffer size for this multicast channel in bytes. The default
value is 4000000. Increasing the buffer helps avoiding losses if the client is temporarily
blocked in IO operation and cannot read the incoming multicast fast enough, e.g. in
case of heavy disk load. On Linux system the following system parameters in
/etc/sysctl.conf must be set to the same or higher values:
net.core.rmem_max=8000000 (reboot the system after a change)
```

```
delay_channel_leave_time=86400
(new parameter since 2.14.4) Keeps the multicast channel joined after end of
transmission for the specified number of seconds. This is particularly important to keep
the pipe configured from source to receiver in order to not lose any packets if a channel
will be switched on again within the specified time. Effectively prevents losses due to
delay in multicast routing configuration on WAN networks.
target_directory=\EUMETCast\received\bas\default
Defines the target directory for the given channel.
tmp_directory=\EUMETCast\tmp\bas
Defines the location where the file fragments will be store during reception that all files
appearing in the target directory are fully written to the file system. The specified
directory must be on the same file system as the target directory.
```

license.ini

- Contains the software license and activated modules. Please do not change this file.

4.5.3 Location of Received Files

In the recv-channels.ini file, the user can specify a target directory for the incoming files. The default is the sub-directory “.\received” in the working directory of the TelliCast software. A wildcard is allowed at the end of the name. Some examples are shown below:

```
[channel]
name=EUMETSAT Data Channel 1
target_directory=\EUMETCast\received\bas\EARS
tmp_directory=\EUMETCast\tmp\bas
# puts EARS data into the specified directory
```

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```
[channel]
name=EUMETSAT Data Channel 2
target_directory=\EUMETCast\received\bas\MSG-HRIT
tmp_directory=\EUMETCast\tmp\bas
# puts MSG HRIT into the specified directory
```

```
[channel]
name=EUMETSAT Data Channel *
target_directory=\EUMETCast\received\bas\EUM
tmp_directory=\EUMETCast\tmp\bas
# wildcards can be used to select a set of channels
```

```
[channel]
name=*
target_directory=\EUMETCast\received\bas\default
tmp_directory=\EUMETCast\tmp\bas
# selects a default directory for all channels. Specific definitions will override the
default
```

4.5.4 File Database

The file database usage has been changed compared to previous Tellicast versions. Not only the time critical control data is written to the file database. The size is therefore much smaller.

The relevant configuration entries are the following ones:

```
[locations]
file_database_directory=<memory>

[parameters]
file_database_size=20000000
file_database_type=control
tmp_directory=\EUMETCast\tmp\bas
```

A default “tmp_directory” entry must be specified for this option to work properly, but it can be overwritten by the entry in the cast-client-channels...ini file.

A ramdisk is not needed any more for the file database as it is kept in memory.

4.5.5 Log Files

TelliCast writes logging information into files specified in the client configuration file, e.g. recv_bas.log. This is useful for investigations and monitoring, but it however creates additional disk traffic. If logging is not required, it can be turned off by specifying "none".

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If required, you should at least use the buffered write mode using ">>" in front of the file name. The location can be anywhere on the system, but also here a file system with non-blocking I/O should be used..

There are two ways to change logging behaviour:

- Change log level in the Web shell,
In the menu "Log File" scroll to the top and select the new log level from the pull down menu. The new setting remains active until the next restart of the client.
- Specify name, log level and buffered mode for logging in cast-client.ini

```
[locations]
log_file=>>recv.log
```

```
[logging]
#log_level=none
#log_level=quiet
log_level=normal
#log_level=verbose
```

The changes will become active at the next restart of the client.

The change of the log level will immediately become active without client restart

4.5.5.1 Description of Log Messages

In this section only the most important messages for troubleshooting are discussed.

**VRB: ... Received announcement for channel `E1B-TPG-1', address
224.223.222.27:7054 (not subscribed)**

The username is registered for product collections, which are distributed on different channels, depending on the registration on our EO Portal.

Each transmission is announced on the Announcement Channel.

TelliCast considers only the channels according to the cast-client-channels.ini file, all other channels are discarded with the "not subscribed" message.

To enable reception on this channel, enter a valid expression in cast-client-channels.ini

**ERR: ... Failed to open data channel `SAF-Americas', address [224.223.222.249:2490](#)
(wrong interface address 192.168.10.100?)**

or

**WRN:... Failed to open data channel `EUMETSAT Data Channel 1', address
224.223.222.1:7003: No data received from sender**

It means that no data is received a couple of seconds after the channel is opened (i.e. after the multicast channel is joined).

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This can be caused by slow network response (router or tcpip kernel in the join operation). If it is due to delays the channel will open few seconds later and files can still be received. Frequent messages like this indicate a performance problem (although no files might be lost).

If no data at all is available on this channel, the PID might not be selected or opening of the multicast channel is prevented by the operating system, e.g. due to a port conflict.

...Internal file system full - removing information about delivered file(s)**... Internal file system full - removing received job(s)**

It is important to avoid these messages.

Either the file database size is too low (should not be the case if default value is used), or too slow (disk access problem), or too many packets are lost and file fragments and additional control sections are filling the file database (see Lost Messages).

...Write error for file No space left on device

This is a self-explanatory error message.

... File transmission ... interrupted: filelist missing/incomplete**... File transmission ... interrupted: N file(s) missing/incomplete**

These messages can be ignored. They indicate transmission interruptions due to higher priority. The transmissions will be resumed later.

... Missed parts of file**... Missed file**

These messages confirm real losses. The cause can only be derived from the context of the messages around, e.g. full file database, lost messages, late opening of channels.

Please read the section about the file database. A slow file system is responsible for most of the local losses. Other reasons are:

- DVB reception losses, low link margin
- Networking losses, due to multicast signalling (for DVB routers)
- Windows XP limitations (see troubleshooting guide)
- Blocking disk I/O due to slow disk interfaces
- Other programs limiting the disk I/O performance

The reasons for lost files are one or more of the following messages:

... Channel N Lost message (message lost)

Typically seen as intermittent or statistical losses.

Lost messages are only reported if they are unrecoverable, this will lead to file losses. The TelliCast Statistics information is an important indicator (Missed, Recovered packets) of packet losses, even before files are lost.

... File transmission ... ended: filelist missing/incomplete**... File transmission ... ended: N file(s) missing/incomplete**

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Displayed if transmission is permanently interrupted until the end of a transmission.

... Announcement Channel ... Lost message (message lost)

Lost messages on the announcement channel may not have an impact if the frequency is low. This is however an indication of packet losses, reasons are the same as for missed files (see above).

If the complete announcement is lost (about 1 to 2 seconds of interruption) then the associated transmission of one or many files get lost as well.

... (key missing)

Can be related to queuing in the ECU communication, or to packets containing key not received, not always an error.

... Critical dongle error (eToken server terminated). Trying to restart child.**... Could not join channel ... Missing key**

The decryption key is not available or is not correct, typically caused communication problem with the ECU, or ECU not matching the username/userkey information.

4.5.6 ECU Problems

The TelliCast client starts communication to the eToken (ECU) at startup without checking the key. After the first announcement the key will actually be used to decrypt the data. If decryption is unsuccessful the client assumes an incorrect key and will disable the ECU until the next restart. This can also be caused by an incorrect password (userkey).

A delay in communication can also trigger client restart. If a “Critical dongle error” occurs, i.e. there is no response within 10 sec. (probably due to a hardware or software communication error), the client will restart.

If immediately after the restart of the client another “Critical dongle error” occurs (another timeout), and only in this condition (dongle error after restart) TelliCast assumes a permanent failure and continues operation without dongle (dongle deactivated).

Reasons for failure are:

- Hard hang-up of the ECU

The ECU freezes and the light goes off. This can only be corrected by a power cycle of the eToken, followed by a restart of the eToken and TelliCast services.

The hang-up can occur at regular intervals from minutes to days after powered on. It is most likely a thermal problem in the eToken

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The eToken must be replaced.

- Soft hang-up of the ECU

The light stays on but ECU is disabled because it did not respond within 10 sec after the TelliCast start. ECU is disabled. Can be caused by overload and slow response of the communication (USB interface, eToken) and may depend on the computer hardware. TelliCast must be restarted.

The eToken should be replaced if no other reason can be found (see hard hang-up).

- Time synchronisation problems

If the time-synchronisation causes frequent jumps in the system time (e.g. by the Windows built-in time sync function over internet), a soft hang-up can be triggered. TelliCast must be restarted.

To test this symptom, the time sync can be disabled. Then the symptom should disappear.

4.5.7 Write-to-disk Performance

The speed used for writing data from the file database to the final files can be adjusted by two parameters, the speed (in bit/s) and the rate in number of files per second.

The following values are used as default for EUMETCast if all services are selected:

```
[parameters]
file_delivery_counter=0
file_delivery_speed=0
maximum speed is used
```

4.5.8 Using the Client Software

Windows only:

If the EUMETCast icon is not present in the tray bar at the lower right hand side of the screen, then the TelliCast application has to be started up manually via the start menu or by double clicking on the previously installed icon on the desktop.

An additional T icon will be displayed in the tray bar at the lower right hand side of the screen. It will initially be yellow or red and remain so until it has successfully connected to the DVB driver application, when it will turn green.

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Right click on the icon to display a popup menu and select the HTML shell item.

Windows and Linux:

The TelliCast shell can also be opened by using the URL according to Table 5, e.g. <http://localhost:8100/> for the basic Service. A browser screen (see Figure 13) will be displayed which allows access to the TelliCast information by connecting to port 8100. This screen has various options to display the current state of the multicast reception.

Service	Shell Port	Web shell URL
BAS	8100	http://localhost:8100
...	...	
HVS-1	8200	http://localhost:8200
HVS-2	8201	http://localhost:8201
...	...	
AFR-1	8300	http://localhost:8300
...	...	
TER-1	8500	http://localhost:8500
TER-2	8501	http://localhost:8501
...	...	

Table 5: Web shell port assignment

The important pages are the overview page and the Log File page. The overview page provides a graphic display of the received data and provides a clear indication that data file is being received.

The Log File page provides low level information on the files being received. Note that this page does not dynamically update. You have to press the refresh button to update.

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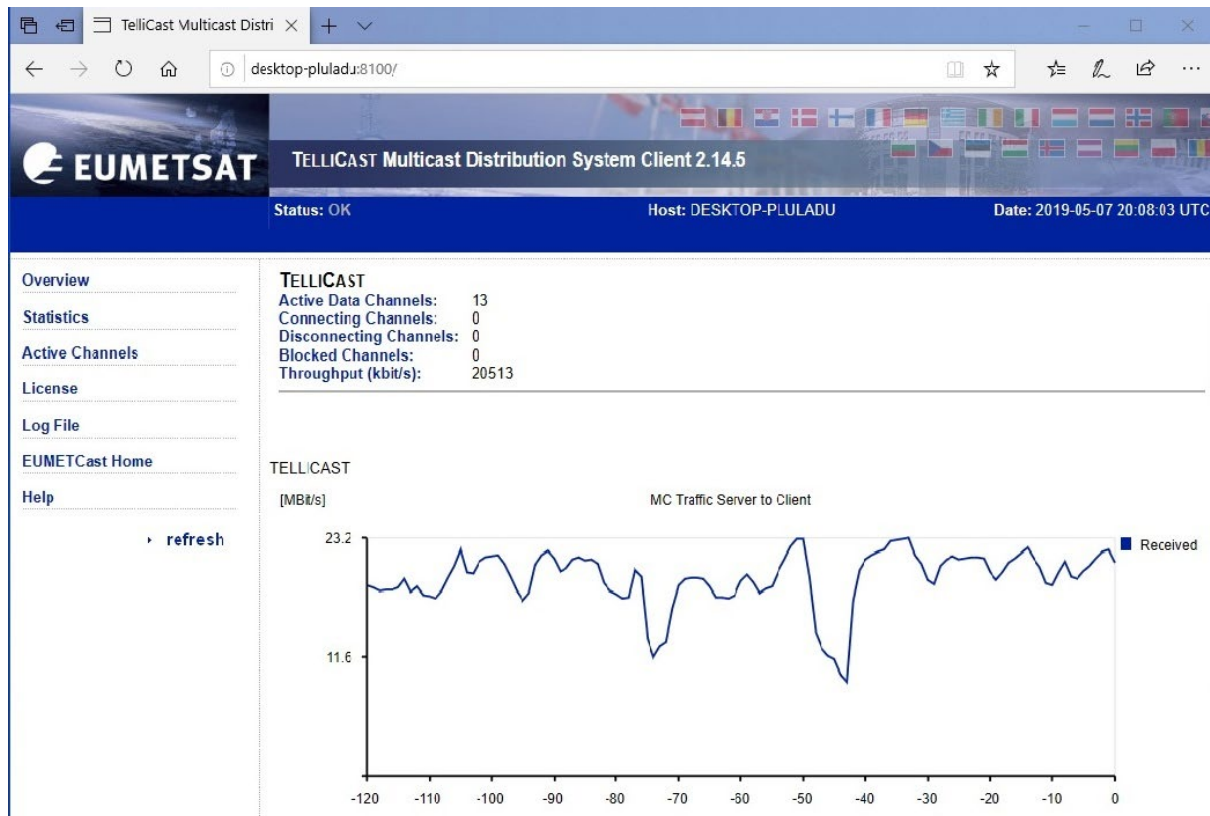


Figure 13: TelliCast Web Shell

After the PC has been running for 30 minutes, files should have been received. Check that these files can be extracted from the PC via the LAN interface and transferred to another location.

The web-shell can also be accessed remotely via an Internet browser.

To ensure correct reception of data the User Station must have a defined directory structure set up. The reception software will deposit the product files in to these directories. Users can define the directory structure in the initialisation files or retain the default setting.

The TelliCast software will deliver product files to the defined directories and create log files relating to the reception and processing of data. It is the responsibility of the User to ensure that these log files and data files are managed so that they do not fill the available disk space.

4.5.9 EUMETCast Encryption Scheme

A EUMETCast Key Unit (EKU) is required for the reception of those data whose access is controlled in accordance with EUMETSAT Data Policy. The EKU is the USB device used in conjunction with a corresponding username and user_key/password to facilitate the reception of licensed services. Only data described as 'open' are available on EUMETCast without the need to operate an EKU.

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A copy of the ECU Software is included in the EUMETCast Client Software licence package DVD/CD-ROM including installation instruction. In order to use the ECU this runtime environment must be installed first.

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5 EUMETCAST REGISTRATION

Registration for EUMETCast delivered services should be done via our Earth Observation Portal. If you do not yet have an account, you should create one. The Portal can be accessed via: <https://eoportal.eumetsat.int>

5.1 Access Controlled Services via EUMETCast

A number of services provided on EUMETCast are access controlled at the request of the Data Provider. In addition, some services require that a licence agreement is concluded before access can be granted.

The following services on EUMETCast provided directly by EUMETSAT are licensed. Access to these services is subject to a licensing procedure:

- Meteosat High Rate SEVIRI - ¼-hourly, ½-hourly, 1-hourly
- Meteosat Low Rate SEVIRI - ½-hourly, 1-hourly
- Meteosat Indian Ocean Data Coverage - ½-hourly, 1-hourly
- Meteosat Rapid Scanning Service - 5 mins
- EPS Global Data Service (Level 1) – data derived from the European instruments (ASCAT, IASI, GRAS & GOME)

In some circumstances an annual licence fee may be charged for access to these data. For further information on EUMETSAT's Data Policy, please consult the EUMETSAT Data Policy on the EUMETSAT website.

5.2 Registration

Access to all EUMETCast services requires that users register via our Earth Observation Portal. The registration process includes the following:

- Creation of an EO Portal account, if you do not already have one
- Subscription to relevant EUMETCast services
- Requesting the EUMETCast Client Software and ECU
- Licensing (if applicable), which includes the acceptance of licensing terms and conditions, in accordance with EUMETSAT's Data Policy.

Once you have completed the licensing procedure (if applicable), you will be sent the EUMETCast Client Software and ECU and access to the requested services will be granted.

5.3 Note to EUMETCast Data Providers

If you produce environmental data and products and would like to explore the potential for using EUMETCast to distribute these to your user community, please contact the EUMETSAT User Service in the first instance and our EUMETCast team will be happy to discuss your requirements.

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6 FURTHER INFORMATION

The EUMETSAT website provides operational information and news concerning all available data, products and services. Information on the individual services provided by EUMETSAT can be found on our Product Navigator: <http://navigator.eumetsat.int/>

6.1 Notification of EUMETCast System Outages

Information concerning scheduled and unscheduled interruptions to services is distributed via EUMETCast and displayed on the EUMETSAT website under the User Notification Service (UNS) webpages. In addition, EUMETSAT offers an email alert service, for details consult the UNS webpages.

6.2 User Service Helpdesk

Requests for further information and all enquiries regarding EUMETCast should be addressed to the EUMETSAT User Service Helpdesk:

Mail:

User Service Helpdesk
EUMETSAT
EUMETSAT Allee 1
D - 64295 Darmstadt
Germany

Telephone: +49 (0) 6151 807 3660/ 3770

Fax: +49 (0) 6151 807 3790

E-mail: ops@eumetsat.int

Website: <http://www.eumetsat.int>

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7 GLOSSARY

CCM	Constant Coding Modulation
DCP	Data Collection Platform
DVB	Digital Video Broadcast
DVB-S2	Digital Video Broadcast Standard version 2
DWDSAT	Deutscher Wetterdienst forecast information on EUMETCast
EFTS	Extended File Transfer Software
EKU	EUMETCast Key Unit
EPS	EUMETSAT Polar System
EUMETCast	EUMETSAT's Broadcast System for Environmental Data
FTP	File Transfer Protocol
GEONETCast	Global network of satellite-based data dissemination systems
IODC	Indian Ocean Data Coverage
IP	Internet Protocol
MSG	Meteosat Second Generation
NREN	National Research Network
NTP	Network Time Protocol
PCI	Peripheral Component Interconnect
PCIe	Peripheral Component Interconnect Express
PID	Packet Identifier
RAM	Random Access Memory
RSS	Rapid Scanning Service
TM	Trade Mark
USB	Universal Serial Bus
VCM	Variable Coding Modulation

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APPENDIX A GUIDELINES ON APPLICATION SOFTWARE

The purpose of these guidelines is to provide a limited overview of Application Software for use with EUMETCast Reception Stations. The term “Application Software” is used in distinction to:

- Software described and specified in this document covering Operating Systems, EUMETCast Client Software, specific driver software etc.;
- Additional software provided by EUMETSAT in support of EUMETCast reception e.g. decompression modules, push agents or housekeeping software.

Application software as described in this document covers: the software required for the further processing of data files once the initial reception, storage, decompression and other housekeeping processes performed by the reception station have been completed. The origin of these data may be geostationary satellites, polar orbiting satellites, in situ data, and products derived from these sources – basically all kinds of data distributed via EUMETCast.

A list of companies providing application software or reception station equipment is maintained by EUMETSAT at the following URL:

<https://www.eumetsat.int/equipment-manufacturers>

This list is based upon information provided from User Station/Software manufacturers to EUMETSAT, complemented by product names retrieved from their websites, but no further analysis of the software has been performed by EUMETSAT and, as such, this list shall only serve as an indication of the range of application software available.

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APPENDIX B ANTENNA SIZE RECOMMENDATION FOR KU BAND EUROPE



EUMETCAST

BASIC SERVICE
(8PSK3/5)

HIGH VOLUME SERVICE
(16APSK2/3)

Service Availability Analysis



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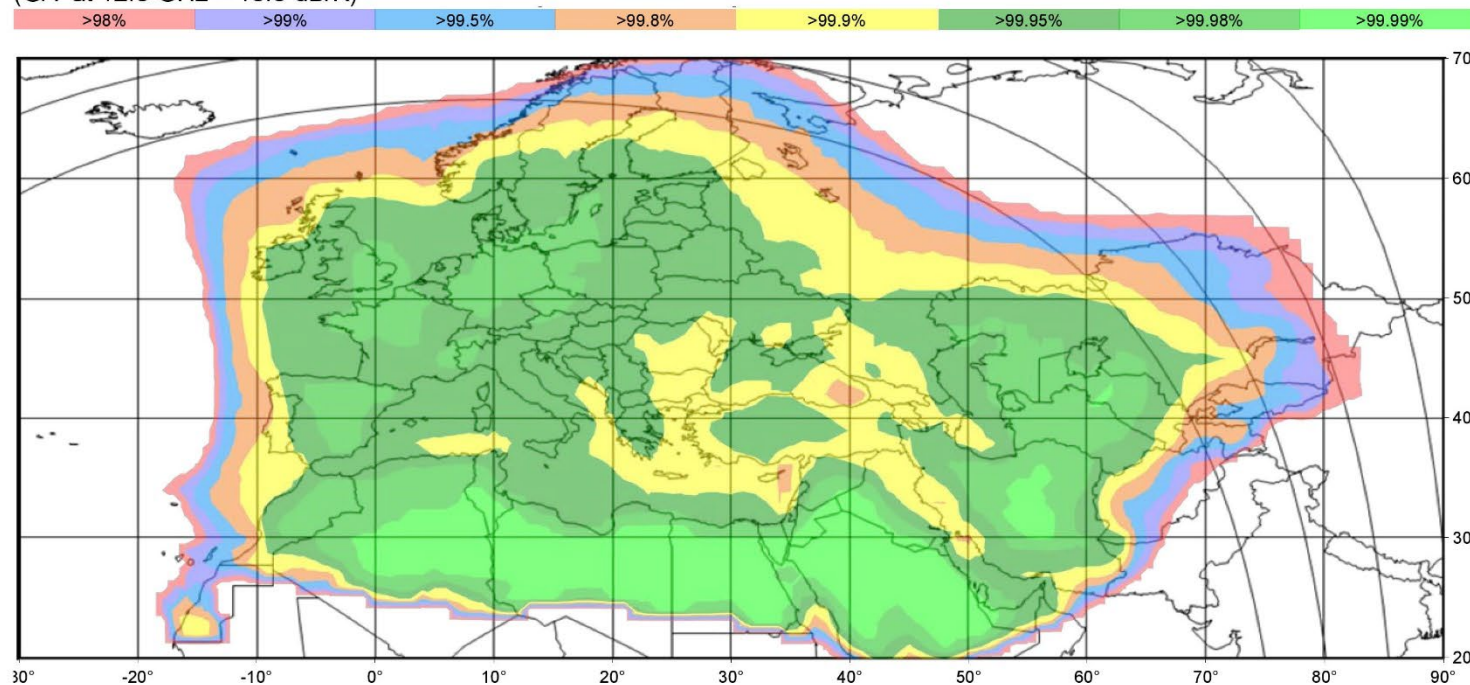


EUMETCAST – BASIC SERVICE

Eutelsat E10A (10°E); 8PSK3/5

0.9m reception antenna rain fade availability

(G/T at 12.5 GHz = 18.5 dB/K)

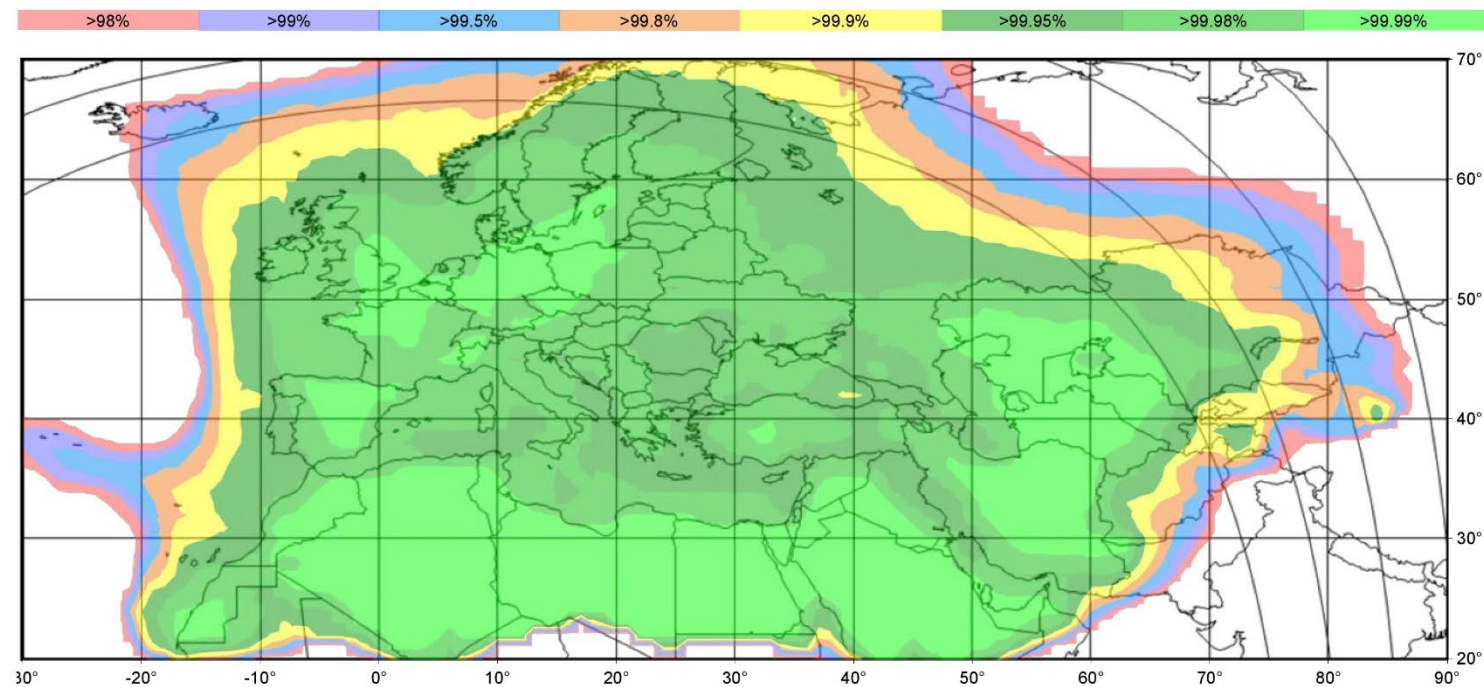




EUMETCAST – BASIC SERVICE

Eutelsat E10A (10°E); 8PSK3/5

1.2m reception antenna rain fade availability
(G/T at 12.5 GHz = 20.5 dB/K)

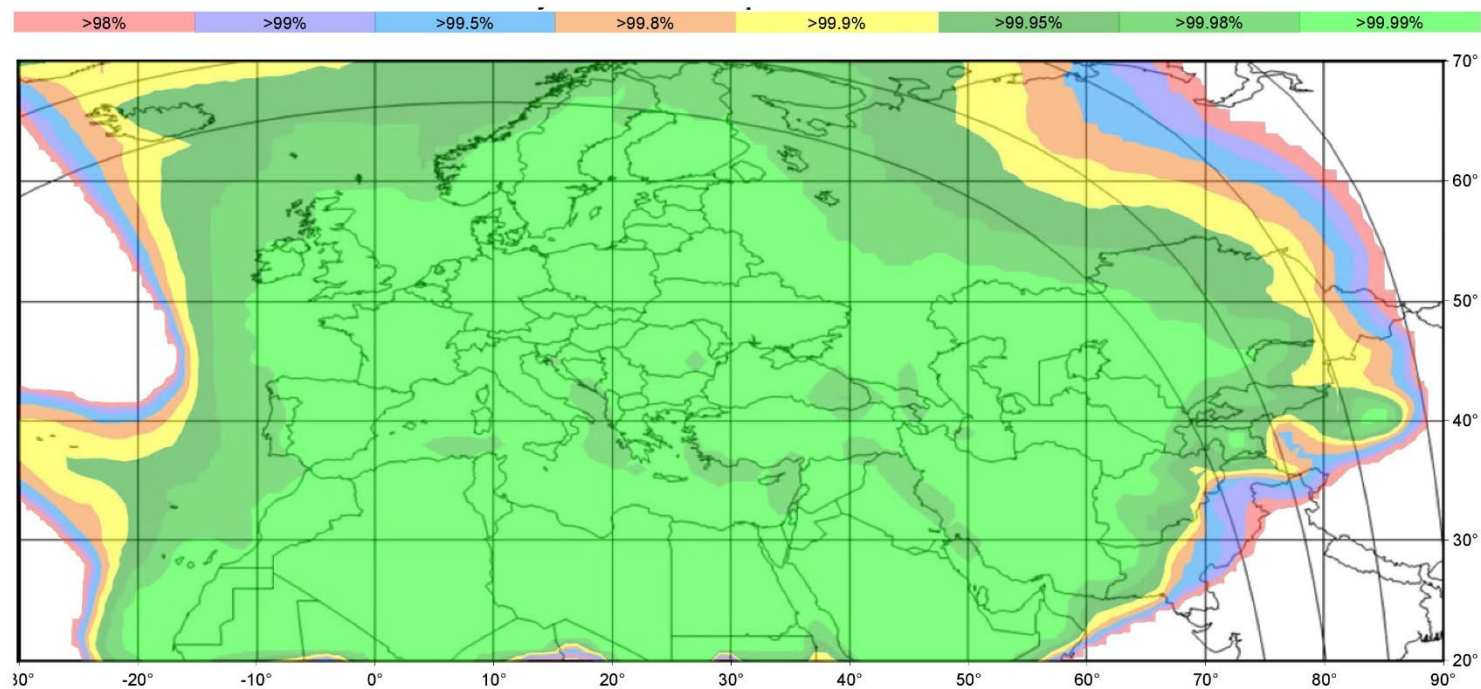




EUMETCAST – BASIC SERVICE

Eutelsat E10A (10°E); 8PSK3/5

1.8m reception antenna rain fade availability
(G/T at 12.5 GHz = 23.5 dB/K)



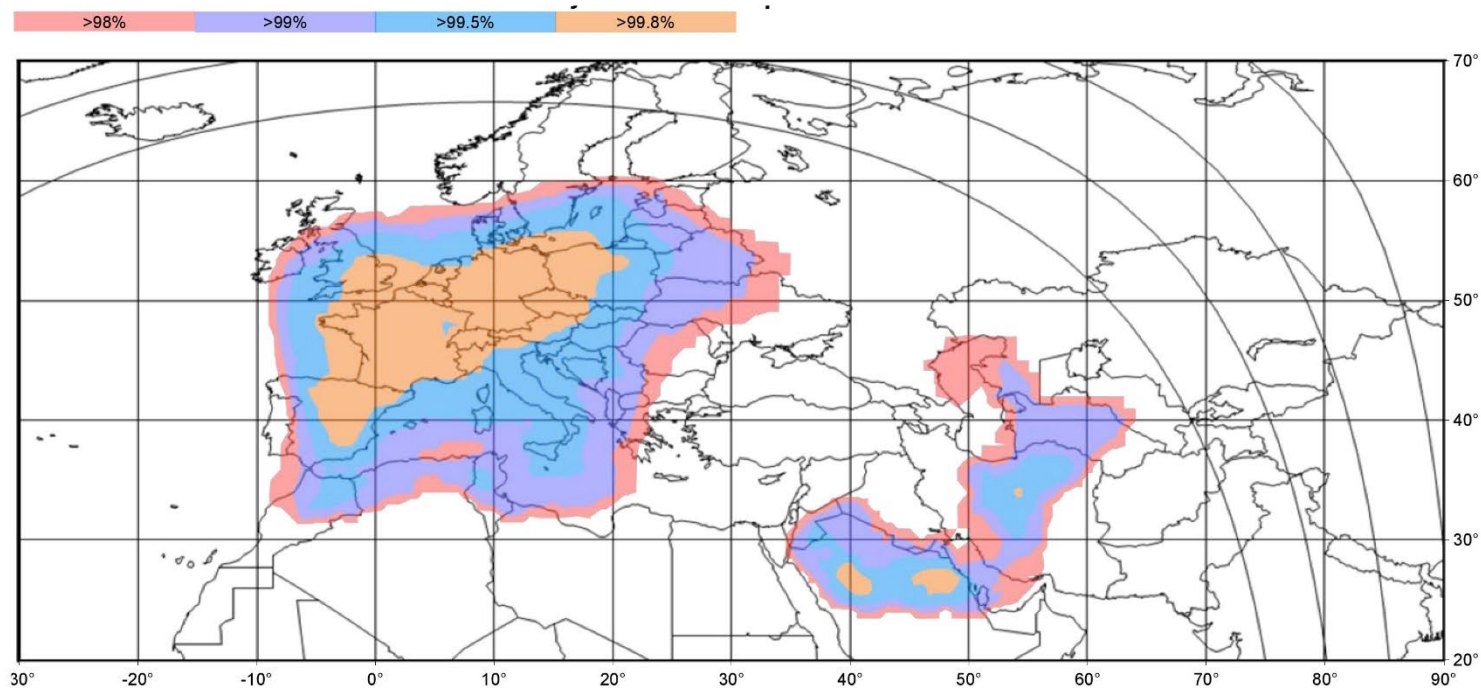
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EUMETCAST – HIGH VOLUME SERVICE

Eutelsat E10A (10°E); 16APSK2/3

0.9m reception antenna rain fade availability
(G/T at 12.5 GHz = 18.5 dB/K)

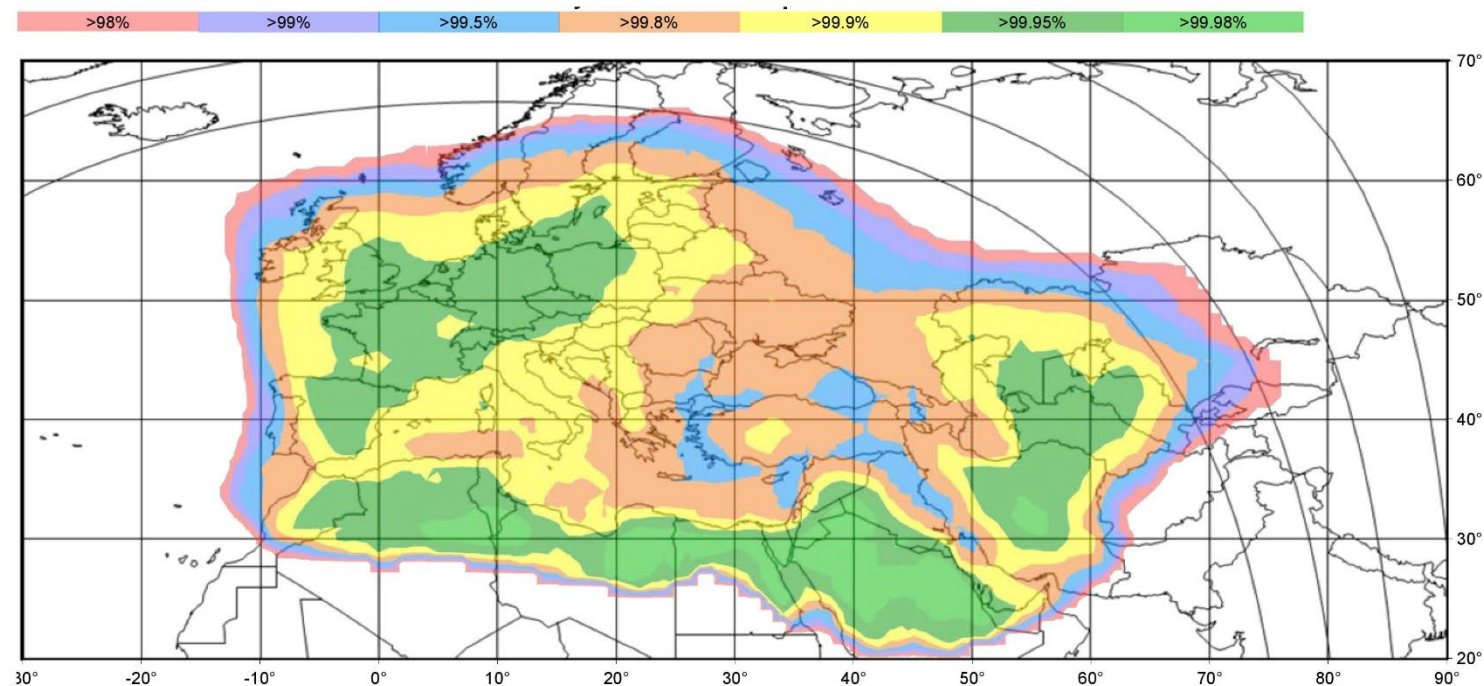




EUMETCAST – HIGH VOLUME SERVICE

Eutelsat E10A (10°E); 16APSK2/3

1.2m reception antenna rain fade availability
(G/T at 12.5 GHz = 20.5 dB/K)

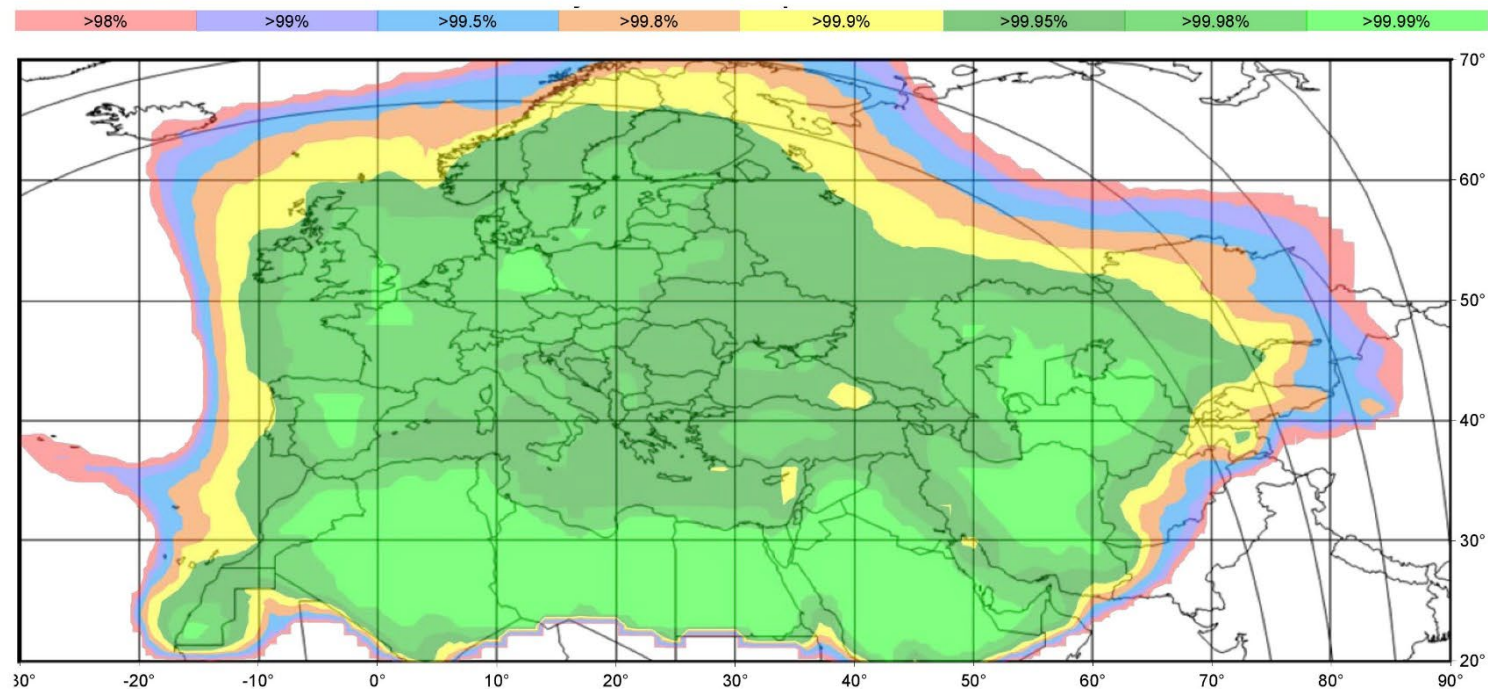




EUMETCAST – HIGH VOLUME SERVICE

Eutelsat E10A (10°E); 16APSK2/3

1.8m reception antenna rain fade availability
(G/T at 12.5 GHz = 23.5 dB/K)

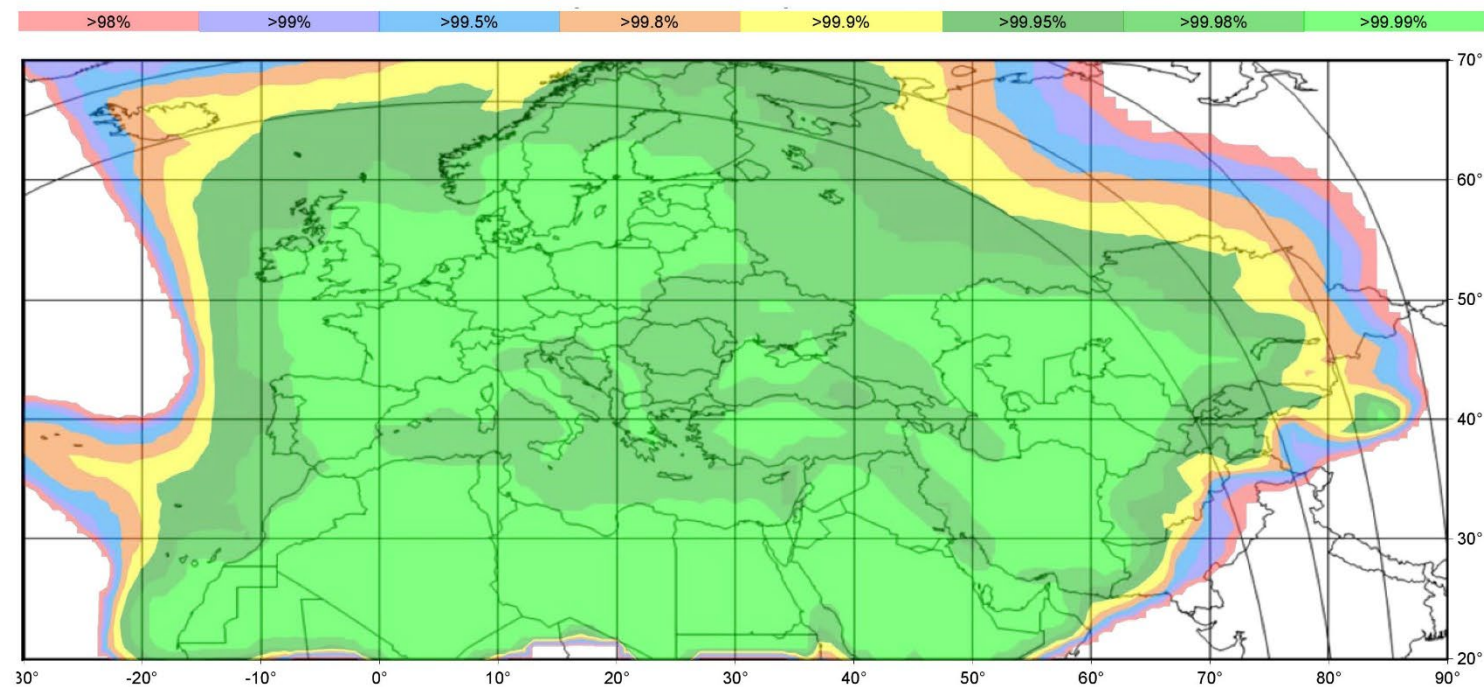




EUMETCAST – HIGH VOLUME SERVICE

Eutelsat E10A (10°E); 16APSK2/3

2.4m reception antenna rain fade availability
(G/T at 12.5 GHz = 26.0 dB/K)

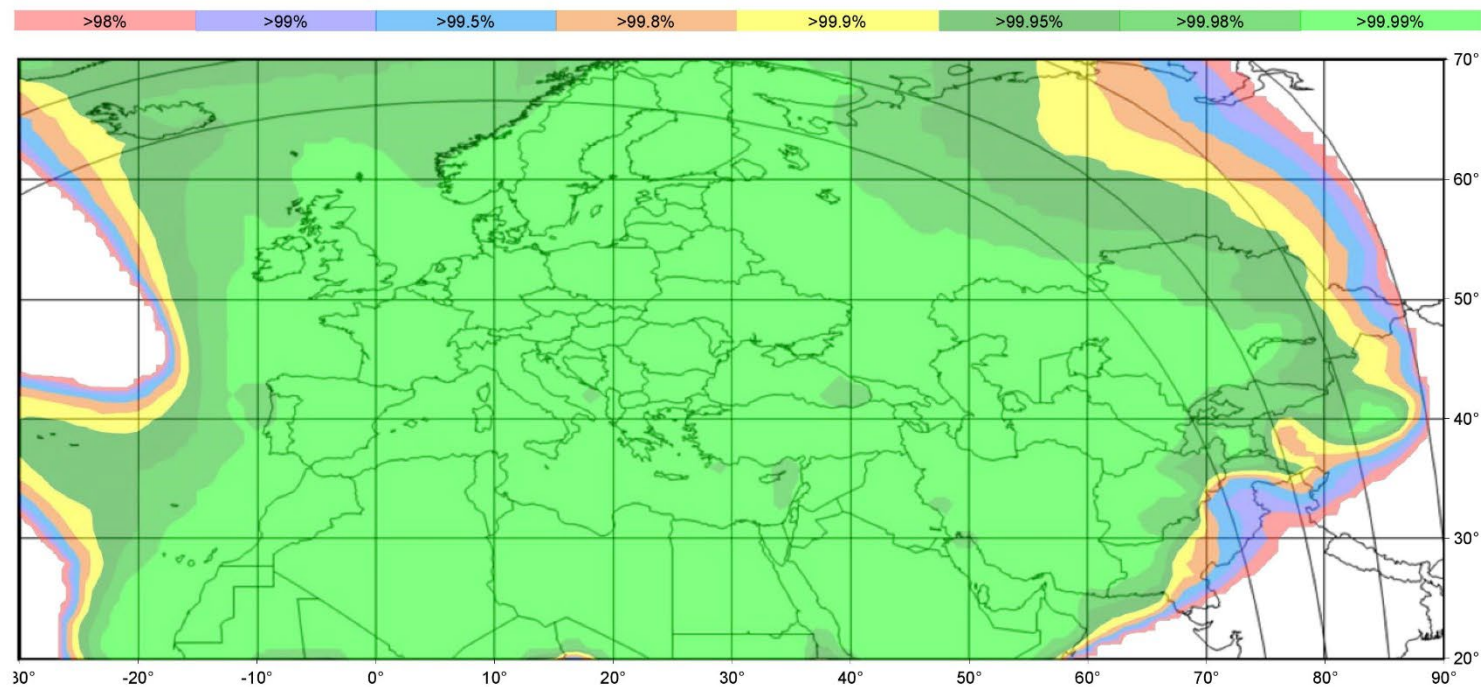




EUMETCAST – HIGH VOLUME SERVICE

Eutelsat E10A (10°E); 16APSK2/3

3.7m reception antenna rain fade availability
(G/T at 12.5 GHz = 28.9 dB/K)



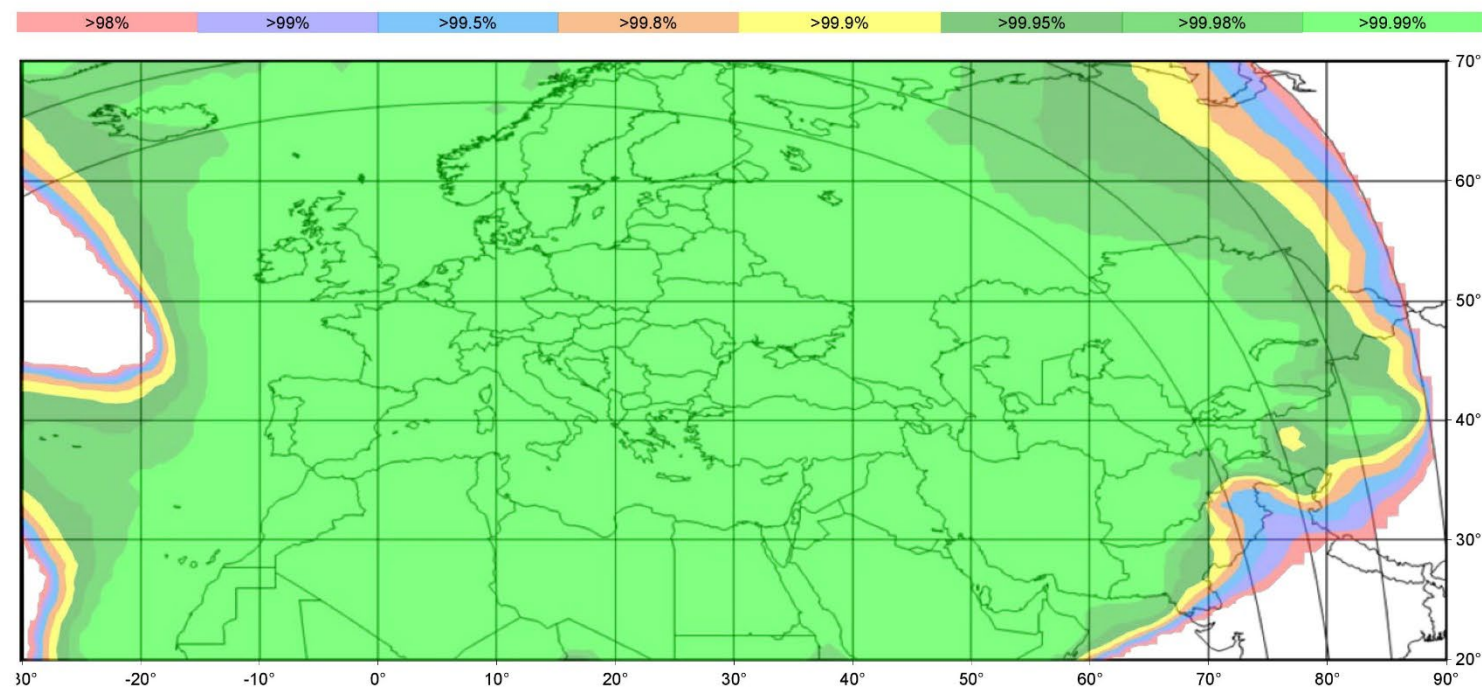
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EUMETCAST – HIGH VOLUME SERVICE

Eutelsat E10A (10°E); 16APSK2/3

4.5m reception antenna rain fade availability
(G/T at 12.5 GHz = 31.5 dB/K)



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APPENDIX C

ANTENNA SIZE RECOMMENDATION FOR C BAND AFRICA

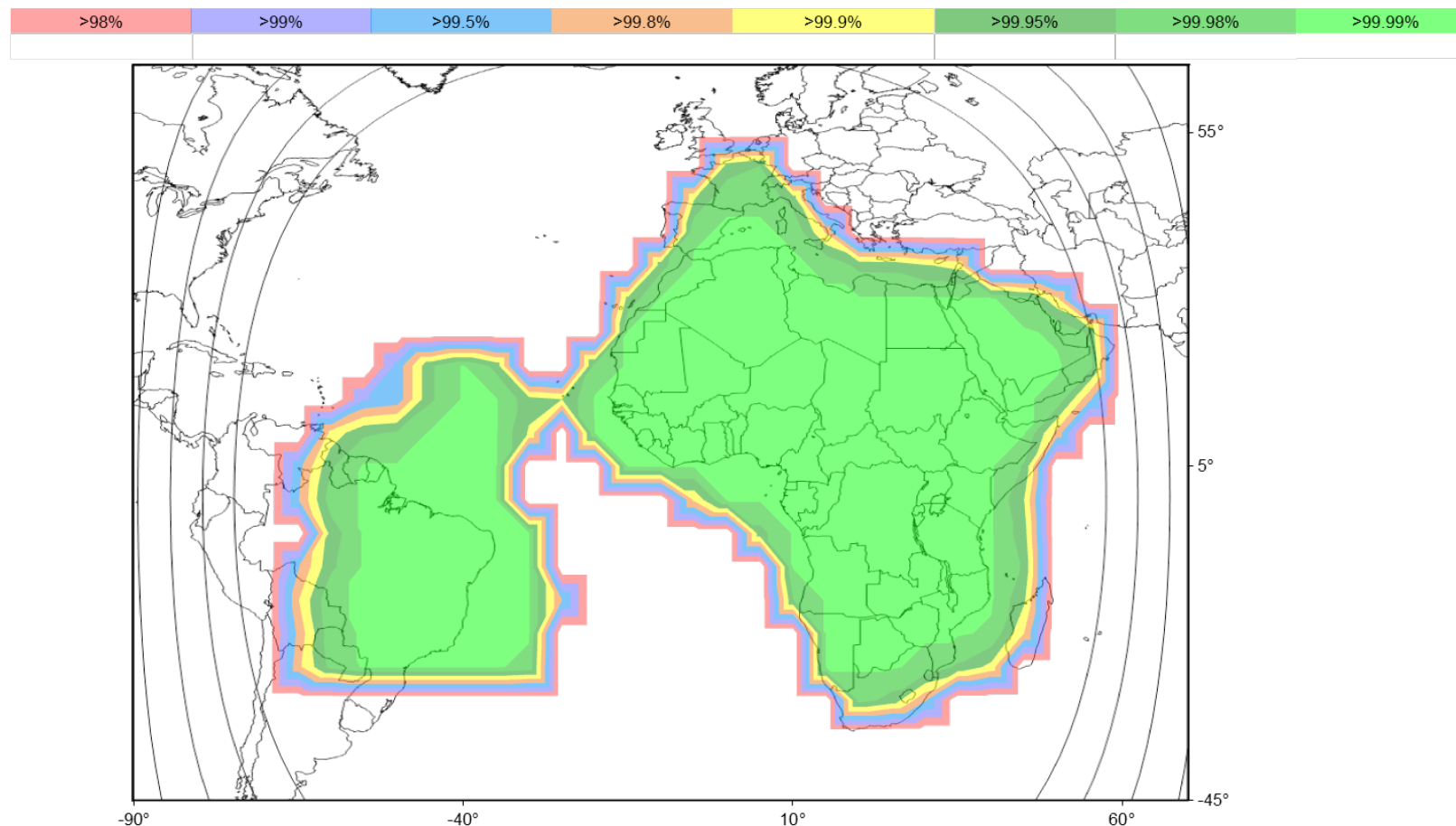


Figure 14: EUTELSAT 8WB, 1,8 m reception antenna rain fade availability

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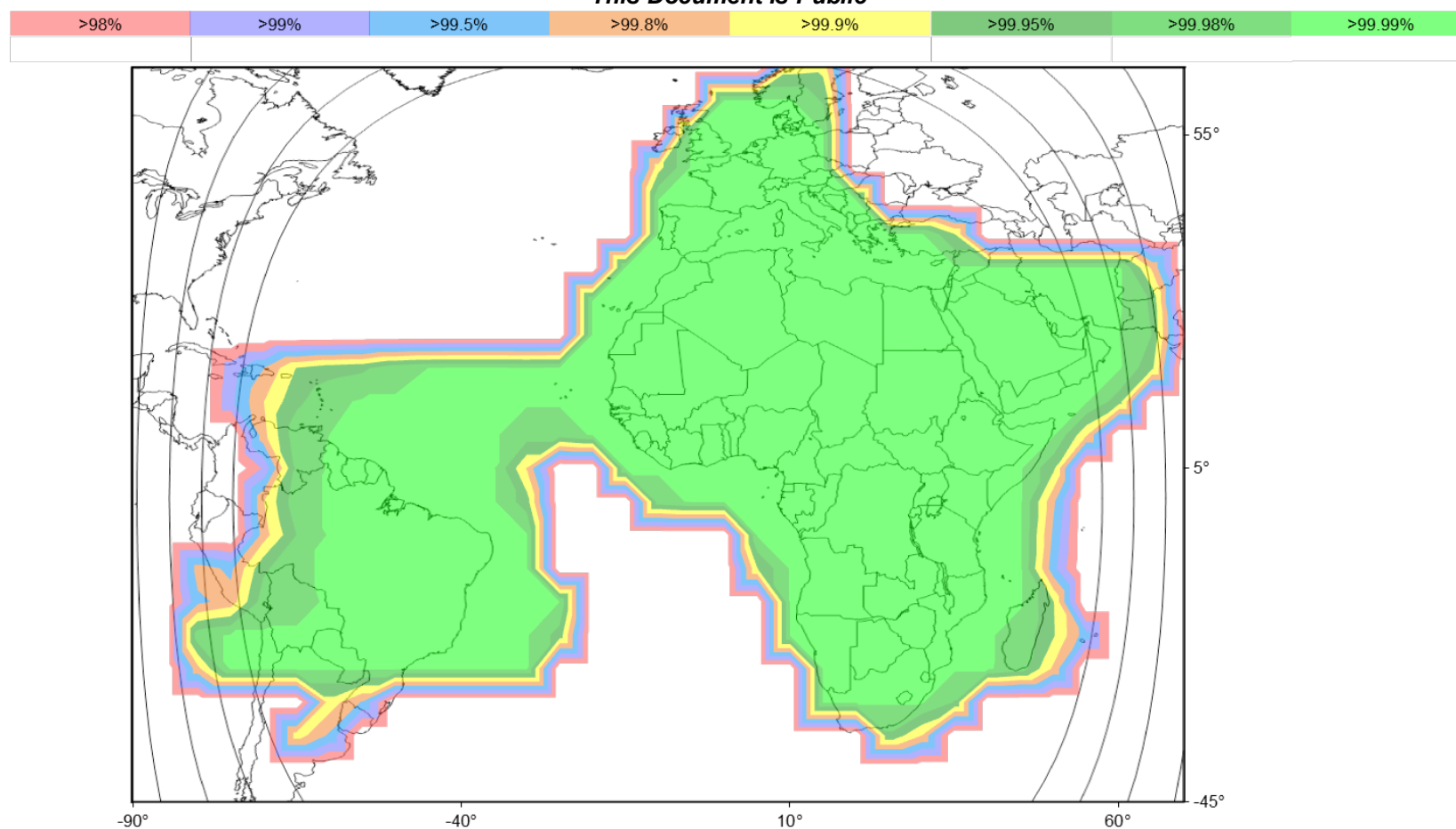


Figure 15: EUTELSAT 8WB, 2.4 m reception antenna rain fade availability

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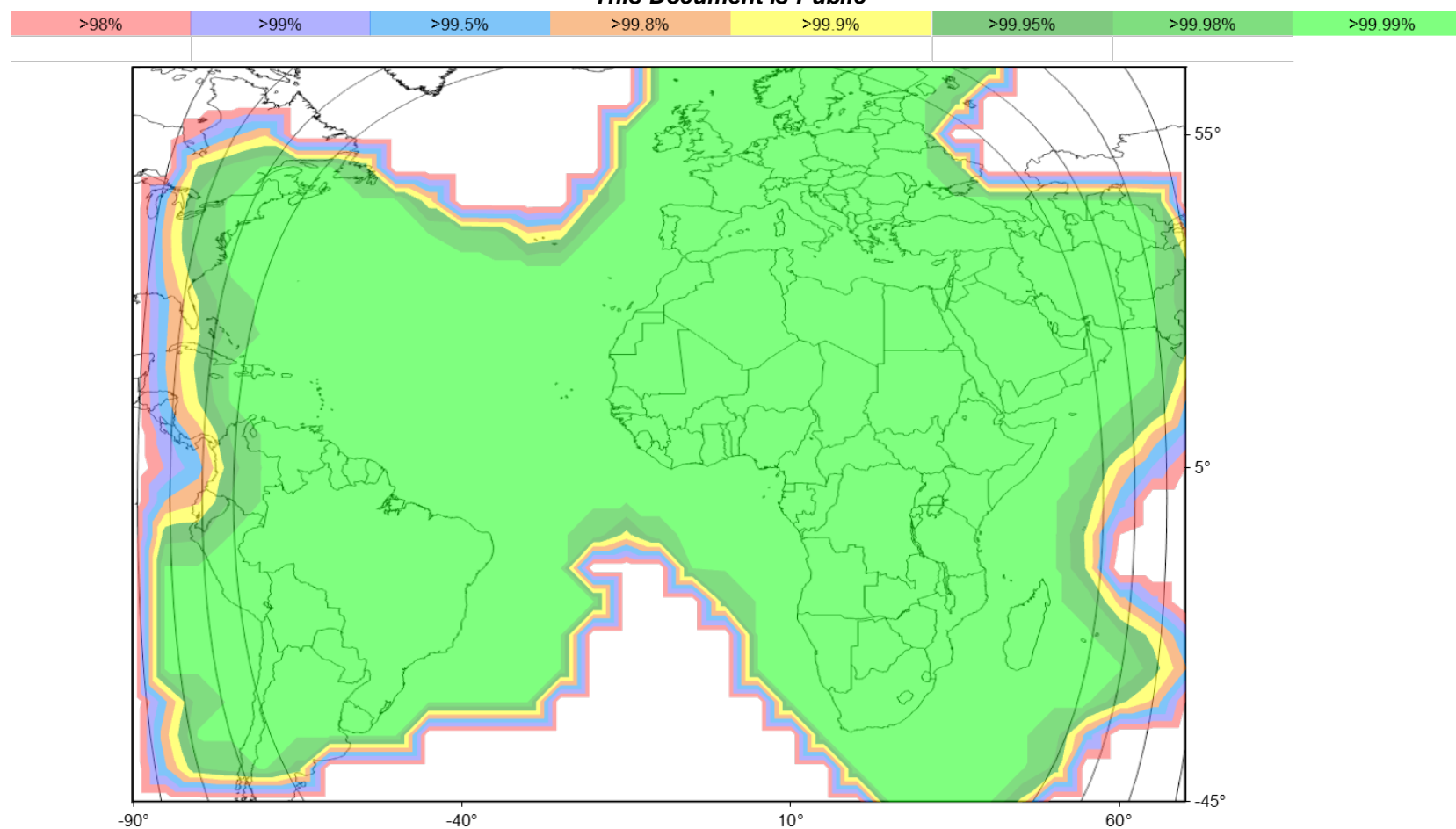


Figure 16: EUTELSAT 8WB, 3.7 m reception antenna rain fade availability