

EUMETCast Terrestrial Service

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MBONED



EUMETCast Terrestrial Service – Overview

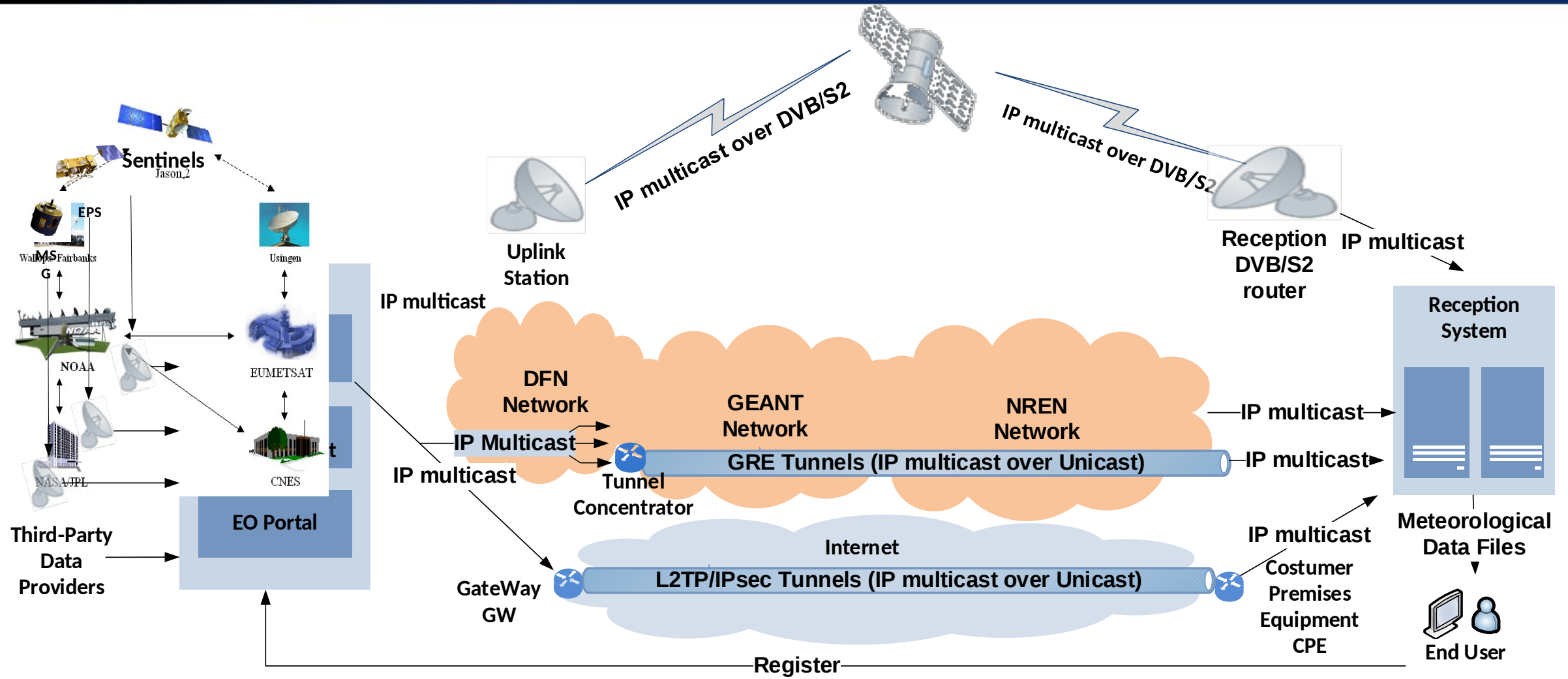
- EUMETSAT Presentation
- EUMETCast Satellite and Terrestrial
 - System Overview
- EUMETCast Terrestrial
 - System Key Features
 - Reliability Measures
 - Encryption
 - Coverage
 - Availability
 - Bandwidth Evolution
 - Costs comparison
 - Key Takeaways
 - Future work - AMT
- Q&A

EUMETSAT – Presentation



- **EUMETSAT** - European Organization for the Exploitation of Meteorological Satellites
- **EUMETSAT** - intergovernmental public sector organization created in 1986 through an international convention and agreed by a current total of 30 European Member States.
- **EUMETSAT** - primary objective is to establish, maintain and exploit European systems of operational meteorological satellites. EUMETSAT is responsible for the launch and operation of the satellites and for delivering satellite data to end-users as well as contributing to the operational monitoring of climate and the detection of global climate changes.
- **EUMETSAT** has established cooperation with operators of Earth observation satellites from Europe, China, India, Japan, Russia, South Korea and the United States

EUMETCast Satellite and Terrestrial – System Overview

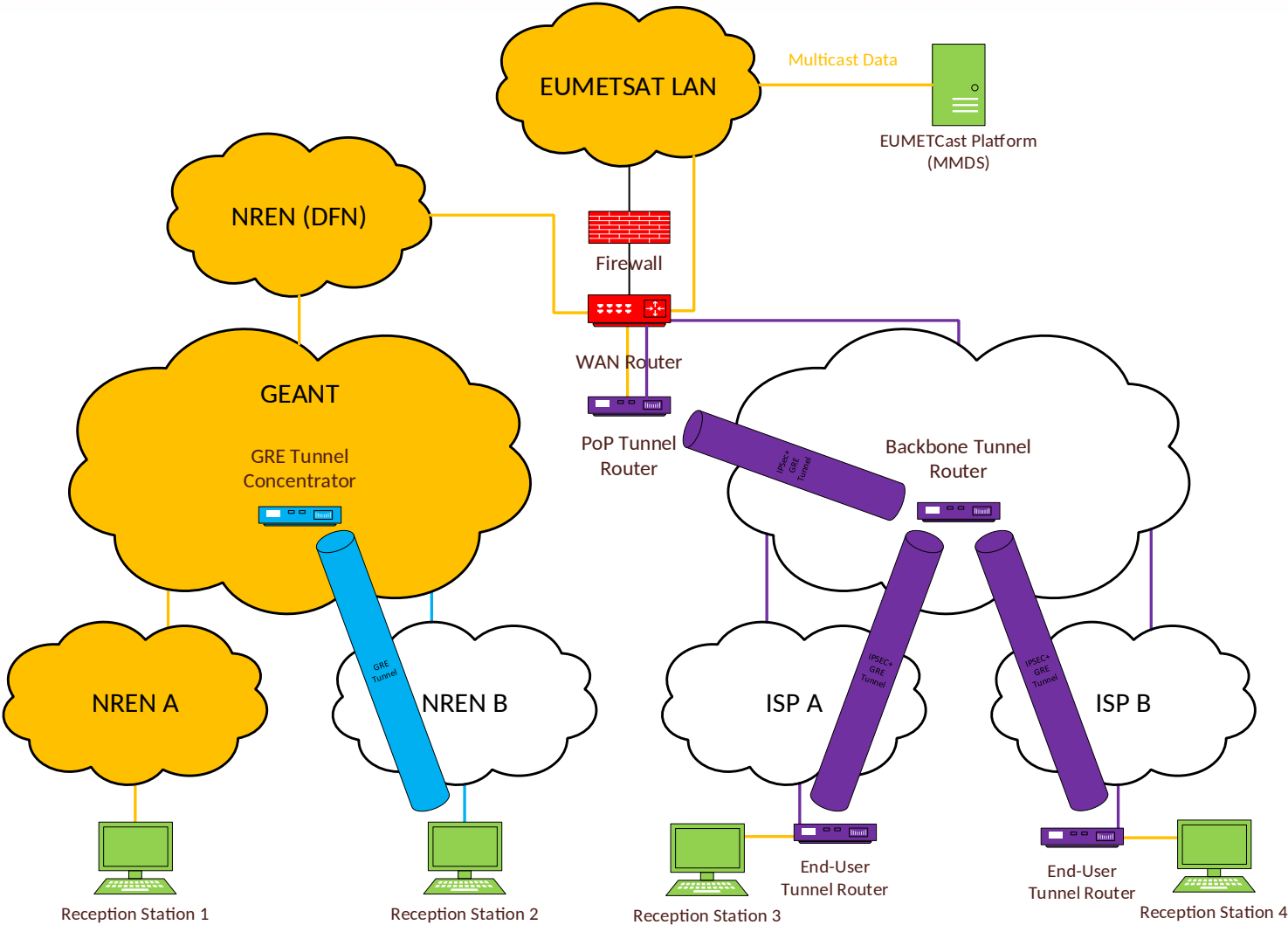


EUMETCast Terrestrial Services – NREN & Internet

Terrestrial Service has several transport layers:

- 1) NREN (GEANT):
 - Native multicast
 - GRE encapsulates multicast
- 2) Internet (Commercial Internet Carrier)
 - L2TP/Ipsec encapsulates multicast

Transport layer	Use Case
GEANT – Native	Default and preferred
GEANT – GRE	Overcome islands of non-enabled multicast, i.e.: Local NREN does not support native multicast
Internet – L2TP/IPsec	User eligibility and data eligibility: <ul style="list-style-type: none">- User is not eligible to connect to NREN, i.e. user is not a research institution (commercial, private...)- Data is not eligible on the NREN, i.e. data is considered of non-research nature



EUMETCast Terrestrial – System Key Features

EUMETCast is a **near real-time data (NRT)** dissemination service which is based on an IP multicast “push” concept and implemented using the TelliCast server and client applications

- EUMETSAT’s near real time dissemination system
- Multicast system for file distribution based in Tellicast Server/Client software package provided by ST Engineering (COTS)
- Based in the [MTP/SO](#) (Self Organizing Multicast) standard – IETF Internet Draft from November 1997
- One-stop-shop delivery mechanism allowing users to receive many data streams via one Reception Station
- Scalable with the number of users and volume of data
- 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 and size, allowing the dissemination of a broad range of products
- Complementary and back-up service to satellite dissemination (with guaranteed SLA)
- Native multicast only for clients connected to the academic networks via their National Research Network providers (NREN), which is only accessible to those users having authorised access to research networks

EUMETCast – Reliability Mechanisms

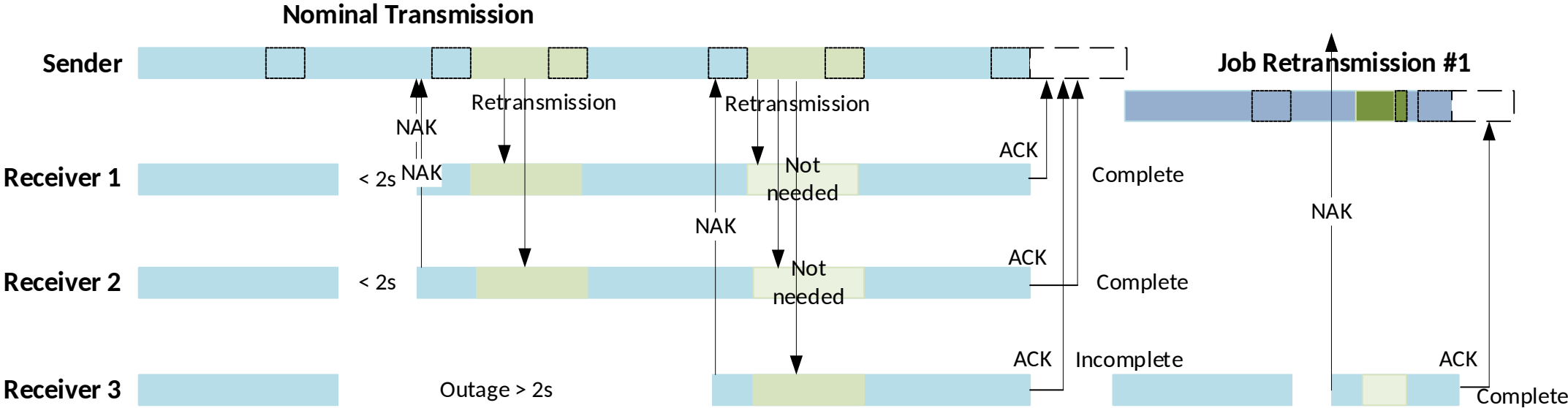
Acronym	Timeliness	Scalability	Return channel	Retransmission	Operational settings (Configurable)
FEC	On-the-fly	Unlimited	No	No	10%
NAK	Upon loss detection	High	UDP Unicast	Threshold	50% (Max. bandwidth allowed for retransmissions)
ACK	Upon job termination	Medium	TCP/IP Unicast	Threshold	40% (No retransmission if user did not receive at least 40% of file) Only 1 retransmission

Stream parameters:

- TTL: 64
- MTU size: 1400 – Default max is 1500, but need to account for GRE header (same source as native multicast)

Loss Characterization:

- Random packet losses below 5% are fully recovered by FEC alone
- Interruptions of less than 400ms are fully recovered by FEC alone
- Interruptions of less than 1-2s are fully recovered by NAK and FEC
- Interruptions of more than 2s can be recovered by ACK



EUMETCast Terrestrial – GEANT World Coverage



EUMETCast Terrestrial – Worldwide Users

Terrestrial Users Feb 2020

Partners:

Australia (NCI)
Brazil (INPE)
China (CMA & NSOAS)
India (ISRO & NCMRWF)
Japan (JAXA)
South Korea (KMA)
UK (ECMWF)
USA (NOAA-STAR)

Member States NMHSs:

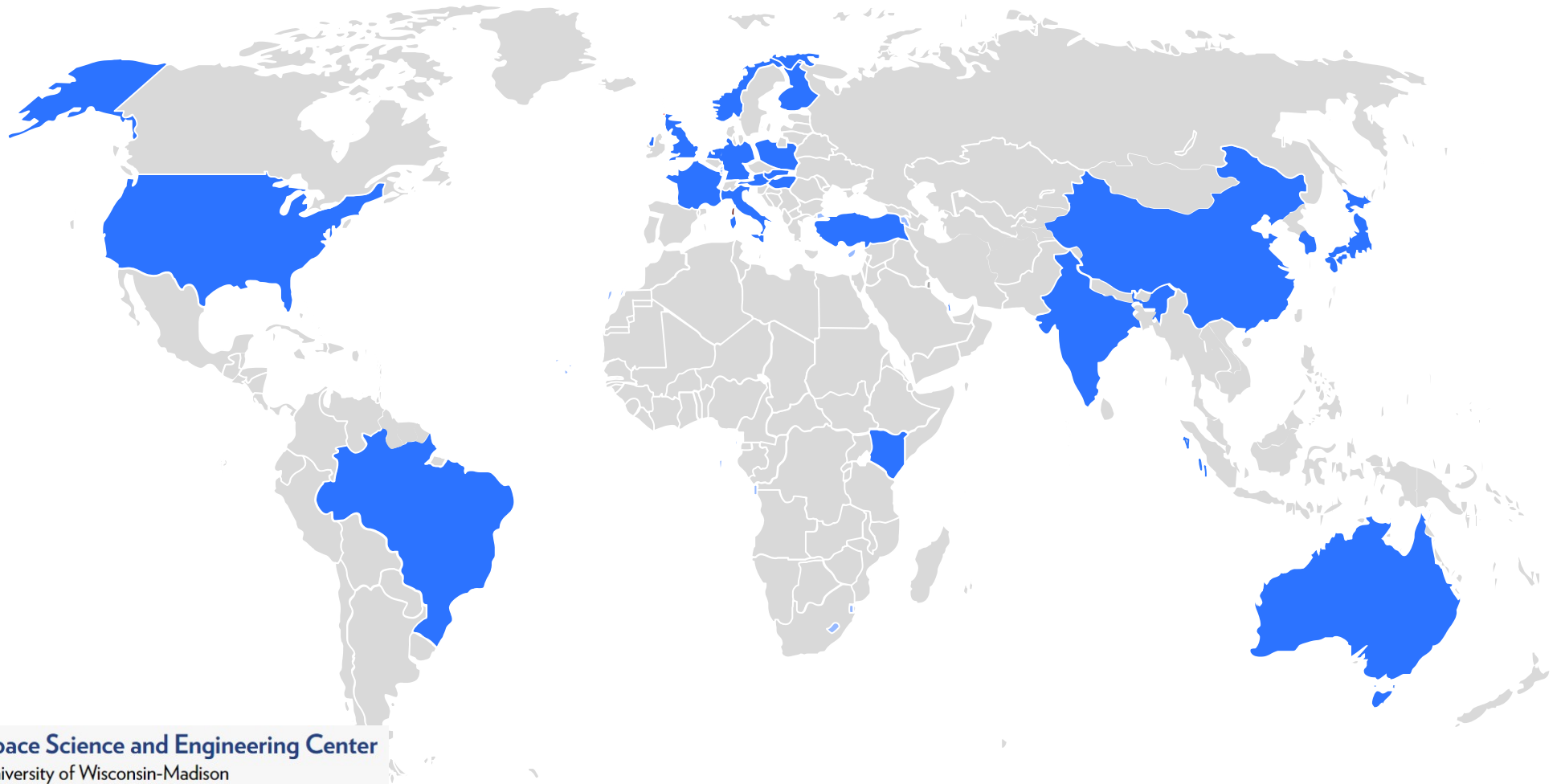
Austria
Finland
France
Germany
Hungary
Italy
Netherlands
Norway
Poland
Slovakia
Turkey
UK

Other users:

Germany (AWI)
Kenya (RCMRD)
USA (SSEC)



Space Science and Engineering Center
University of Wisconsin-Madison



EUMETCast Terrestrial – File based availability

Feb 2021

End-to-end file based monitoring

- Monitoring of network by service providers across multiple networks
- EUMETSAT can only monitor end-to-end file delivery via feedback channel (TCP/IP)
- Including: NOAA, KMA, JRC, JAXA, CMA, INPE, NCMRWF and ISRO

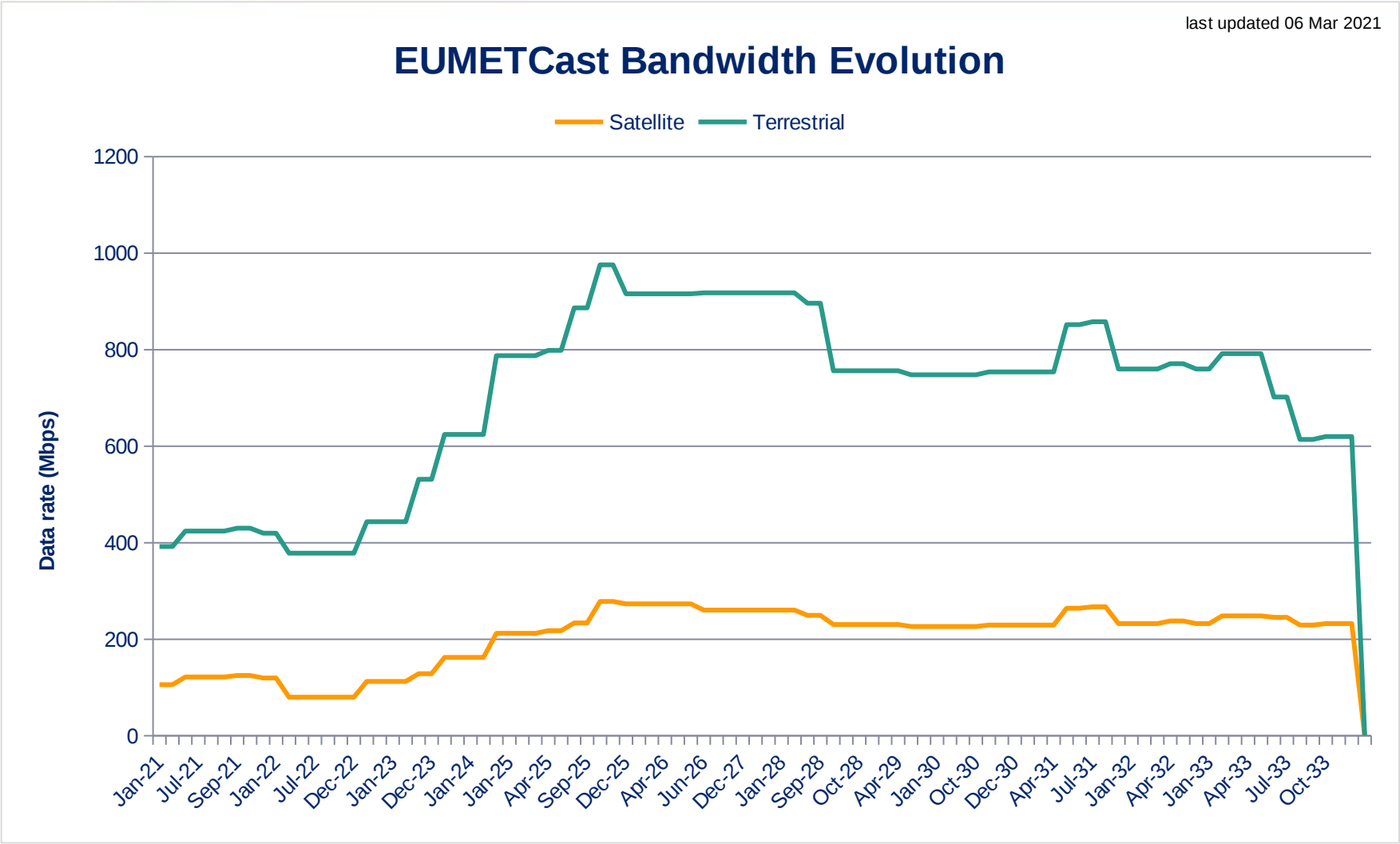
Common reasons for lower availability

- Network bottlenecks and congestion
- Insufficient last mile bandwidth
- TCP/IP competes for bandwidth with multicast
- Firewall updates on end-user side
- Difficult to troubleshoot problems

	availability > 99.5% (EUMETCast Satellite SLA)
	availability > 90% and availability < 99.5%
	availability < 90%

Date					~380Mbps				~380Mbps		~75Mbps	
											MBONE	
01/02/2021	100.00%	100.00%	100.00%	100.00%	100.00%	99.92%	100.00%	99.14%	95.91%		100.00%	
02/02/2021	100.00%	100.00%	99.99%	100.00%	100.00%	100.00%	100.00%	99.52%	97.37%		100.00%	
03/02/2021	99.91%	100.00%	99.76%	100.00%	99.99%	100.00%	99.98%	94.22%	98.22%		99.90%	
04/02/2021	99.94%	98.99%	99.89%	99.92%	100.00%	100.00%	99.88%	98.57%	94.29%		99.94%	
05/02/2021	99.96%	100.00%	99.88%	99.98%	100.00%	100.00%	99.40%	99.85%	98.24%		99.98%	
06/02/2021	99.99%	100.00%	99.97%	100.00%	100.00%	100.00%	99.80%	99.30%	98.51%		100.00%	
07/02/2021	100.00%	100.00%	99.99%	100.00%	100.00%	100.00%	100.00%	99.06%	97.91%		100.00%	
08/02/2021	100.00%	100.00%	99.98%	100.00%	99.99%	99.99%	100.00%	96.92%	98.48%		100.00%	
09/02/2021	99.92%	100.00%	99.89%	99.98%	100.00%	100.00%	100.00%	99.37%	98.52%		99.92%	
10/02/2021	99.97%	100.00%	99.93%	100.00%	100.00%	99.86%	99.86%	99.54%	98.14%		99.96%	
11/02/2021	100.00%	100.00%	99.99%	100.00%	100.00%	99.95%	99.95%	99.48%	98.37%		79.46%	
12/02/2021	100.00%	100.00%	98.44%	100.00%	100.00%	100.00%	100.00%	99.10%	96.71%		99.99%	
13/02/2021	100.00%	100.00%	99.99%	100.00%	99.99%	100.00%	98.03%	99.94%	98.00%		100.00%	
14/02/2021	99.99%	100.00%	100.00%	100.00%	100.00%	99.92%	99.83%	99.68%	98.34%		99.81%	
15/02/2021	99.98%	100.00%	99.83%	100.00%	100.00%	99.96%	99.17%	99.51%	95.91%		99.99%	
16/02/2021	100.00%	100.00%	99.45%	100.00%	100.00%	99.92%	99.89%	99.12%	95.36%		100.00%	
17/02/2021	99.96%	99.88%	99.31%	99.98%	100.00%	99.99%	99.87%	99.82%	94.06%		99.95%	
18/02/2021	99.94%	99.89%	99.41%	99.96%	100.00%	100.00%	99.98%	99.63%	96.46%		99.87%	
19/02/2021	99.98%	100.00%	99.42%	99.97%	100.00%	99.99%	100.00%	99.17%	99.16%		99.97%	
20/02/2021	100.00%	91.73%	99.35%	100.00%	100.00%	100.00%	99.57%	99.36%	98.42%		99.98%	
21/02/2021	100.00%	100.00%	99.61%	99.99%	100.00%	100.00%	100.00%	99.31%	98.22%		100.00%	
22/02/2021	99.99%	100.00%	98.24%	100.00%	100.00%	100.00%	97.16%	99.83%	97.95%		100.00%	
23/02/2021	99.96%	100.00%	99.76%	99.94%	100.00%	99.93%	100.00%	100.00%	98.62%		99.95%	
24/02/2021	99.98%	99.92%	99.52%	99.91%	100.00%	99.99%	99.88%	99.83%	98.43%		99.94%	
25/02/2021	100.00%	99.94%	99.73%	100.00%	100.00%	99.77%	99.98%	100.00%	97.96%		99.94%	
26/02/2021	100.00%	100.00%	99.44%	99.99%	100.00%	100.00%	99.91%	99.92%	98.24%		100.00%	
27/02/2021	100.00%	100.00%	99.79%	100.00%	100.00%	100.00%	99.78%	99.87%	98.47%		100.00%	
28/02/2021	100.00%	100.00%	99.95%	100.00%	100.00%	100.00%	100.00%	58.37%	97.75%		100.00%	

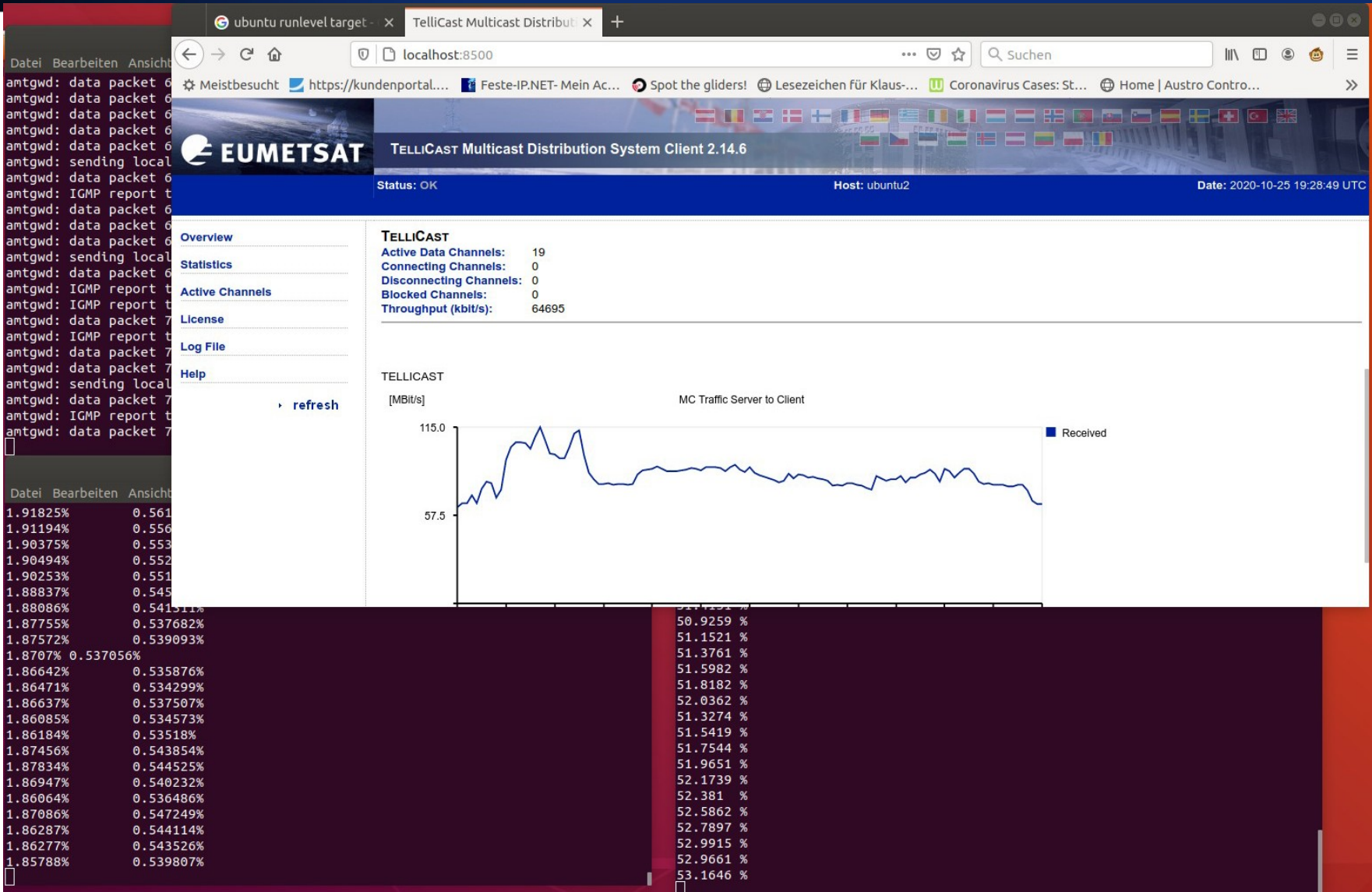
EUMETCast – Bandwidth Evolution



EUMETCast Terrestrial – via AMT

- AMT (Automatic Multicast Tunneling) was analyzed for its potential use, triggered by publication:
“Public AMT Relay Between Internet2 and Commodity Internet” <http://www.cs.virginia.edu/~wyz3sp/pub-amt-relay.pdf>
- Using the amtgwd software from <https://github.com/GrumpyOldTroll/amt>
- Started by a simple 13 line script, that sets up a tunnel interface and connects to one of the AMT Relay sources of amt-relay.m2icast.net
- EUMETCast client was ready to receive the complete EUMETCast Terrestrial stream via Internet2 AMT relays in USA.
- Performance on 400 Mbps internet connection in Germany
 - Without return channel > 100 Mbps: 0.6% packets lost after FEC, 50% files received
 - With NAK enabled: at 90 Mbps, for 2 hour test period, no packets lost, 100% files received
 - Peak reception of full stream > 300 Mbps was possible, done for few minutes only

EUMETCast Terrestrial – via AMT, raw performance



EUMETCast Terrestrial – Native Multicast – Key Takeaways

- One-to-many – One single source
- Highly scalable with number of users and data volume
- Cost effective for above 10 users
- High availability **IF** protocol reliability is implemented
- World coverage vs. satellite footprint only
- Handling of any file format and size
- Path-diversity via Terrestrial links – Backup of Satellite

However....

- Requires multicast enabled network infrastructure – Internet is not (yet) multicast ready
- Requires expertise in network setup
- End-users resistance to enable native multicast on their network
- Risk of Cross-impact – If not properly handled, users with bad quality links can impact the availability and timeliness of nominal transmission

EUMETCast Service – Q & A

