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TECHNICAL REPORT

**EUMETCast Terrestrial over Automatic Multicast
Tunneling (AMT) at NCMRWF:
Nov-Dec 2023**

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10	Abstract	<p>The purpose of the EUMETCast Terrestrial station using AMT (Automatic Multicast Tunneling) is to access EUMETCast Terrestrial multicast streams in the absence of end-to-end multicast connectivity. This solution is entirely software-based and installed on physical infrastructure at National Center for Medium Range Weather Forecasting (NCMRWF) with multicast-enabled internet connectivity.</p> <p>To subscribe to the EUMETCast Terrestrial services, users need to register on the Earth Observation Portal, on successful registration user will obtain user key and username. Along with an EKU USB-based eToken, which is couriered by EUMETSAT to the user location physically, and a URL for software access is provided for system preparation. The server has been prepared by installing Ubuntu OS version 18. The AMT Gateway,</p>

		<p>TelliCast client, and EKU software are installed and configured. Additionally in firewall, multicast is enabled and rules have been made to allow UDP and TCP packets and multicast data reception over ports.</p> <p>This setup allows for seamless access to EUMETCast Terrestrial services, ensuring reliable data reception for meteorological observations and forecasts. The registration process is user-friendly with robust configuration of software and hardware components. This will enhance the efficiency and effectiveness of the EUMETCast Terrestrial station using AMT at NCMRWF.</p>
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सारांश

एएमटी का उपयोग करने वाले EUMETCast टेरैस्ट्रियल स्टेशन का उद्देश्य एंड-टू-एंड NKN कनेक्टिविटी की अनुपस्थिति में EUMETCast टेरैस्ट्रियल मल्टीकास्ट स्ट्रीम तक पहुंच बनाना है। यह समाधान पूरी तरह से सॉफ्टवेयर-आधारित है और मल्टीकास्ट-सक्षम इंटरनेट कनेक्टिविटी के साथ राष्ट्रीय मध्यम अवधि मौसम पूर्वानुमान केन्द्र (एनसीएमआरडब्ल्यूएफ) में भौतिक बुनियादी ढांचे पर स्थापित किया गया है।

प्रासंगिक EUMETSAT टेरैस्ट्रियल सेवाओं की सदस्यता लेने के लिए, उपयोगकर्ताओं को अर्थ (Earth OP) ऑब्जर्वेशन पोर्टल पर पंजीकरण करना होगा, जिसके परिणामस्वरूप उपयोगकर्ता कुंजी और उपयोगकर्ता नाम प्राप्त होगा। पंजीकरण के बाद, ईयूएमईटी द्वारा एक ईकेयू यूएसबी-आधारित ईटोकन भेजा जाता है, और सिस्टम तैयारी के लिए सॉफ्टवेयर एक्सेस के लिए एक यूआरएल प्रदान किया जाता है। सर्वर को उबंटू ओएस संस्करण 18 स्थापित करके तैयार किया गया है। एएमटी गेटवे, टेलिकास्ट क्लाइंट और ईकेयू सॉफ्टवेयर स्थापित और कॉन्फिगर किए गए हैं। इसके अतिरिक्त फ़ायरवॉल में, मल्टीकास्ट सक्षम है और पोर्ट पर यूडीपी और टीसीपी पैकेट और मल्टीकास्ट डेटा रिसेप्शन की अनुमति देने के लिए नियम बनाए गए हैं।

यह सेटअप EUMETSAT टेरैस्ट्रियल सेवाओं तक निर्बाध पहुंच की अनुमति देता है, जिससे मौसम संबंधी टिप्पणियों और पूर्वानुमानों के लिए विश्वसनीय डेटा रिसेप्शन सुनिश्चित होता है। उपयोगकर्ता के अनुकूल पंजीकरण प्रक्रिया, सॉफ्टवेयर और हार्डवेयर घटकों के मजबूत कॉन्फिगरेशन के साथ मिलकर, राष्ट्रीय मध्यम अवधि मौसम पूर्वानुमान केंद्र में एएमटी का उपयोग करके ईयूएमईटीकास्ट टेरैस्ट्रियल स्टेशन की दक्षता और प्रभावशीलता को बढ़ाती है।

Abstract

The purpose of the EUMETCast Terrestrial station using AMT (Automatic Multicast Tunneling) is to access EUMETCast Terrestrial multicast streams in the absence of end-to-end multicast connectivity. This solution is entirely software-based and installed on physical infrastructure at National Center for Medium Range Weather Forecasting (NCMRWF) with multicast-enabled internet connectivity.

To subscribe to the EUMETCast Terrestrial services, users need to register on the Earth Observation Portal, on successful registration user will obtain user key and username. Along with an EKU USB-based eToken, which is couriered by EUMETSAT to the user location physically, and a URL for software access is provided for system preparation. The server has been prepared by installing Ubuntu OS version 18. The AMT Gateway, TelliCast client, and EKU software are installed and configured. Additionally in firewall, multicast is enabled and rules have been made to allow UDP and TCP packets and multicast data reception over ports.

This setup allows for seamless access to EUMETCast Terrestrial services, ensuring reliable data reception for meteorological observations and forecasts. The registration process is user-friendly with robust configuration of software and hardware components. This will enhance the efficiency and effectiveness of the EUMETCast Terrestrial station using AMT at NCMRWF.

1. Introduction

The purpose of the EUMETCast Terrestrial station using AMT (Automatic Multicast Tunneling) is to access EUMETCast Terrestrial multicast streams in the absence of end-to-end multicast connectivity. This solution is entirely software-based and has been installed on physical infrastructure at the National Center for Medium Range Weather Forecasting (NCMRWF) with multicast-enabled internet connectivity.

1.1 AMT Protocol

Automatic Tunneling is a method that uses UDP (User Datagram Protocol) to encapsulate multicast traffic into UDP packets, which makes it efficient and reliable for the delivery of data over the IP network. It creates multicast tunnels dynamically between multicast enabled networks and networks that support only unicast and allows the multicast packets to be delivered to the intended recipients even if the underlying network doesn't have native multicast support.

The tunneling is implemented between AMT relay and an AMT gateway, using UDP encapsulation. This allows users to receive data from a multicast source, even in the absence of end-to-end multicast connectivity. AMT relays receive the traffic natively and unicast-encapsulate it to gateways. AMT is specific to encapsulating multicast traffic within unicast tunnel and requires far less manual configuration and management of the tunnel on both ends.

1.2 AMT software

The AMT functionality is provided in the form of a software package. This is open-source software, supported by Juniper Networks as a product of the Multicast backbone Deployment (MBONED) Working Group of the Operations and Management Area of the IETF (The Internet Engineering Task force).

- **AMT Gateway:** This software package can be installed on any Linux-based system in order to allow any end-user to receive the multicast data from EUMETSAT, even in the absence of end-to-end native multicast connectivity. This works in conjunction with the TelliCast client software to request and receive the multicast data to which an end-user has subscribed to via the EO (Earth Observation) Portal.

1.3 AMT Hardware (GEANT-hosted AMT relays)

GEANT has procured AMT-compatible routers which are installed at 3 locations: Frankfurt, London and Amsterdam. These routers have direct access to the operational EUMETCast Terrestrial multicast streams. NCRMWF has setup using AMT Gateways(software) to connect to GEANT network to receive data.

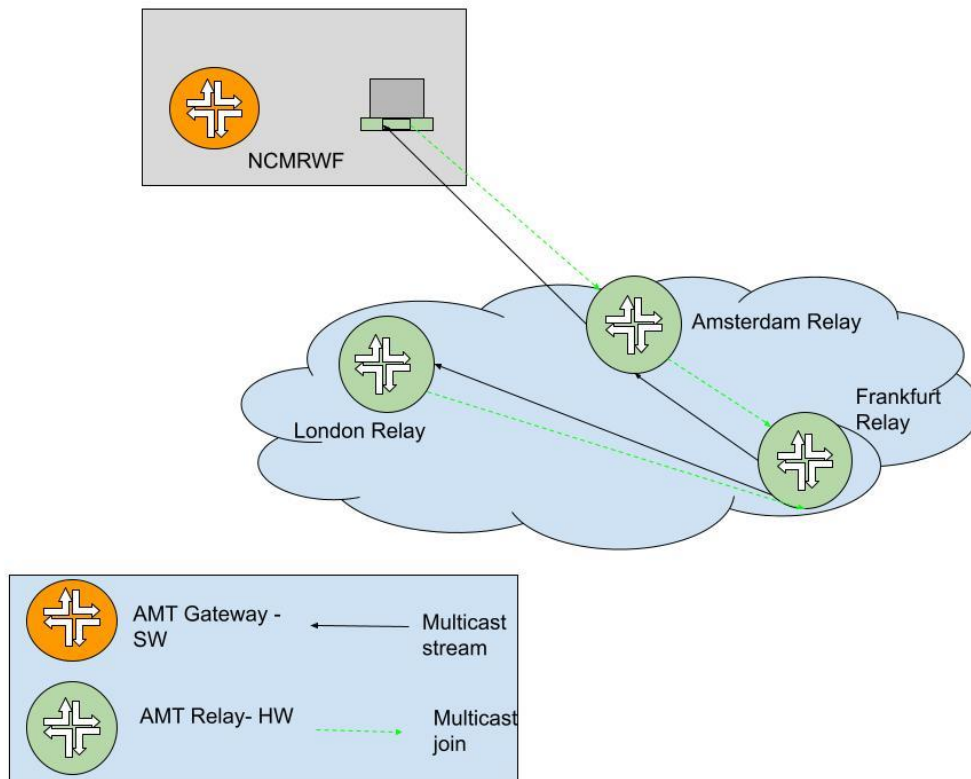


Figure 1: EUMETCast Terrestrial over AMT at NCRMWF

1.4 AMT Connectivity

The IP-multicast streams from the Tellicast Server running on the EUMETCast Platform are received by EUMETSAT's Wireless Access Network (WAN) router and routed to the GEANT network via EUMETSAT's local NREN. From there, they can be accessed directly by the AMT dedicated relays installed in the GEANT infrastructure.

Requests originate from AMT Gateways installed at NCRMWF Reception station. AMT gateways work to send multicast traffic from the multicast network to NCRMWF. Multicast traffic is routed from the AMT Relay, located in either

location Frankfurt, Amsterdam or London, via the GEANT network, to the NCMRWF Reception station.

Reception stations can be hosted on unicast or multicast enabled networks and can receive the data streams via the commercial internet. End-to-end network connectivity can be seen in *figure 2* below.

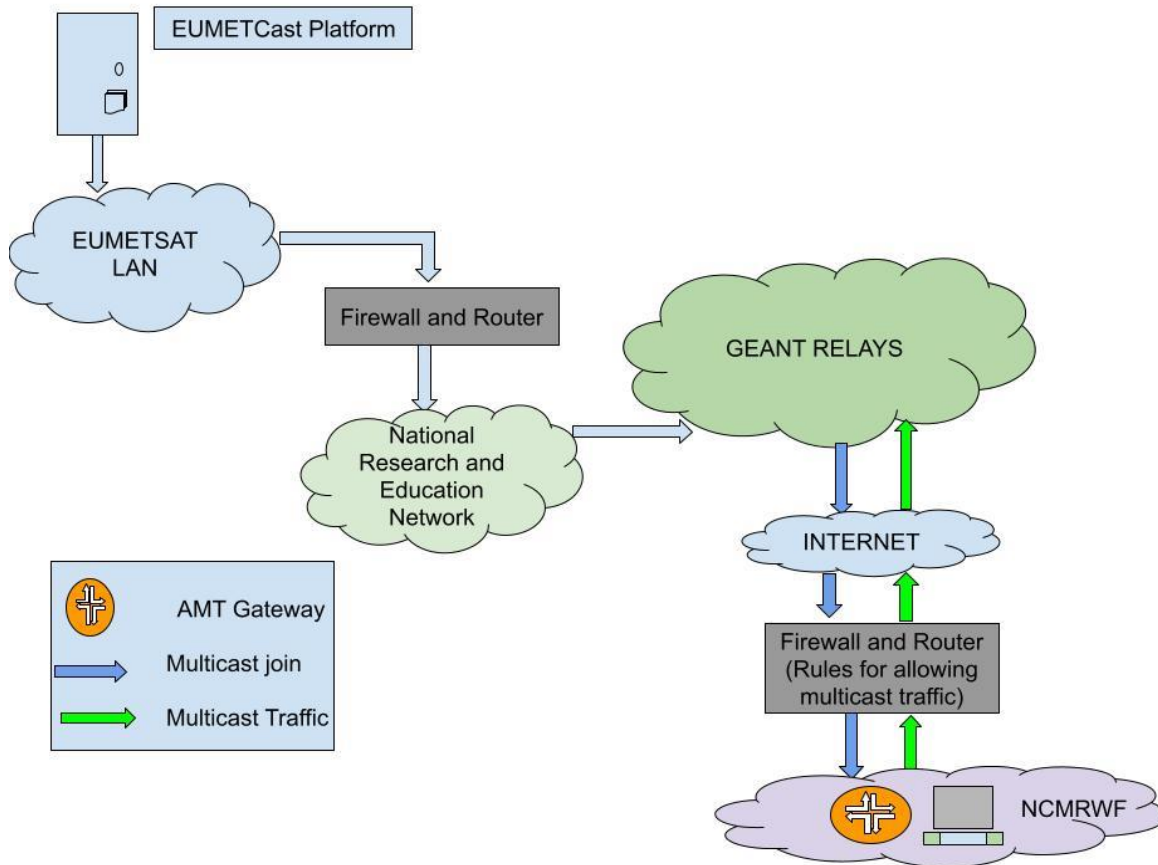


Figure 2: AMT Network Connectivity

TelliCast acknowledgement messages are sent using traditional Feedback channels over the internet.

The default port used by the AMT software is 2268.

1.5 AMT Advantages

The most relevant AMT characteristics and benefits for EUMETCast Terrestrial users are:

- Carrier Independence: AMT works seamlessly across different types of networks like internet.

- Software-based solution: AMT doesn't require any dedicated hardware for its implementation. It is software based and can be installed in a virtual machine or server
- Simple Setup: The setup process is simple and straightforward, taking less than 30 minutes to complete.
- Firewall friendly: It doesn't require any firewall rule update
- AMT is Network Address Translation enabled. Therefore, it can work seamlessly across networks that use NAT, eliminating the need for router configuration by end users.

2. Subscription

Registration for the EUMETCast Terrestrial over AMT service shall be done via the Earth Observation Portal (EOP). An account can be created at <https://eoportal.eumetsat.int/>

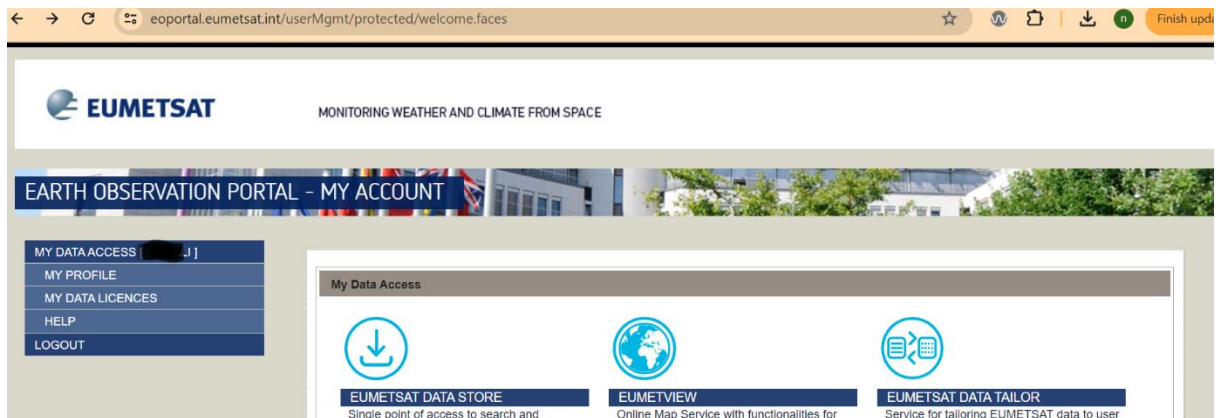


Figure 3: EUMETSAT Registration Portal

Source: eoportal.eumetsat.int

The registration procedure includes the following steps:

- Create an EOP account:
- Subscribe to relevant EUMETCast Terrestrial services
- License: which includes the acceptance of licensing terms and conditions, in accordance with EUMETSAT's Data Policy.

Once registration and licensing procedure is completed, EUMETCast Client Software access is granted to NCMRWF.

Figure 4, shows the list of services subscribed by NCMRWF user.

EARTH OBSERVATION PORTAL - MY ACCOUNT

MY DATA ACCESS []

MY PROFILE

MY DATA LICENCES

HELP

LOGOUT

View Subscribed Service



EUMETCAST TERRESTRIAL

The details of your selected service are shown on this page. You can modify them by clicking on the Modify link next to each header.

SERVICE NAME

►MODIFY

- ▼ **Meteosat Services**
- ▼ **0° Service**
- ▼ **0° Meteosat Meteorological Products**
All other Meteorological Products
- ▼ **45.5° E Indian Ocean Data Coverage**

- ▼ **IODC SEVIRI Level 1.5 Image Data**
1/4-hourly data transmissions **
1/2-hourly data transmissions **
1-hourly data transmissions
- ▼ **IODC Meteosat Meteorological Products**
All other Meteorological Products
- ▼ **Metop, SNPP and NOAA Global Data Services**
- ▼ **GDS-Metop-B**
AVHRR Level 1
AMSU-A Level 1
MHS Level 1
ASCAT L1 Sigma0 at Full Sensor Resolution **
- ▼ **IASI Level 1**
All Spectral Samples **
Reduced Spectral Samples (500 channels)
Principal Component Scores
GRAS Level 1
GOME-2 Level 1 **
IASI Sounding Products
ASCAT Soil Moisture
AVHRR Polar Winds
- ▼ **Multi-Sensor Products**
Polar Multi-sensor Aerosol Product
- ▼ **GDS-Metop-C**
AVHRR Level 1
AMSU-A Level 1

- MHS Level 1
ASCAT L1 Sigma0 at Full Sensor Resolution **
- ▼ **IASI Level 1**
All Spectral Samples **
Reduced Spectral Samples (500 channels)
Principal Component Scores
GRAS Level 1
GOME-2 Level 1 **
IASI Sounding Products
ASCAT Soil Moisture
AVHRR Polar Winds
- ▼ **Multi-Sensor Products**
Polar Multi-sensor Aerosol Product
- ▼ **GDS-Multi-Metop**
Multi-Metop Wind Products
- ▼ **GDS-SNPP/JPSS**
ATMS SDR
CrIS SDR
VIIRS EDR
- ▼ **Regional Data Services**
- ▼ **RDS-EARS**
EARS-ATOVS
EARS-AVHRR
EARS-ASCAT
EARS-IASI Level 1
EARS-ATMS

- EARS-CriS
- EARS-VIIRS
- EARS-NWC
- EARS-VASS (Regional FY-3 Sounder Service)
- EARS-MERSI
- EARS-MWRI

▼ **Satellite Application Facility Services**

- OSI SAF Products
- LSA SAF Products
- AC SAF Products

▼ **Copernicus**

▼ **Copernicus Sentinel-3 (Transponder 2)**

▼ **SRAL Global Level 1**

- SRAL Level 1B NRT

▼ **SRAL Global Level 2**

- SRAL Sea Surface Height, Wind Speed Significant Wave Height NRT
- SRAL Sea Surface Height, Wind Speed Significant Wave Height STC
- SRAL L2P Sea Level Anomaly Products NRT
- SRAL L2P Wave Products NRT

▼ **OLCI Global Level 1**

- OLCI Level 1B Reduced Resolution NRT

▼ **OLCI Global Level 2**

- Ocean Colour Reduced Resolution NRT
- Total Columnar Water Vapour BUFR product NRT

▼ **SLSTR Global Level 1**

- SLSTR Level 1B NRT

▼ **SLSTR Global Level 2**

▼ **SLSTR Level 2 Marine Products**

- SLSTR Sea Surface Temperature NRT

▼ **SLSTR Level 2 Atmospheric Products**

- SLSTR Fire Radiative Power NRT
- SLSTR Aerosol Optical Depth NRT

▼ **Copernicus Jason-3**

- Jason-3 OGDRs

▼ **Copernicus Sentinel-6 Michael Freilich (Transponder 2)**

▼ **Poseidon-4 Level 2 Altimetry**

- High Resolution Poseidon-4 Level 1A Altimetry products NTC
- High Resolution Poseidon-4 Level 1A Altimetry products STC
- High Resolution Poseidon-4 Level 1B Altimetry products NTC
- High Resolution Poseidon-4 Level 1B Altimetry products STC
- High Resolution Poseidon-4 Level 2 Altimetry products NTC
- High Resolution Poseidon-4 Level 2 Altimetry products STC
- High Resolution Poseidon-4 Level 2 Altimetry products NRT
- Low Resolution Poseidon-4 Level 1B Altimetry products NTC
- Low Resolution Poseidon-4 Level 2 Altimetry products NTC
- Low Resolution Poseidon-4 Level 2 Altimetry products NRT
- High Resolution Poseidon-4 Level 2P Altimetry products NRT
- High Resolution Poseidon-4 Level 2P Altimetry products STC
- Low Resolution Poseidon-4 Level 2P Wave products NRT
- High Resolution Poseidon-4 Level 3 Altimetry products STC
- Low Resolution Poseidon-4 Level 3 Wave products NRT

▼ **Advanced Microwave Radiometer**

- Advanced Microwave Radiometer Level 2 products NTC

▼ **Radio Occultation**

- Radio Occultation Level 1B products NTC

▼ **Third Party Data Services**

▼ **Third Party Data Service - GEO**

- Himawari-9 10-minute image data

- FY-2

- FY-4 data

▼ **Third Party Data Service - LEO**

- FY-3 - Restricted to Member State NMHSs and partner organisations

- HY-2 Altimeter Level 2 - Restricted to Member State NMHSs and partner organisations

- HY-2 Scatterometer Level 2 - Restricted to Member State NMHSs and partner organisations

▼ **Multimission Regional Products**

- Polar Winds - Multimission

- SMAP Level 1

- NESDIS IMS data

- Commercial Radio Occultation Level 1B data in BUFR ¹

▼ **Third Party Data Distribution**

▼ **NMS Data Distribution Service - Restricted to NMHSs ²**

- WMO RA VI (BMD)

▼ **Other Data Distribution Services**

- OSFAC Products

▼ **ESA SMOS Products**

- ESA SMOS L2

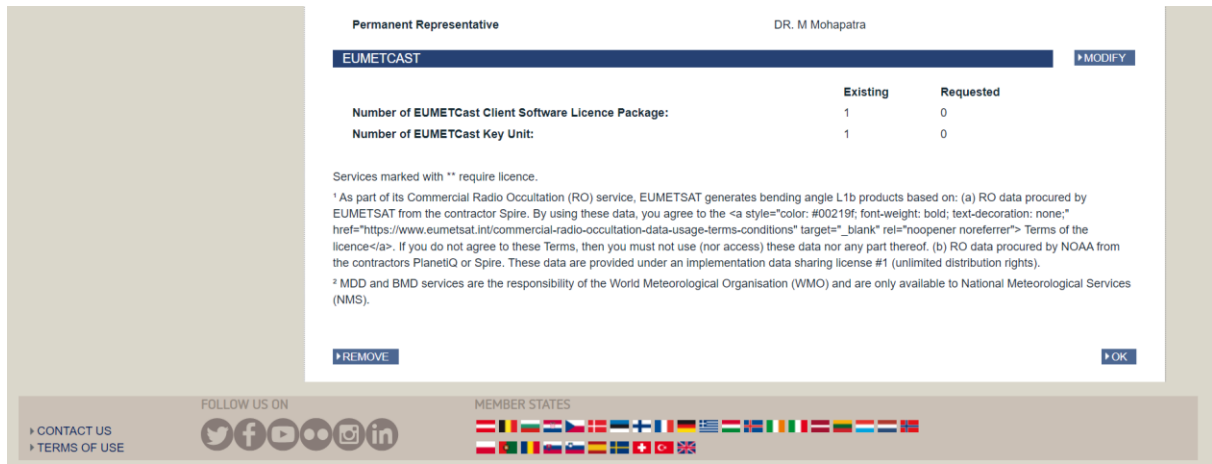


Figure 4: EUMETCAST subscribed services

Source: eoportal.eumetsat.int

3. Software Installation

The software is compatible with any Linux OS and verified on Ubuntu OS version Ubuntu 18.04 LTS.

3.1 AMT Gateway

In order to install the AMT Gateway software, please upload the package on the reception station and run the following command:

- AMT Gateway Software Location:
 - a. Software Location: `/home/amtdir/amt-setup.tgz`
 - b. Copy the above tar to Software Location on Eumet Server: `/home/software`
 - c. Untar the package: `tar xzf amt-setup.tgz`
- Install AMT Package:
 - a. `cd /home/software/amt-station/amtgwd-package/packages`
 - b. `sudo apt-get install ./amt_1.0-2_amd64.deb`

3.2 Tellicast Client

- Download TelliCast Client Software:
 - a. `https://sftp.eumetsat.int/public/folder/uscvknoovksydcgpmimjnj/User-/EUMETCast_Support`
 - b. location on eumet station: `/home/software/EKU.zip`
 - c. command to unzip: `unzip EKU.zip`
- Installation commands for Tellicast Client Software:

```
sudo dpkg --add-architecture i386
```

```
sudo apt-get install ibc6:i386 libncurses5:i386 libstdc++6:i386
```

```
sudo dpkg -i tellicast-client-2.14.7-1_i386.deb
```

3.3 Safenet ECU driver

EKU device is provided by EUMETSAT.

This device is compatible on Ubuntu 18.04 x64 for deb based distributions

The Safenet drivers depend on

- a. pcsc-lite (rpm) or pcscd (deb)
- b. libccid (containing ifd-handler)
- c. libgtk2 GTK+ toolkit library (version 2)

Compatible with Tellicast client version 2.14.5 or later

- Installation:

```
sudo apt-get install ./SafenetAuthenticationClient-core-9.0.43-0_amd64.deb  
sudo apt-get install -f
```

- Check ECU communication
 - a. Insert the ECU
 - b. Restart Tellicast client
 - c. Test the ECU connection

```
$ tc-cast-client -k
```

the last line should show:

```
host_key_4 = ****_****_****_**** (Aladdin EToken PRO)
```

If above is the case, ECU communication is working.

4. Software Configuration

4.1 AMT Gateway

Open AMT Gateway startup script `/etc/init.d/amtgwd` and ensure `$CFG_DIR` points to the absolute path of the directory containing `amt-relays.txt` file. This configuration file contains the hostnames of the AMT Relays installed at GEANT and is required to access multicast data.

- Check the Status of AMT Gateway:

a. Check the Status of AMT Tunnel

```
eumet@eumetamt: sudo systemctl status tunnel
```

- Ensure AMT Tunnel is activated

```
eumet@eumetamt: sudo systemctl status tunnel

eumet@eumetamt: ip addr
eumet@eumetamt:~/software$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN
group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eno1np0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state
UP group default qlen 1000
    link/ether f4:02:70:a5:9f:9e brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.34/24 brd 192.168.0.255 scope global noprefixroute eno1np0
        valid_lft forever preferred_lft forever
    inet6 fe80::4f2b:a767:6b66:de07/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
3: eno2np1: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq
state DOWN group default qlen 1000
    link/ether f4:02:70:a5:9f:9f brd ff:ff:ff:ff:ff:ff
4: enp179s0f0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq
state DOWN group default qlen 1000
    link/ether 00:0a:f7:be:39:5e brd ff:ff:ff:ff:ff:ff
5: enp179s0f1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq
state UP group default qlen 1000
    link/ether 00:0a:f7:be:39:5f brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.34/24 brd 192.168.0.255 scope global noprefixroute enp179s0f1
        valid_lft forever preferred_lft forever
    inet6 fe80::a1bd:6ea5:6a8e:d941/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
6: tun1: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc
fq_codel state UP group default qlen 500
    link/none
    inet 10.0.0.11/24 scope global tun1
        valid_lft forever preferred_lft forever
    inet6 fe80::2dd8:41c8:b129:9d1a/64 scope link stable-privacy
        valid_lft forever preferred_lft forever
```

b. Start AMT Gateway

```
sudo systemctl restart amtgwd
```

c. Ensure AMT Gateway is running


```

eumet@eumetamt:~$ sudo systemctl status amtgwd
[sudo] password for eumet:
● amtgwd.service - LSB: AMT Gateway
   Loaded: loaded (/etc/init.d/amtgwd; disabled; vendor preset: enabled)
   Active: active (running) since Mon 2023-11-06 12:58:09 IST; 3 days ago
   Docs: man:systemd-sysv-generator(8)
   Tasks: 3 (limit: 37905)
   CGroup: /system.slice/amtgwd.service
           └─ 2336 /bin/bash /etc/init.d/amtgwd start
              └─ 74142 amtgwd -a 62.40.96.18 -c tun1
                 └─ 99955 sleep 30

Nov 10 03:06:22 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel
Nov 10 04:05:21 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel
Nov 10 05:04:20 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel
Nov 10 06:07:41 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel
Nov 10 07:04:29 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel
Nov 10 08:07:50 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel
Nov 10 09:15:33 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel
Nov 10 10:21:06 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel
Nov 10 11:17:53 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel
Nov 10 12:14:41 eumetamt amtgwd[2317]: amtgwd: IP Proto 128 len 48 from
tunnel

eumet@eumetamt:~$ eumet@eumetamt:~$ ps -ef | grep -i amt
eumet@eumetamt:~/software$ ps -ef | grep -i amt
root    2336    1  0 Nov06 ?        00:00:51 /bin/bash /etc/init.d/amtgwd start
avahi   51924    1  0 Nov07 ?        00:00:02 avahi-daemon: running
[eumetamt.local]
root    74142  2336 13 Nov09 ?        01:41:32 amtgwd -a 62.40.96.18 -c tun1
eumet   99932  96962  0 12:20 pts/1  00:00:00 grep --color=auto -i amt
eumet@eumetamt:~/software$

```

4.2 Tellicast Client

- Software Configuration of EUMETCast client on the Reception Station (192.168.0.34):
 - a. TelliCast Client configuration
 - i. Edit `/etc/tellicast-client.cfg` to Specify EUMETCast TER-1 data:

INSTANCE_START_ORDER=ter-1

ii. Edit /etc/cast-client_ter-1.ini file:

1. Input [recipient] section to add user credentials:

```
[recipient]
user_name=NCMRWF_2
user_key=*****
```

2. Update [parameters] section to set interface address to that of the tunnel created.

```
[parameters]
source_address=193.17.9.3
interface_address=10.0.0.11
```

iii. Edit /etc/cast-client-channels_ter-1.ini

Uncomment the ter-1 channels as provided in list at location:

<https://eumetsatspace.atlassian.net/wiki/spaces/DSEC/pages/1989640193/EUMETCast+Terrestrial+Re-organisation>

```
[channel]
name=T01-EDC-12
target_directory=/home/data/eumetcast/ter-1/T01-EDC-12
tmp_directory=/home/data/tmp/ter-1
```

iv. Start/Restart TelliCast Client:

```
eumet@eumetamt:~$ sudo systemctl restart tellicast-client
```

v. Ensure TelliCast Client is running:

```
eumet@eumetamt:~$ sudo systemctl status tellicast-client
● tellicast-client.service - LSB: Tellicast client
   Loaded: loaded (/etc/init.d/tellicast-client; generated)
   Active: active (exited) since Thu 2023-11-09 17:23:12 IST; 19h ago
     Docs: man:systemd-sysv-generator(8)
   Process: 59892 ExecStop=/etc/init.d/tellicast-client stop (code=exited,
status=0/SUCCESS)
   Process: 59975 ExecStart=/etc/init.d/tellicast-client start (code=exited,
status=0/SUCCESS)

Nov 09 17:23:12 eumetamt su[61915]: pam_unix(su:session): session opened
for user root by (uid=0)
Nov 09 17:23:12 eumetamt tellicast-client[59975]: mesg: ttyname failed:
Inappropriate ioctl for device
Nov 09 17:23:12 eumetamt su[61915]: pam_unix(su:session): session closed
for user root
Nov 09 17:23:12 eumetamt su[62083]: Successful su for root by root
Nov 09 17:23:12 eumetamt su[62083]: + ??? root:root
```

```

Nov 09 17:23:12 eumetamt su[62083]: pam_unix(su:session): session opened
for user root by (uid=0)
Nov 09 17:23:12 eumetamt tellicast-client[59975]: Starting tellicast-client
instance ter-1: mesg: ttyname failed: Inappropriate ioc
Nov 09 17:23:12 eumetamt su[62083]: pam_unix(su:session): session closed
for user root
Nov 09 17:23:12 eumetamt tellicast-client[59975]: OK
Nov 09 17:23:12 eumetamt systemd[1]: Started LSB: Tellicast client.

eumet@eumetamt:~$

```

5. Network Configuration

5.1 Description

The requests originated from the AMT Gateway installed at NCMRWF Reception station are sent to the closest of three available AMT relays hosted on the GEANT platform via UDP tunnels. All three relays have direct access to the operational multicast streams. The multicast data is unicast encapsulated and sent to the NCMRWF via same UDP source port opened by the gateway.

London	amt1.lon2.uk.geant.net	62.40.96.18	Available
Frankfurt	amt1.fra.de.geant.net	62.40.96.41	Available
Amsterdam	amt1.ams.nl.geant.net	62.40.96.44	Available

AMT relays are accessible on port 2268.

5.2 Firewall

- Firewall rules configured at NCMRWF (end user reception station).

Allow	Rules
AMT traffic	UDP traffic between IP's (62.40.96.18, 62.40.96.41,62.40.96.44) port 2268 and IP of end user station on port range 60100 to 61100.
NAK's Feedback Channel to the server	UDP packets from range 60100-61100 to 193.17.9.1/29(source IP currently 193.17.9.3) also on range 60100-61100
ACKs- Feedback channel to the EUMETCast server	TCP packets from the range 60100-61100 to 193.17.9.1/29 port 60003

- Multicast forwarding in NAT mode has been enabled as:

```

config system settings
set multicast-forward enable
end

```

This has been enabled by networking team on firewall

6. TelliCast Client Web GUI interface

<http://192.168.0.34:8500/>

Public IP: <http://14.139.63.157:8500/>

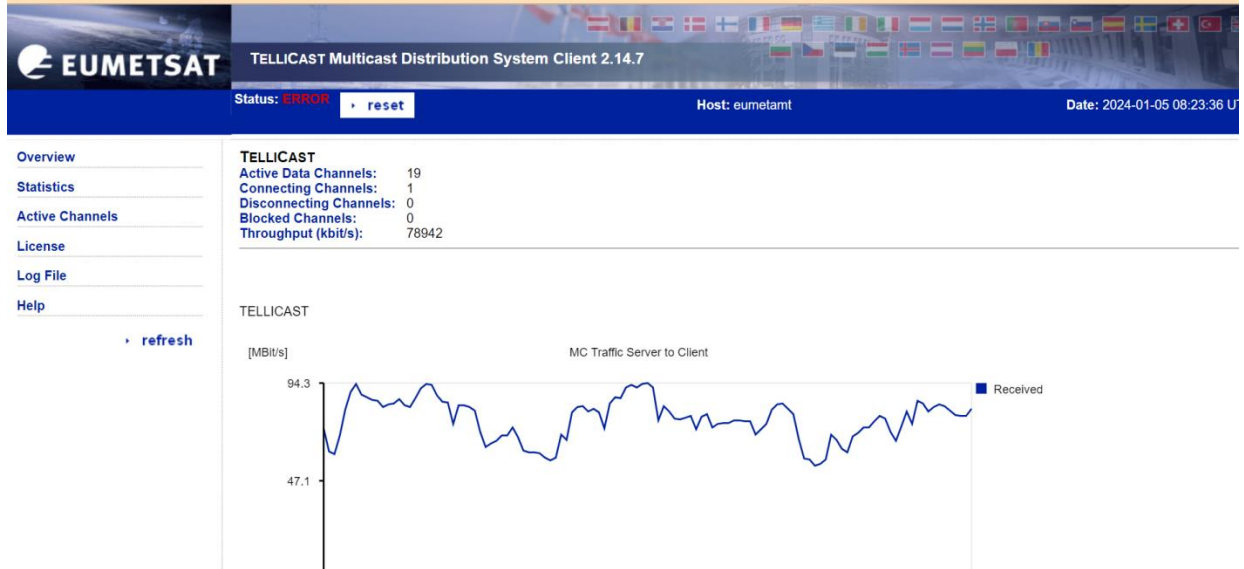


Figure 5: Tellicast Client Web GUI Interface at NCMRWF

7. Summary and Conclusion

The EUMETCast Terrestrial station using AMT facilitates access to EUMETCast Terrestrial multicast streams without end-to-end multicast connectivity. This software-based solution, installed on physical infrastructure at NCMRWF, requires users to register on the Earth Observation Portal to receive a user key and username. After registration, users are provided with an EKU USB-based eToken and a URL for software access. The server is set up with Ubuntu OS version 18 and includes the installation and configuration of the AMT Gateway, TelliCast client, and EKU software. The firewall is configured to enable multicast and allow UDP and TCP packets over designated ports. This setup ensures reliable data reception for meteorological observations and forecasts, offering a user-friendly registration process and robust system configuration to enhance the efficiency of the EUMETCast Terrestrial station at NCMRWF.

The EUMETCast Terrestrial over AMT deployment has been set up at the National Centre for Medium Range Weather Forecasting as a backup in case the NKM-based EUMETSAT system faces connectivity issues.

8. Author Contribution:

Shivali Gangwar has completed System preparation, Operating System installation, Application software installation and configuration, testing, and report preparation. Dr. Athiyaman has provided technical information about support infrastructure, allowed Facility Management Services (FMS) to support in system preparation and network configuration on the firewall, along with guidance, revision, discussion, and finalization of the report. Dr. Srinivas Desamsetti assisted with client interaction for issue resolution. Dr. Indira Rani assisted with ECU procurement. The idea behind the implementation of EUMETCast Terrestrial using AMT as a backup at NCMRWF was provided, and work was allocated by Dr. V. S. Prasad.

Acknowledgement

The EUMETCast Terrestrial over AMT deployment has been set up at the National Centre for Medium Range Weather Forecasting as a backup in case the NKM-based EUMETSAT system faces connectivity issues. We appreciate the support from Mr. Pooran FMS Manager, Mr. Anurag Network Engineer and Mr. Prabhat System Admin from FMS team during this work.

References

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- [3] <https://datatracker.ietf.org/meeting/115/materials/slides-115-mboned-eumetcast-over-amt-00.pdf>

