TD 18 Metop Direct Readout AHRPT Technical Description

Doc.No.	:	EUM/OPS/TEN/08/1663
Issue	:	v2
Date	:	2 May 2013

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Document Change Record

Issue / Revision	***Date***	***DCN. No***	***Changed Pages / Paragraphs***
1	26/03/09		Initial Issue
1J	28/03/11		Updated to include AHRPT zone extensions
2	02/05/13		Updated for Metop-B. Title changed AHRPT switch on/off updated

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1 Introduction

This document describes the Metop Direct Readout Service for users wishing to establish and operate User Stations to receive Metop AHRPT data.

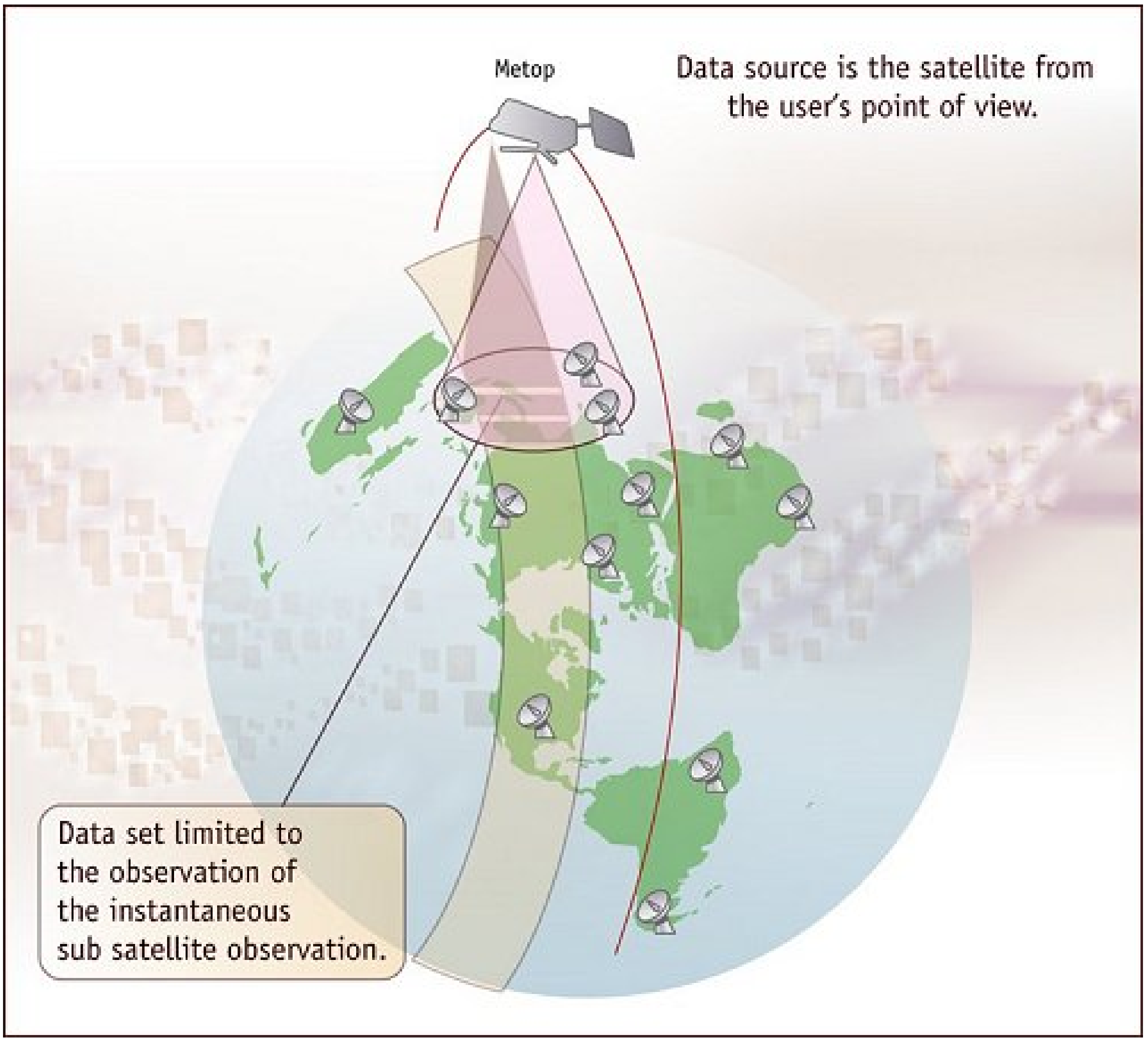

Figure 1 Metop AHRPT Reception

2 Overview

2.1 Service Characteristics

The Metop Direct Readout Service provides to local user stations the real-time transmission of data limited to the instantaneous sub-satellite observation. The data source is the satellite as it passes over the user's field of view as illustrated in Figure 1. Readout of all instrument data can be achieved in the form of Advanced High Resolution Picture Transmission (AHRPT).

Data disseminated via AHRPT are:

- AVHRR/3 High Rate
- AMSU-A1
- AMSU-A2
- HIRS/4
- SEM
- A-DCS
- IASI
- MHS
- ASCAT
- GOME-2
- GRAS
- HKTM including Administration Message

2.2 System Overview

The current Direct Readout service comprises two satellites, Metop-A and Metop-B. AHRPT data are disseminated in L-Band, with a data rate of 3.5 Mbps. Local data coverage is of a radius of up to 1500 km centred at the sub satellite point. The AHRPT frequency of Metop-A and Metop-B is:

1)Prime 1701.3 MHz
2)Backup 1707.0 MHz

In the case of the Metop-B satellite, the nominal service is full global AHRPT readout. However, due to technical problems with the transponders on-board the Metop-A satellite, the current service has geographical coverage limitations. Details of the Metop-A coverage zone and transponder switch on and switch off parameters can be found in APPENDIX B. The EUMETSAT web site contains the most up to date information on this subject. (www.eumetsat.int).

2.3 Applicable Documentation

[AD1]	MO-IF-MMT-SY-0001	Metop Space to Ground Interface Specification
[AD2]	EPS/SYS/SPE/95413	HRPT/LRPT Direct Broadcast Service Specification
[AD3]	EUM/OPS/USR/09/0579	EPS Data Denial Guide
[AD4]	EUM/TSD/MAN/04/0341	EPS Key Dissemination System - User Guide
[AD5]	MO.IC.SES.GR.0008	GRAS Measurement Data Interface Control Document
[AD6]	IA-ED-1000-6477-AER	IASI Measurement and Validation Data
[AD7]	MO.IC.MMT.GM.0001	GOME-2 Instrument Interface Control Document
[AD8]	EUM/OPS/TEN/07/1573	Multi-Mission Administrative Message User Guide

2.4 Reference Documents

The following documents are referenced:

[RD1]	EUM/LAD/DOC/05/0350	Data Policy for Metop Data and Products
[RD3]	EUM/OPS/REQ/08/1903	HRPT Reference User Station Technical Requirements Document
[RD4]	EUM/MSG/ICD/114	Meteosat Second Generation Interface Control Document Station Key Unit
[RD5]	EPS.SYS.SPE.95424	EUMETSAT Polar System (EPS) / Meteorological Operational satellite (Metop) Encryption System Specification
[RD7]	EPS.SYS.SPE.95413	EPS - HRPT Direct Broadcast Services Specification

Further information, as well as the above referenced documents, may also be obtained from the EUMETSAT User Service (see Chapter 5 “User Support Information”) or directly from the EUMETSAT web site http://www.eumetsat.int

3 AHRPT Data Stream

This section provides an overview of the AHRPT data stream from the perspective of a user wishing to establish a User Station. The aim is to describe the basic characteristics of AHRPT such that users can determine the requirements of their user station and any software that might be required to manipulate the received data. Full details of AHRPT protocols and file formats are described in **[RD7]**

3.1 Data Structure

Data are distributed as a stream containing Channel Access Data Units (CADUs), which require further processing to produce Metop L0 products. The stream holds multiplexed data from all Metop instruments, as well as spacecraft telemetry and administrative messages. In addition to being time ordered, frame synched and randomized, CADU's also hold Reed-Solomon decoding information and quality information.

A CADU packet can be processed further up to CVCDU, VCDU, M-PDU and Instrument Source Packets (ISPs) as CCSDS source packets; this is shown by the following diagram:

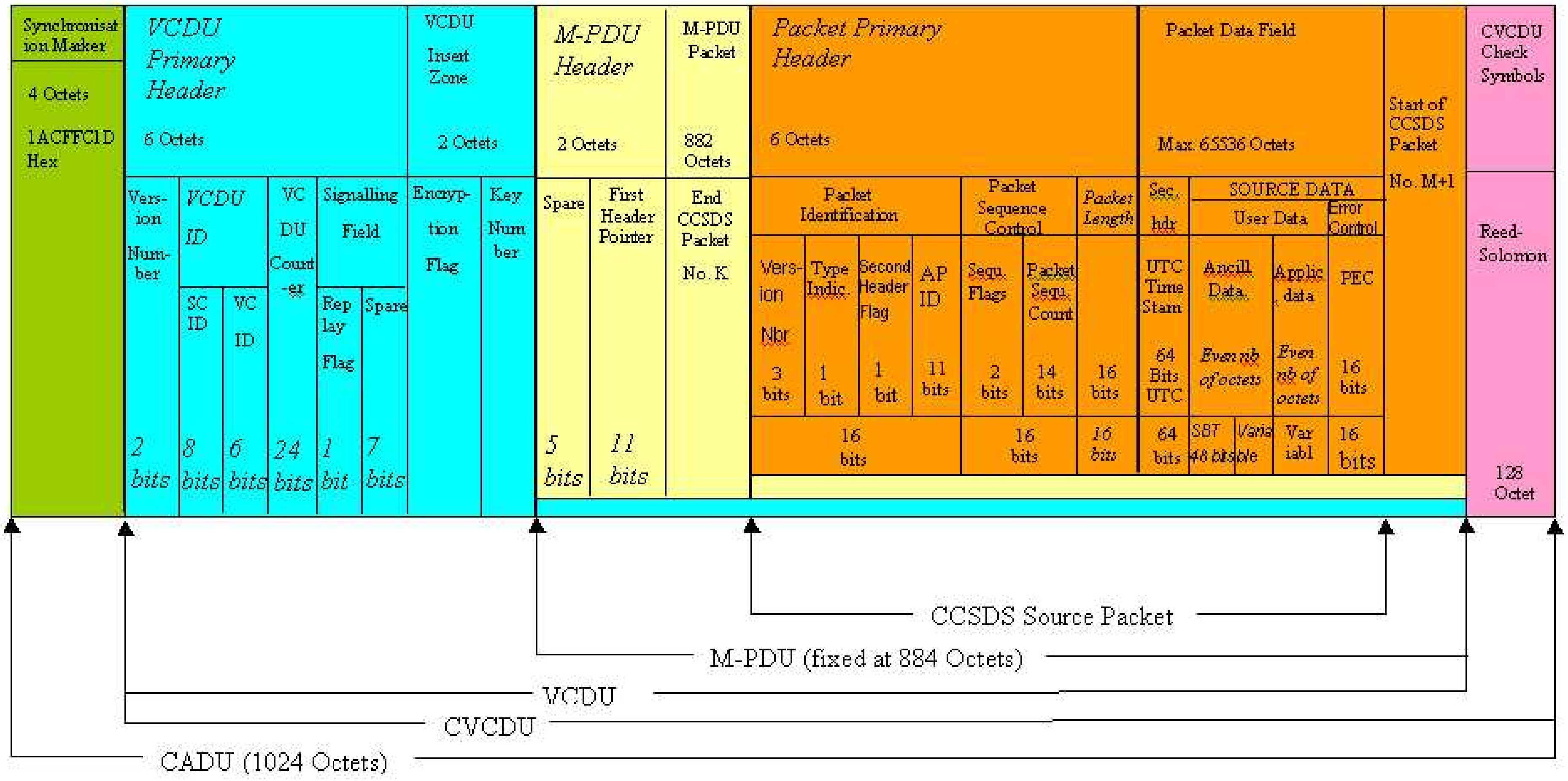

Figure 2 Channel Access Data Unit (CADU) Struture]

Futher details (e.g; PEC schemes, Reed-Solomon decoding description) can be found in [AD2].

3.2 Data Content

This section describes the various data disseminated via AHRPT.

Instrument/Application	VCID	APID	Instrument/Application data rate (bps)
AVHRR/3 High Rate	9	103, 104	622368
AMSU-A1	3	39	2102
AMSU-A2	3	40	1142
HIRS/4	3	38	2907.5
SEM	3	37	165.5
A-DCS	27	35	7462
IASI	10	130, 135, 140, 145, 150, 160, 180	1578860
MHS	12	34	3924
ASCAT	15	192…255	41032
GOME-2	24	384…447	399744
GRAS Occultation data	29	448…511	60000
Instruments' data sub-total:			**2719707**
Satellite housekeeping packet	34	1	4352
Admin messages	34	6	2008
GRAS positioning and timing data	34	2, 3	80
VCID 34 data sub-total:			**6440**
All VCIDs (excluding overhead)			2726147
Protocol and RS-coding overhead (+16.1%) on all data:			438910
All VCIDs (including overhead)			**3165057**
Fill data			**334943**
Satellite complete data rate			**3500000**

Table 1 : Data disseminated via AHRPT

3.3 Data Processing

The structure of the data received through a local station follows the Metop implementation of the CCSDS standard.

Note that the M-PDU packet is of fixed size (884 bytes) and can contain a variable number of CCSDS source packets or parts of CCSDS source packets (orange in Figure 1 above) depending on the instrument.

Note as well the following deviations from the reference documentation required for the generation of L0 products, for some of the instruments:

- GOME : CRC encoder/decoder should be initialised with “all zeros” (see [AD7]);
- GRAS: extraction of its SBT must be performed according to the explanation given in the GRAS Measurement Data Interface Control Document [AD5], not the one in [AD1];
- IASI: measurement packets transmission sequence differs from the temporal sequence, and some packets have invalid time stamps (refer to table below for a solution to this problem, and to [AD6]).

Transmission/downlink order:

subcycle #1 PX1, PX2, PX3, PX4, IP
then subcycle #2, etc., upto subcycle #30,
then individual verification packets,
then subcycle #37 VPE, AP, IP32, IP33, IP35, IP36

PX1 apid=130
PX2 apid=135
PX3 apid=140
PX4 apid=145

IP, IPx apid=150
VPx apid=160
AP apid=180

Subcycles:

#1	#2	#3	#4	#5	…	#25	#26	#27	#28	#29	#30	#31	#32	#33	#34	#35	#36	#37
																		VPE
PX1	PX1	PX1	PX1	PX1	packet	PX1	PX1	PX1	PX1	PX1	PX1							AP
PX2	PX2	PX2	PX2	PX2	pattern	PX2	PX2	PX2	PX2	PX2	PX2							IP32
PX3	PX3	PX3	PX3	PX3	repeated	PX3	PX3	PX3	PX3	PX3	PX3							IP33
PX4	PX4	PX4	PX4	PX4	for 30	PX4	PX4	PX4	PX4	PX4	PX4							IP35
IP	IP	IP	IP	IP	subcycles	IP	IP	IP	IP	IP	IP	VPC		VPA	VPB		VPD	IP36

Datation/time-stamping order

packets in subcycles #1 to #30 are time-stamped in accordance with the transmission order (as indicated below)
AP and IPx packets are time-stamped according to the diagram below (ie. not on the transmission subcycle)

PX1	PX1	PX1	PX1	PX1	packet	PX1	PX1	PX1	PX1	PX1	PX1						
PX2	PX2	PX2	PX2	PX2	pattern	PX2	PX2	PX2	PX2	PX2	PX2						
PX3	PX3	PX3	PX3	PX3	repeated	PX3	PX3	PX3	PX3	PX3	PX3						
PX4	PX4	PX4	PX4	PX4	for 30	PX4	PX4	PX4	PX4	PX4	PX4		AP				
IP	IP	IP	IP	IP	subcycles	IP	IP	IP	IP	IP	IP		IP32	IP33		IP35	IP36

VPC can have a timestamp corresponding to any of the subcycles, and
can in addition have a zero timestamp (OBT/UTC=0) if generated on subcycle #35 or #36
VPA can have a timestamp corresponding to any of the subcycles
VPB can have a timestamp corresponding to any of the subcycles
VPD can have a timestamp corresponding to any of the subcycles
VPE can have a timestamp corresponding to any of the subcycles

Proposed solution:
use directly timestamps for subcycles #1 to #30,
use timestamp for subcycle #30 as timestamp for all verification packets received on apid 160,
if no packets have been received for subcycle #30, use the timestamp of the last subcycle received,
use directly timestamps for AP and IPx packets

Note: the OBT/UTC fields will remain unchanged for all packets,
for verification packets the record start time field of the MDR will be forced to a different subcycle timestamp

Proposed datation/time-stamping order

PX1	PX1	PX1	PX1	PX1	packet	PX1	PX1	PX1	PX1	PX1	PX1						
PX2	PX2	PX2	PX2	PX2	pattern	PX2	PX2	PX2	PX2	PX2	PX2						
PX3	PX3	PX3	PX3	PX3	repeated	PX3	PX3	PX3	PX3	PX3	PX3						
PX4	PX4	PX4	PX4	PX4	for 30	PX4	PX4	PX4	PX4	PX4	PX4		AP				
IP	IP	IP	IP	IP	subcycles	IP	IP	IP	IP	IP	IP		IP32	IP33		IP35	IP36
											VPC						
											VPA						
											VPB						
											VPD						
											VPE						

Table 2 : IASI Instrument Source Packet re-ordering scheme

The on-board time stamp available in the instruments’ packets should not be used. Instead, it is recommended to use the OBT/UTC correlation parameters that are provided as part of the Admin message. See the EUMETSAT web site for details.

The EPS mission control centre maintains the on-board TMUTC source by uploading OBT-to-UTC correlation coefficients at regular intervals. Typically, the resulting accuracy of the TMUTC time stamp is in the order of +/- 0.007 second relative to UTC. However, this typical performance is not guaranteed and reliance on this parameter is not recommended. In light of the above, it is recommended that users strictly use the OBT_ISP time stamp and perform the translation to UTC in their ground processing via the OBT-to-UTC correlation parameters. These parameters will be sent via the ADMIN message and published on the EUMETSAT web pages. The formula for computing UTC based on OBT_ISP and the correlation parameters are described in the Metop Space-to-ground Interface Specification [AD1]

Likewise, the orbit information (state vectors) should be extracted from the Admin Message (APID 6) to perform the geo-location of the data.

Information on Level 1 and Level 2 processing of Metop instruments’ data can be found in the product guides available on the EUMETSAT WEB site (www.eumetsat.int)

4 RECEPTION STATION REQUIREMENTS

EUMETSAT has established a set of baseline recommendations for the "Direct Readout User" of Metop AHRPT data, these recommendations are set out in Section 4.1 "Recommendations on the Performance of an AHRPT User Station" and detailed as requirements in [RD3].

4.1 Recommendations on the Performance of an AHRPT User Station

Baseline requirements:

- A tracking antenna. The satellite tracking function shall be able to track the Metop satellites throughout each satellite pass from the visible horizon (assume less than 5º) to 90º of elevation including zenith pass orbits and an azimuth range of at least 0º to 360.
- Receiver for Demodulation, bit synchronisation and viterbi decoding.
- Front end processor (FEP) to demultiplex the CADU data and reconstruct the instrument source packets .

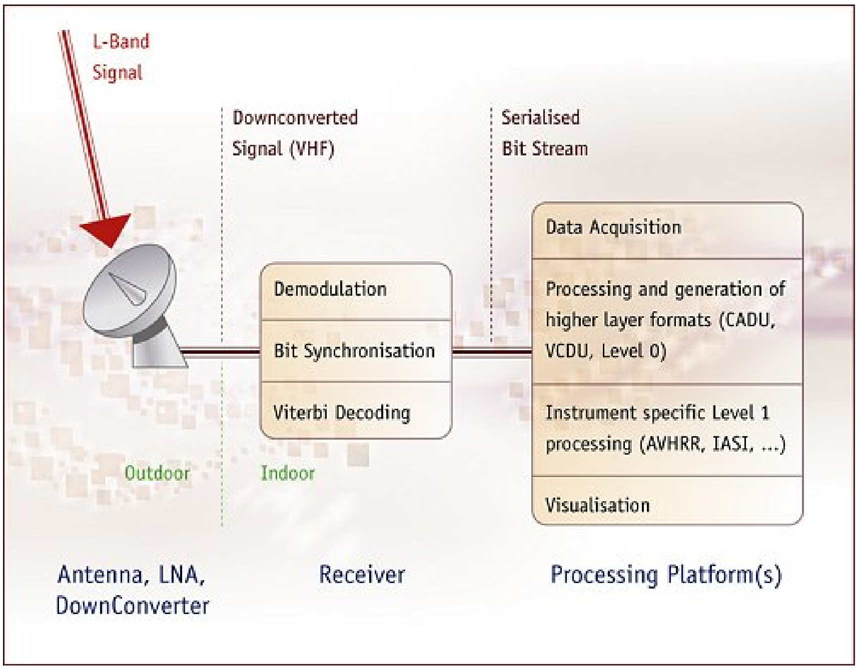

Figure 3 Functional Diagram of an AHRPT User Station

EUMETSAT maintains a list of known manufacturers of User Stations. This list is available from the EUMETSAT Web site, (see section 5.1 for the contact details).

4.1.1 RF Characteristics

Table 3 presents the characteristics of the radio frequency transmissions from the Metop satellites.

	AHRPT
Centre Frequency	1701.300 MHz or 1707.000 MHz
Bandwidth	4.5 MHz (99 % of the total signal power)
Polarisation	RHCP
Data rate	3.5 Mbps/4.666667 Mbps
Total coded data rate	2.3Mbps
Modulation	QPSK FEC 3/4
Satellite Axial Polarization	< 4.5 dB
Power Flux Density evolution during satellite Pass	154 dBW/m2 4 kHz to -133 dBW/m2 1.5 MHz
Carrier Frequency Deviation	$\leq \pm 25\ 10_{-6}$

Table 3 Key characteristics of the L-Band AHRPT MetopA,B & C

4.1.2 Antenna

The following table presents the antenna characteristics to achieve the required figure of merit for a User Station as quoted in Table 4.

	AHRPT
Antenna Type	Parabolic tracking
Antenna Diameter	1.8 m
Azimuth Travel	450°
Elevation travel	–5º to 185º
Azimuth speed	< 20°/s
Elevation speed	< 8°/s
Tracking Accuracy	< 0,1°
G/T @ 5º elevation and clear sky	6 dB/K
Pointing loss	< 0.5 dB
Ground Station axial ratio	< 1 dB

Table 4 Recommended User Station antenna characteristics

The following may permit a reduction of the antenna size:

Use of a better low noise amplifier reducing the system noise temperature;

Use of an antenna system with higher efficiency;

Fine resolution tracking system.

4.1.3 Low Noise Amplifier and Down Converter

The low noise amplifier should be mounted onto the antenna as near to the feed as possible. Normally the (first) down-converter will be integrated with the low noise amplifier. There are no particular recommendations for the choice of intermediate frequencies.

4.2 Data Encryption

Encryption mechanisms are used to control access to parts of the AHRPT data stream during periods of Data Denial, see [AD3]. A set of message keys that allow the activation of an Station Key Unit (SKU) are distributed to the registered user via the Key Dissemination System (KDS) refer to [AD4]. Valid Public Keys are necessary for the operation of the SKU during periods of Metop data encryption.

Only AVHRR, AMSU, HIRS and SEM data will be subject to encryption during periods of Data Denial. Outside periods of Data Denial **all** data will be disseminated in the clear.

4.2.1 Station Key Unit

A Station Key Unit (SKU) is a hardware device required to provide codes used in the decryption of the AHRPT data file during periods of Data Denial see [AD3]. The SKU contains a microprocessor that is pre-programmed with a Master Key which, when combined with the other keys within the AHRPT allow decryption of the data. The keys that are used in the SKU for decryption purposes are so-called DES3 keys, which are composed by concatenation of 3 single DES keys. The keys are numbered Key (1), Key (2) and Key (3) from left to right.

The SKU interface provides a full duplex serial interconnection based on the TIA/EIA RS-422 standard.

For decryption to take place the user needs to load Public Keys into the SKU. The public keys are combined with the master key within the SKU to produce the Pseudo Noise key needed for the DES3 decryption process.

Front - View **Back - View**

Figure 4 The EUMETSAT SKU

Files, which are transmitted in an encrypted form, are then decrypted using the Pseudo Noise Key obtained from the SKU. For each 100th CADU, the SKU has to calculate a dedicated Pseudo Noise Key (PNK).

An SKU is obtained either directly from EUMETSAT or via the station manufacturer where pre-integration is often performed. Full specification of the SKU is provided in [RD4].

EUMETSAT is the sole supplier of SKUs and for each SKU there is a one-off, non-refundable charge of EUR 400. If preferred, the user can request that an SKU is supplied via their chosen manufacturer to allow for pre-integration into their user station. Registration of the User Station with EUMETSAT is mandatory if an SKU is required. .

4.2.2 Key Updates

The PUBLIC keys are updated periodically. When new keys are available the user will be informed automatically via email. The new keys will be placed on a EUMETSAT web server for immediate download by the registered user. This service is password protected. The user name and password will be sent to the user upon registration. This service is known as KDS (Key Dissemination System) documented in [AD4].

The same SKU will be able to handle the keys for Metop A,B &C.

5 USER SUPPORT INFORMATION

5.1 User Notification Service

The User Notification Service (UNS) provides up-to-date orbital information for the Metop and NOAA satellites which form part of the Initial Joint Polar-Orbiting Operational Satellite System (IJPS).

5.1.1 Multi-Mission Administrative Message User Guide

The Multi-Mission Administrative Message (MMAM) contains operational information relevant to users of the Metop HRPT direct broadcast service.

The MMAM is structured to contain administrative information for multiple satellites from multiple missions or programmes. An overview of the structure is provided on the right. A wide range of information is contained for the satellite transmitting the MMAM via its HRPT direct readout signal, including:

- Operational announcements
- Spacecraft and instrument status
- Navigation data, including orbital position, attitude and events
- Processing data, including OBT/UTC time correlation information

For further information on the MMAM either refer to AD8 or search for MMAM on the EUMETSAT web site www.eumetsat.int

5.1.2 Two Line Elements

In addition to the orbital information provided in the Admin Message, EUMETSAT makes available Two Line Elements (TLE) covering a period of roughly 3 days before and 3 days after a planned manoeuvre. The TLE information can be accessed from the UNS pages of the EUMETSAT Web site in either HTML or ASCII format.

5.2 User Registration

Users are requested to register their systems for three important reasons:

- Firstly, it informs EUMETSAT that Users are actively using the Direct Readout service;
- Secondly, it allows EUMETSAT to contact users to inform them on any service enhancements;

- Thirdly, and most important of all, it ensures that relevant points of contact (e.g. email address information) necessary for the delivery of decryption keys during periods of Data Denial are maintained.

Users can register their station via the online registration form available from the EUMETSAT Web site. To obtain up-to-date advice on user registration process, it is recommended that the prospective user first contact the EUMETSAT User Service.

5.3 User Service Helpdesk

The EUMETSAT Web pages, www.eumetsat.int, provide the latest information on the operational data, products and services provided by EUMETSAT. If you require any further information, please contact the EUMETSAT User Service Helpdesk:

Mail:
EUMETSAT User Service
Eumetsat-Allee 1
D - 64295 Darmstadt
Germany

Telephone: +49 (0) 6151 807 366 / 377
Fax: +49 (0) 6151 807379
E-mail: ops@eumetsat.int

Web Site: http://www.eumetsat.int

6 Glossary

A-DCS	Advanced Data Collection System
AHRPT	Advanced High Resolution Picture Transmission
AVHRR	Advanced Very High Resolution Radiometer for visible and infrared imagery, flown in polar orbit
AMSU	Advanced Microwave Sounding Unit
APID	Application Process Identifier
ASCAT	Advanced Scatterometer
CADU	Channel Access Data Unit
CCSDS	Consultative Committee for Space Data Systems
CVCDU	Coded Virtual Channel Data Unit
DES	Data Encryption Standard
DES3	Triple DES encryption
EPS	EUMETSAT Polar System
EUMETSAT	European organisation for the exploitation of meteorological satellites
EUR	Euro
FEP	Front End Processor
GRAS	GNSS Receiver for Atmospheric Sounding
GOME	Global Ozone Monitoring Experiment
HIRS	High Resolution Infrared Sounder
HKTM	House Keeping Telemetery
IASI	Infrared Atmospheric Sounding Interferometer
ICD	Interface Control Document
IJPS	Initial Joint Polar-Orbiting Operational Satellite System
KDS	Key Dissemination System
Mbps	Mega bits per second
MHS	Microwave Humidity Sounder
MHz	Megahertz
NOAA	National Oceanic and Atmospheric Administration (of the USA)
PBK	Public Key
PNK	Pseudo Noise Key
RF	Radio Frequency

RHCP	Right Hand Circular Polarisation
RUS	Reference User Station
SEM	Space Environment Monitor
SKU	Station Key Unit
TD	Technical Description
TLE	Two Line Elements
UG	User Guide
UTC	Universal Time Code
VCDU	Virtual Channel Data Unit
VCID	Virtual Channel Data Unit

APPENDIX A AHRPT SKU Files

A.1 Differences in the SKU files

There are two different types of SKU files. Firstly, there are the files that are supplied, via KDS, to the user community; these files are described in the next section. Secondly, there are the files that are used by the reference User Station (RUS) at EUMETSAT HQ; this format is described later in this Appendix for the sake of completeness. *N.B.* The reference document [RD3] refers to the RUS SKU file format and not the format supplied to the user community.

A.2 User SKU files

The SKU files supplied to users of the Metop direct readout service will be supplied the SKU files in the formats described in this section. The files are made available for download from KDS in one ZIP archive. There are two formats, one XML-marked-up and one plain-text file. Users should use the file format that is required by their User Station. The other file can be ignored.

A.2.1 XML example

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE DECRYPTION_FILE SYSTEM "DOWNLOAD.DTD">
<DECRYPTION_FILE ID="testuser3" DATE="20070227150423">
     <KEYSET CHANNEL="L" SKU="0007" DATE="27 Feb 2007">
          <KN ID="20">
               <PBK>47B6F0986C98379DF1D9212E2F2A7C47990F067914211233</PBK>
               <CRC>5265</CRC>
          </KN>
          <KN ID="21">
               <PBK>8CC081320A6624C7CF4FBAF7D4E50C5747B3894466B174DB</PBK>
               <CRC>00C3</CRC>
          </KN>
     </KEYSET>
     <KEYSET CHANNEL="H" SKU="0008" DATE="27 Feb 2007">
          <KN ID="20">
               <PBK>D029E67127702776BACD3174D20FABCF4CF69811B7DD0017</PBK>
               <CRC>21E3</CRC>
          </KN>
          <KN ID="21">
               <PBK>9242F2D7076EDC6E615C81D95FC446061AA7D631BC27E564</PBK>
               <CRC>AC5D</CRC>
          </KN>
     </KEYSET>
</DECRYPTION_FILE>
```

A.2.2 User SKU file ASCII example

```
Channel: LRPT     SKU: 0007     Date: 27 Feb 2007
Key Number: 20     Public Key:
47B6F0986C98379DF1D9212E2F2A7C47990F067914211233     CRC: 5265
Key Number: 21     Public Key:
8CC081320A6624C7CF4FBAF7D4E50C5747B3894466B174DB     CRC: 00C3
```

```
Channel: HRPT     SKU: 0008     Date: 27 Feb 2007
Key Number: 20     Public Key:
D029E67127702776BACD3174D20FABCF4CF69811B7DD0017     CRC: 21E3
Key Number: 21     Public Key:
9242F2D7076EDC6E615C81D95FC446061AA7D631BC27E564     CRC: AC5D
```

A.3 RUS SKU file XML example

The following XML extract is an example of the format of the SKU file format that is used only for the RUS at EUMETSAT HQ. This format is not made available to end users. It is included here only for completeness, and because some User Station manufacturers have been supplied with copies of the file format.

```
<?xml version='1.0'?>
<!DOCTYPE RUS_Encryption_Keys SYSTEM "RUS_Encryption_Keys.dtd">
<RUS_Encryption_Keys>
     <SKU ID="17">
          <KeyNumber ID="20">

<PublicKey>53CDB7EA3D4F002B53CDB7EA3D4F002B07815B0FAB4FF8B3</PublicKey>
               <CRC>98D3</CRC>
          </KeyNumber>
          <KeyNumber ID="21">

<PublicKey>AA098A5B44BFBAEAAA098A5B44BFBAEA01130BB7847F3588</PublicKey>
               <CRC>2ACB</CRC>
          </KeyNumber>
          <KeyNumber ID="26">

<PublicKey>07815B0FAB4FF8B307815B0FAB4FF8B353CDB7EA3D4F002B</PublicKey>
               <CRC>5D7C</CRC>
          </KeyNumber>
          <KeyNumber ID="28">

<PublicKey>07815B0FAB4FF8B307815B0FAB4FF8B31AC288653F11821C</PublicKey>
               <CRC>4603</CRC>
          </KeyNumber>
          <KeyNumber ID="29">

<PublicKey>01130BB7847F358801130BB7847F3588DF3F2B6EBF29196A</PublicKey>
               <CRC>F8AF</CRC>
          </KeyNumber>
          <KeyNumber ID="2E">

<PublicKey>07815B0FAB4FF8B307815B0FAB4FF8B307815B0FAB4FF8B3</PublicKey>
               <CRC>F7AD</CRC>
          </KeyNumber>
     </SKU>
</RUS_Encryption_Keys>
```

APPENDIX B Metop A AHRPT Switching Parameters

B.1 Service Description

Investigations into the failure of the Metop-A AHRPT side A have concluded that the root cause was heavy ion radiation causing the failure of a component of the AHRPT Solid State Power Amplifier (SSPA). The investigations additionally concluded that the redundant Metop-A AHRPT-B sub-system is likely to suffer a similar problem.

To minimise the risk of failure to the AHRPT-B unit whilst still offering the User community a service, EUMETSAT has decided to implement a "partial" AHRPT service in those areas where the risk of damage from heavy ion radiation is reduced. For southbound passes, the AHRPT side B will be activated for all orbits over the North Atlantic and European area starting at around 60°N. The AHRPT will then be switched off before the spacecraft reaches the Southern Atlantic Anomaly region, at around 10°N. The diagram below indicates the zone of activation of the AHRPT.

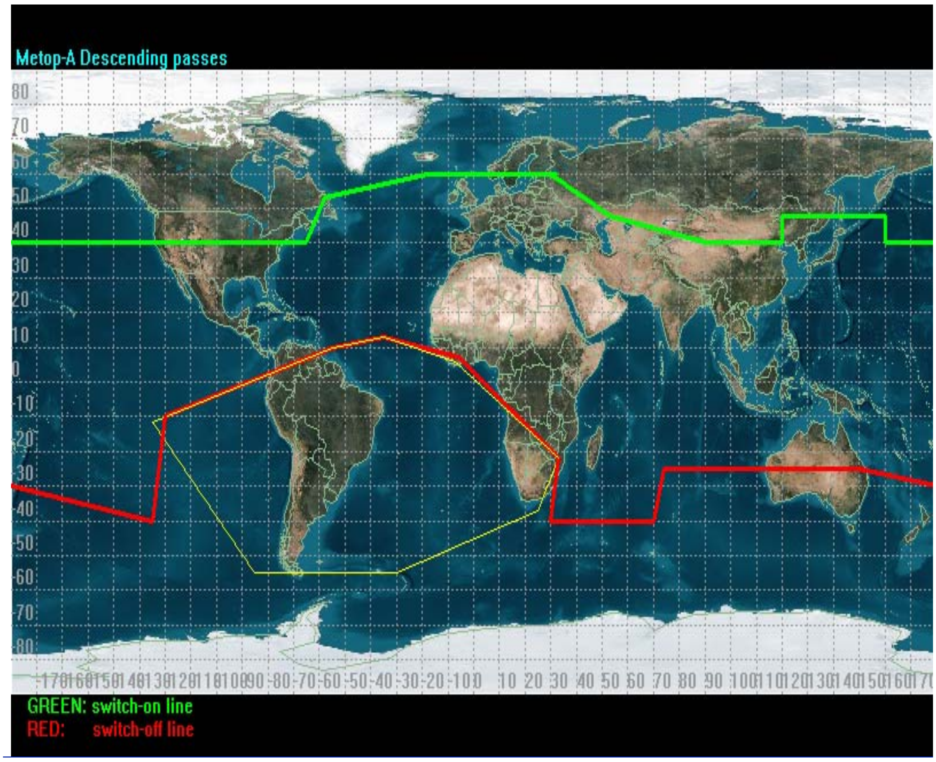

Figure 5 Metop-A HRPT switch zone - Decending Passes (2011)

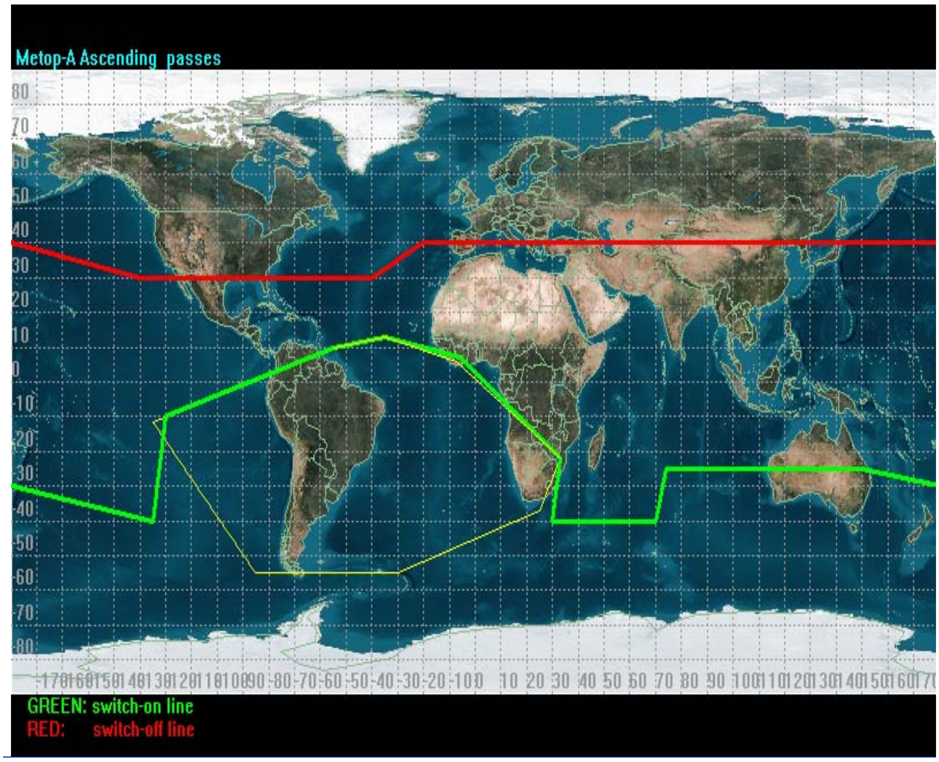

Figure 6 Metop-A HRPT switch zone – Ascending Passes(2011)

The switch-on of the AHRPT service for the descending passes over Europe and North Atlantic region, will allow ASCAT, ATOVS, AVHRR and IASI data to be available in due course from the EARS network of stations.

Specific switch on details are included in the METOP ADMIN message.

A retrofit of the SSPA component which failed on Metop-A has been implemented on both Metop-B and the future Metop-C.