Meteosat Data Collection and Retransmission System

Technical Description
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Preface

The aim of this document is to describe the collection of environmental data from data collection platforms (DCP) and its subsequent distribution to users via Meteosat. The document is divided into two parts:

Part 1 describes the data collection system and gives technical details on DCPs and the format of data messages transmitted.

Part 2 describes how DCP messages are retransmitted using Meteosat dissemination direct to user stations.

This version of the document has been prepared by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), Darmstadt, which is the body responsible for the Meteosat satellite system.

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1.1 INTRODUCTION

The primary missions of Meteosat are:

- image acquisition and dissemination;
- environmental data collection and distribution;
- the relay of meteorological information from various centres;
- the extraction of meteorological products from imagery and their subsequent distribution;
- the relay of images from foreign satellites;
- a data archive and retrieval service.

The collection and distribution of environmental data is achieved via the Meteosat Data Collection System (DCS) by which Meteosat provides a data relay service for data transmitted from sensors located on the surface of the earth and within its atmosphere.

The DCS mission is particularly useful for the collection of data from remote and inhospitable locations where it may indeed provide the only possibility for data relay. Nevertheless, the system still has very many uses in regions with a highly developed infrastructure. The installations required to relay the data tend to be inexpensive, unobtrusive and normally blend easily into the local environment.

The environmental data are usually measured by sensors mounted on a data collection platform (DCP) and transmitted to Meteosat, which, in this case, serves merely as a transponder or data relay. Since Meteosat is located over the equator at a longitude of 0°, the DCS can be used by all DCPs situated within its telecommunications field of view, which is approximately 80° great circle arc of the subsatellite point (see Figure 1.1). The transponded data are received from the satellite at the Primary Ground Station (PGS) and routed to the Mission Control Centre (MCC) located in Darmstadt, Germany, for further data processing and distribution to the users. It is also possible to receive retransmitted DCP data directly using a rather simple reception station. In this case certain DCP data are received in the PGS and automatically retransmitted in near-real time to the data users via the satellite, in the gaps between WEFAX images. Part 2 of this document describes this DCP Retransmission System (DRS).

In order to allow users to operate DCPs in a wider area than the footprint of a single geostationary satellite, the characteristics of the Meteosat DCS are coordinated by the Coordination Group for Meteorological Satellites (CGMS) with the other operators of geostationary meteorological satellites, namely Japan, People’s Republic of China, Russia and USA. This means that each of the satellites (GMS, FY-2B, GOMS and GOES, respectively) operate a DCS system with very similar characteristics to that of Meteosat and share an identical block of 33 (International) DCP frequency channels. This coordinated system is called the International Data Collection System (IDCS).
1.2 SOME APPLICATIONS OF THE METEOSAT DCS

The Meteosat DCS is used to gather a wide variety of measured environmental parameters. The following examples serve to demonstrate some of the possibilities offered by the system. A more complete listing and corresponding descriptions can be found in the user guide “Data Collection System” (see Ref. 1 in Appendix E).

1.2.1 Meteorological Data Collection at Remote Land Sites

The availability of meteorological observations from sparsely inhabited land areas is often poor. The use of automatically operated DCPs in such areas can provide this information, which is essential for accurate weather prediction. This type of DCP station is usually self-contained, i.e. it does not normally require any external ground-based infrastructure such as a power supply, and needs infrequent visits for maintenance purposes.

Meteorological messages from the DCPs are processed in Darmstadt and distributed via the Global Telecommunication System (GTS) of the World Meteorological Organization (WMO) to all meteorological centres requesting the data.

Figure 1.1 Meteosat DCS Coverage Area
1.2.2 Water Management

The management of water resources can be greatly assisted by making use of the DCS. The measurement of precipitation, river flow rates and river level are just some of the parameters that can easily be relayed with a DCP. This type of DCP might also be operated in the alert mode, for example a special message might be transmitted once a particular parameter threshold has been exceeded to warn of impending flood danger resulting from the high water level of a river.

1.2.3 Collection of Meteorological Information from Aircraft

The Aircraft to Satellite Data Relay (ASDAR) programme of the WMO is an example of the use of DCPs in a mobile application. This programme, which is coordinated by the WMO and managed by the UK Met. Office in Bracknell, England, is designed to collect meteorological information from aircraft using specially developed, air-certified platforms installed on wide-bodied aircraft. These platforms store data extracted from onboard avionics systems several times per hour and transmit them hourly throughout the flight.

The data messages provided by the ASDAR DCPs are received as binary data at EUMETSAT. The data is converted to Aircraft Meteorological Data Relay (AMDAR) bulletins for distribution via the GTS. Refer to Annex 15 in the International DCS Users’ Guide (Ref. 3 in Appendix E) for details.

1.2.4 Meteorological Data Collection from Ships

The cost of providing regular upper air meteorological information, such as temperature, humidity and wind speed and direction, over the oceans has been considerably reduced by the introduction of the WMO’s Automated Shipboard Aerological Programme (ASAP). A standard container carried on a merchant ship provides the facility for the semi-automatic launching of a balloon with an attached radiosonde package. Data from the instruments are relayed to the container and thence via a DCP to the satellite and the users.

1.2.5 SEAS Programme

The Shipboard Environmental Data Acquisition System (SEAS) is a programme developed by the National Oceanic and Atmospheric Administration (NOAA) to provide accurate meteorological and oceanographic data in real-time from ships at sea through the use of satellite data transmission techniques. The system transmits data through IDCS channels and is routed to NOAA via the GTS. This is one of the largest programmes using the IDCS channels, currently involving over 300 DCPs.
1.3 DESCRIPTION OF THE DCS

1.3.1 General

Meteosat, located in geostationary orbit at 0° longitude, provides a permanent telecommunications link to all DCPs located within the satellite field of view (see Figure 1.1). Depending upon local topographical features, this can extend to approximately 80° great circle arc of the sub-satellite point, though a more realistic limit is about 75°, corresponding to a ground antenna elevation of 5°. Meteosat’s large permanent area of coverage provides an important advantage when compared with the collection of similar data via the polar orbiting meteorological satellites, which only traverse a particular point of the earth’s surface on average around every 12 hours. Use of the International DCS, described in Ref. 3 in Appendix E, allows coordinated DCP design and message formats, thus permitting the uninterrupted collection of messages from mobile DCPs, such as aircraft, balloons, ships and drifting ocean buoys, to be received and processed by any of the geostationary meteorological satellites which have been located around the globe in such a way that almost continuous telecommunication coverage is possible in most regions of the globe, except the poles.

1.3.2 Types of DCP

Depending upon the timing of data transmissions from the platform, DCPs can be of three types:

**Self-timed** These DCPs transmit at regular intervals controlled by an internal clock, according to a scheduled agreed by the user and the satellite operator. In practice, each hour is divided into time slots of 1 min 30 sec. Included within this slot are two guard bands of 15 seconds which are positioned at the start and end of the one minute DCP message period. 40 time slots are thus available for transmissions each hour of the day. In certain situations, a single 15 second guard band can be inserted between consecutive DCP messages from the same DCP operator, in which case up to 48 transmissions per hour are possible. The purpose of the guard bands is to accommodate any drift over a period of time of the internal clock of the DCP.

**Alert** These DCPs transmit short messages, not exceeding 10 seconds duration, when the value of one or more measured parameters exceeds a preset threshold. The platform will repeat the message two or three times every 10 to 15 minutes in order to reduce the risk of possible interference by other alert DCP messages on the same dedicated channel.

**Hybrid** This is a DCP which combines the self-timed and alert modes of operation.

1.3.3 The Data Collection System

1.3.3.1 Overview

The elements of the Meteosat DCS are shown in Figure 1.2. The DCP first transmits its message to Meteosat in the UHF radio frequency band. The satellite transponds the message and transmits the data to the Primary Ground Station using L-band. The satellite transponder bandwidth has been divided into 66 channels, and depending upon its role, each DCP will be allocated to one of the 66 channels. Since a DCP could report in either self-timed or alert mode, many platforms can share a single channel. At the PGS the messages are received and checked before being routed to Darmstadt.
for processing, short-term archive and distribution. Distribution can be by means of the WMO GTS, or, for non-real time application and when specially agreed with the satellite operator, by magnetic tape, telex, fax etc. Special processing or distribution will normally incur additional costs for the user. The EUMETSAT data policy, including details of charges, can be found in Appendix A.

Users can also obtain information about the operation of their DCPs via the EUMETSAT Internet web server. Authorised users can obtain information about the performance of their DCPs. The capability to download recent message data to their home site is also provided by arrangement with EUMETSAT.

Figure 1.2 The Meteosat Data Collection and Retransmission System
The distribution of DCP messages is also possible using the DCP Retransmission System (DRS). In this system the selected DCP messages received in the PGS are immediately and automatically rebroadcast to users via Meteosat using the gap available between each WEFAX image format. A small modification to a Meteosat Secondary Data User Station (SDUS), used for WEFAX image reception station, will also allow the direct reception of retransmitted DCP messages. Full details of the DRS can be found in Part 2 of this document.

The relay of messages from a DCP, therefore, makes use of the satellite, the PGS, the data processing centre, the data distribution network and the Internet if required. Further details of these components are provided in the following paragraphs.

1.3.3.2 Transmission through the Satellite

DCP data telecommunication is performed using the satellite S/UHF transponder, an electronically despun L-band antenna (since the satellite spins at 100 rpm), a UHF reception antenna and, serving as a back-up, an L-band toroidal pattern transmission antenna.

The DCP messages are received by the satellite in the UHF band between 402.001 and 402.200 MHz and are transmitted to the ground in L-band between 1675.182 and 1675.381 MHz. The UHF antenna is designed to receive circularly polarised transmissions. The antenna hardware consists of four half-wave dipoles wrapped on a dielectric cylinder having a diameter of about one quarter of a wavelength. The four dipoles are inclined at about 22° with respect to the equatorial plane and are fed with equal phase and amplitude.

The EUMETSAT reception system has a number of tolerances that must be observed by DCPs to ensure that their transmissions can be successfully captured. One important tolerance is the channel transmission frequency. Transmissions must be within ±600 Hz of the centre frequency of the allocated channel.

1.3.3.3 Data Transmission through the Ground Station

Satellite transponded DCP messages are received by the EUMETSAT Primary Ground Station (PGS), located in Fucino, Italy. At the PGS, each DCP reception chain (one for each DCP channel) comprises:

- a carrier demodulator with phase-locked loop;
- a bit conditioner including a bit synchroniser;
- a format synchroniser which recognises the 15-bit SYNC word (see Section 1.6) and sums up the report length, adding several quality indicators and the time of receipt of the report before preparing the complete message for relay via the communications link to Darmstadt.

In addition to the reception of user DCP transmissions, the PGS also transmits special reference DCP messages. These are used by EUMETSAT to monitor the performance of the regional DCS channels. One transmission is made per hour on each of the operational DCP regional channels. These transmissions have the platform address 162096C4. Users can also use these transmissions to confirm correct operation of their reception equipment or the channel in which they are allocated. Details of the reference message contents can be found in Appendix C.
1.3.3.4 Data Processing

The DCP messages received by the data processing centre in Darmstadt enter a dedicated data handling system which performs the following functions:

1. Checking the completeness of data blocks.
2. DCP address recognition.
3. Storage of DCP messages and processing information in a temporary buffer at the ground station. This buffer avoids loss of data when the satellite data dissemination subsystem is temporarily not available for any reason, e.g. for one or two hours around midnight during the twice-yearly solar eclipse periods of six weeks in the Spring and Autumn.
4. Monitoring the regular transmissions from dedicated reference DCPs, which provide an indication on each of the operational DCS channels of correct functioning of the transmission and reception chains.
5. Logging of received and processed messages, including any anomalies.
6. Processing of DCP data and bulletin preparation for messages to be sent to the Regional Telecommunications Hub (RTH) in Offenbach as the entry point for distribution via the WMO GTS.
7. Local archiving of DCP data, allowing data retrieval for DCP users for data up to one month old, and for the operation and performance monitoring of the DCS.
8. Generation of a performance database, providing details on the identification and quality of all received DCP messages. This database serves as the primary tool for performance monitoring (e.g. bit error rate, correctness of transmission time, inappropriate use of allocated time slots, evaluation of message quality and time slot administration).

1.3.3.5 DCP User Support

The Meteosat DCS makes use of many facilities available within the EUMETSAT Mission Control Centre (MCC), and support to the user community can be provided 24 hours per day. Personnel dedicated to DCS operations are available during normal (European) working hours, whilst overnight and at weekends limited support can be provided by the MCC shift staff.

During normal operations, the technical performance of DCPs is monitored and parameters such as transmitted power, transmission time and transmission frequency are analysed. This information is available monthly on the EUMETSAT Web site and can be provided to operators on request. Whenever these parameters are out of tolerance ranges the operators of the platform are informed by fax or e-mail in order that they can immediately take the necessary corrective actions. Similarly the platform operators are informed if their platform has ceased operations for a certain period of time.

1.3.3.6 DCS Performance

The mean availability of the DCS is specified as better than 95%. This means that the users can expect that 95% or more of the messages successfully transmitted by their DCP will be received, processed and distributed.
Occasionally, there may be temporary radio interference with a DCP channel resulting in message corruption. In this case the user is informed and is invited to transfer the operation of the DCP to an interference-free DCS channel, usually with the same time slots.

The time between DCP message reception and distribution through the GTS can vary between a few minutes and one hour and is a function of the actual time of transmission and the bulletin processing schedule. Received alert DCP messages and self-timed messages specified for immediate bulletin distribution are processed and distributed within a few minutes of reception.

1.3.3.7 DCP Data Distribution

Facilities provided for the distribution of DCS messages relayed via Meteosat are:

- data transmission via the GTS;
- DCP Retransmission System (DRS) (see Part 2);
- as a back-up, DCP messages are also available for downloading from the Internet via the EUMETSAT Web server.

The Meteosat ground data processing computer is connected to the GTS using a 64 kbit/s data link between the MCC and RTH Offenbach, operated with an X.25, level 3 protocol (HDLC-LAPB). The RTH in Offenbach distributes the messages according to a prefixed routine procedure on the GTS Main Trunk or to other meteorological centres as specifically agreed. See Appendix B for the recommended coding for GTS messages.
1.4 RESPONSIBILITIES OF EUMETSAT AND OPERATORS

This section describes the responsibilities of EUMETSAT (as DCP Coordinator) and of the DCP operator. The International DCS Users’ Guide (Ref. 3 in Appendix E) also provides details of EUMETSAT and operator responsibilities.

1.4.1 EUMETSAT Responsibilities and Services

EUMETSAT is responsible for assigning DCP addresses and transmission schedules for use by DCP operators.

EUMETSAT can provide operators with information on the performance of their DCPs to assist operators to resolve any problems with their DCPs. Information such as number of messages received per day, carrier level, frequency offset and modulation index can be provided. These data are available for the previous month of operations.

EUMETSAT will monitor DCP transmissions to ensure transmissions are being made in accordance with agreed time slots and transmission characteristics, and also that they are continuing to operate. In particular EUMETSAT will inform operators:

- if any of their DCPs are not transmitting in accordance with the agreed schedule (out-of-slot);
- if any of their DCPs are exhibiting bad transmission characteristics such as:
  - low carrier level,
  - excessive offset of frequency from nominal channel centre,
  - wide variations in modulation index;
- of prolonged periods of non-reception of transmissions from any of their DCPs such that they are being considered for deallocation (discipline).

EUMETSAT will monitor the performance of DCPs in terms of percentage of allocated slot usage. Operators will be informed of DCPs found to be performing below nominal to help identify DCPs with possible transmission problems.

EUMETSAT will monitor the performance of the whole DRS system for external interference. If necessary affected DCPs will be reallocated to another channel.

1.4.2 Operator Responsibilities

The DCS is dependent upon operators running their DCPs in accordance with EUMETSAT guidelines for the successful operation of the system. It is therefore important that operators rectify any problems with their DCPs as quickly as possible to minimise any impact on other users of the system.

Operators can contact EUMETSAT to ask questions on any issues relating to DCPs. These include information on allocation of new DCPs and queries on the performance of their DCPs.

Operators should perform regular checks on their DCPs to ensure that they are transmitting in accordance with the agreed schedule.
Operators should respond to communications from EUMETSAT such as notification of out-of-slot transmissions or bad transmission characteristics.

Operators should inform EUMETSAT of any change in status of their DCPs such that they will not be transmitting for an extended period (greater than three months). This is to ensure disciplinary action is not taken.

Operators should inform EUMETSAT of any changes to the point of contact for their DCPs. This is to ensure that EUMETSAT can efficiently inform operators of any observed problems with their DCPs.

Operators should inform EUMETSAT if slots are no longer required or they no longer intend to operate any of their DCPs. The DCP slots can then be deallocated and assigned to another user.

1.4.3 Operation Guidelines

1.4.3.1 Out-of-slot

EUMETSAT will inform operators of any regular out-of-slot transmissions as soon as they are noted.

Operator should confirm the receipt of out-of-slot notification within one week detailing the planned date of correction. This is particularly important if the DCP cannot be adjusted immediately so that EUMETSAT can take necessary action on behalf of other operators.

If EUMETSAT has not received any confirmation of out-of-slot behaviour after one week from notification, the DCP will become subject to disciplinary actions. These actions will include disabling retransmission of messages from the DCP.

1.4.3.2 Discipline

DCPs should transmit on a regular basis. Any DCP that does not transmit for a three month period, unless by prior agreement, will be subject to deallocation.

EUMETSAT will inform operators of DCPs that have not transmitted for three months. If no reply or suitable plan is received within a further month then the operator will be contacted again and deallocated shortly after.
1.5 DCP MESSAGE CHARACTERISTICS

DCP transmissions are limited to a maximum duration of 60 seconds and each transmission is called a DCP message. In certain applications, data collected over a period of time between transmissions could be compiled and stored in a data buffer and released to the transmitter just prior to the time of transmission. Therefore, one DCP message could contain several sets of data or reports.

In the alert mode, a DCP message transmission is restricted to a maximum duration of 10 seconds, to reduce the risk of interference with other alert transmissions using the same frequency.

The message format is shown in Table 1.1 below.

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Preamble</th>
<th>Sync code</th>
<th>Address</th>
<th>Self-timed Data</th>
<th>EOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 seconds</td>
<td>250 bits</td>
<td>15 bits</td>
<td>31 bits</td>
<td>up to 5192 bits</td>
<td>31 bits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Preamble</th>
<th>Sync code</th>
<th>Address</th>
<th>Alert Data</th>
<th>EOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 seconds</td>
<td>250 bits</td>
<td>15 bits</td>
<td>31 bits</td>
<td>up to 184 bits</td>
<td>31 bits</td>
</tr>
</tbody>
</table>

Table 1.1 Message Characteristics of Self-timed and Alert DCP Messages

The elements of the DCP message are:

**Carrier** Unmodulated, lasting 5 seconds. This period of time allows the appropriate Primary Ground Station DCS receiver to lock onto the carrier.

**Preamble** Containing 250 alternating 0 and 1 bits, the preamble permits the receiver bit conditioner and synchroniser to acquire the bit rate and lock onto it.

**Sync code** A 15-bit Maximal Linear Sequence (MLS) synchronisation word:

\[(FTB) 1000 1001 1010 111 (LTB)\]

\[
FTB = \text{First Transmitted Bit} \\
LTB = \text{Last Transmitted Bit}
\]

**Address** A 31-bit Bose-Chaudhuri-Hocquenghem (BCH) coded word. This address word uniquely identifies the DCP. The first 21 bits are the address itself, the remaining 10 are derived from the first 21 bits and serve as an error check.

When applying for admission to the DCS, an address is uniquely assigned to the platform to identify the originator of the message. The address is generated in hexadecimal coding, in such a way that the user can easily identify several characteristics of the DCP, as shown in the following:
i) The first 4 bits denote the admitting authority for the platform. For example, EUMETSAT has been allotted three codes (though only one and two are currently used):

- EUMETSAT 0001 Hex code 1
- " 0010 Hex code 2
- " 0011 Hex code 3

The other geostationary meteorological satellite operators have been allotted different codes (see the International DCS Users’ Guide (Ref. 3 in Appendix E) for details).

ii) The second set of 4 bits denotes the type of platform:

- International DCS aircraft 0000 Hex code 0
- International DCS ship 0001 Hex code 1
- Regional self-timed land 0110 Hex code 6
- Regional alert land 1110 Hex code E

Other address codes may be added to this list as required.

iii) The third to the fifth sets of 4 bits uniquely identify the platform.

iv) The 21st bit is always set to 0.

v) The remaining 10 bits are used for error checking.

**Data**

Maximum of 5192 bits (649 eight-bit words or bytes) in self-timed messages and a maximum of 184 bits (23 eight-bit words or bytes) in alert messages.

Transmissions may use full 8 bit coding (binary) transmissions, or may be limited to a specific code subset such as ASCII, BCD etc. If the message data field contains other than ASCII data, it is the responsibility of the DCP to avoid the unique EOT sequence (e.g. by a bit-stuffing mechanism) within the data field to avoid interruptions in the message reception. Binary type transmissions can only be accessed by users via DCS retransmissions.

For alert messages the message data field should contain four repeats of the synchronisation and address words.

If the message data are to be distributed via the GTS then the International Alphabet No. 5 code (IA5) must be used. This is the only coding acceptable to the GTS. The WMO publication on GTS codes should be used as a guide for the formatting of these types of messages (see Ref. 2 in Appendix E). The recommended data format is the abridged version of IA5 coded using eight bits per character (see Table B.1).

One exception to the above rule is the distribution of ASDAR transmissions as AMDAR GTS bulletins. A special agreement has been reached with the WMO whereby binary data transmissions from ASDARs are processed and converted into the IA5 coded GTS bulletins.
The bit numbering shall follow the convention:

- \( b_1 \) is transmitted first and contains the LSB
- \( b_8 \) is transmitted last and contains the MSB.

If the data field is IA5 coded, \( b_8 \) shall contain a parity bit used for error detection. The parity bit shall be set to make the parity of the byte odd, i.e. \( b_8 = 0 \) if \( b_1 \) through \( b_7 \) contain an odd number of ‘ones’.

**EOT**

End of Transmission sequence, comprising 31 bits. The first 8 bits are the End of Text (EOT) character of IA5.

(FTB) 0010 0000 1011 1011 0101 0011 1100 011 (LTB)
1.6 DCP UP-LINK CHARACTERISTICS

DCP messages are transmitted to Meteosat in the 402 MHz part of the UHF radio frequency band. The characteristics of the transmissions are described in the following sections. The technical specifications apply typically over the temperature range of -20°C to +50°C and over one year.

1.6.1 Modulation Technique

The DCP data rate is 100 bps. It shall have a long-term and temperature stability better than 50 parts per million (ppm).

The carrier is phase modulated by the serial bit stream, the index of modulation being 60°. The phase of the unmodulated carrier should correspond to 0°. Since the message data are Manchester coded, the datum "0" consists of a +60° carrier phase shift for 5 msec followed by a -60° carrier phase shift, also for 5 msec. The datum "1" consists of a -60° carrier phase shift for 5 msec (see Figure 1.3 for details).

The data asymmetry shall not exceed ±1% of the bit period (this equals ±0.05 msec).

![Figure 1.3 Definition of the Modulation](image)

It is recommended that a 300 Hz two-pole Bessel pre-modulation filter be included. In the absence of such a filter, the modulation index shall be 60° with a tolerance of 0% to -10%. When the filter is included, the modulation index shall be such that a carrier reduction of between 6 dB and 4.6 dB is achieved.

1.6.2 Radiated Power

The radiated power is such that the power flux at the spacecraft is -145 dBW.m⁻² ±5 dB. The design of the DCP must ensure that the maximum allowed power flux, under any combination of operating conditions is not exceeded. The Effective Isotropic Radiated Power must, therefore, not exceed 52 dBm.
1.6.3 Antenna Polarisation

The antenna polarisation should be right-hand circular and have an axial ratio of equal to or less than 6 dB on axis.

1.6.4 Transmission Frequencies

The transmission frequencies dedicated to DCPs are located in the UHF band between 402.001 MHz and 402.200 MHz. The bandwidth of the Meteosat transponder is split into 66 channels each with a bandwidth of 3 kHz. 33 of these channels are common to all geostationary meteorological satellites and are called “International Channels”. The remaining 33 channels are allocated for local use within the field of view of Meteosat and are called “Regional Channels”. Regional and International Channel frequencies are shown in Table 1.2.

<table>
<thead>
<tr>
<th>Channel Number</th>
<th>Frequency (MHz) International</th>
<th>Frequency (MHz) Regional</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>402.0025</td>
<td>402.1015 ***</td>
</tr>
<tr>
<td>2</td>
<td>402.0055</td>
<td>402.1045 ***</td>
</tr>
<tr>
<td>3</td>
<td>402.0085</td>
<td>402.1075 ***</td>
</tr>
<tr>
<td>4</td>
<td>402.0115</td>
<td>402.1105</td>
</tr>
<tr>
<td>5</td>
<td>402.0145</td>
<td>402.1135</td>
</tr>
<tr>
<td>6</td>
<td>402.0175</td>
<td>402.1165</td>
</tr>
<tr>
<td>7</td>
<td>402.0205</td>
<td>402.1195</td>
</tr>
<tr>
<td>8</td>
<td>402.0235</td>
<td>402.1225</td>
</tr>
<tr>
<td>9</td>
<td>402.0265</td>
<td>402.1255</td>
</tr>
<tr>
<td>10</td>
<td>402.0295</td>
<td>402.1285</td>
</tr>
<tr>
<td>11</td>
<td>402.0325</td>
<td>402.1315</td>
</tr>
<tr>
<td>12</td>
<td>402.0355</td>
<td>402.1345</td>
</tr>
<tr>
<td>13</td>
<td>402.0385</td>
<td>402.1375 *</td>
</tr>
<tr>
<td>14</td>
<td>402.0415</td>
<td>402.1405</td>
</tr>
<tr>
<td>15</td>
<td>402.0445</td>
<td>402.1435 *</td>
</tr>
<tr>
<td>16</td>
<td>402.0475</td>
<td>402.1465</td>
</tr>
<tr>
<td>17</td>
<td>402.0505</td>
<td>402.1495</td>
</tr>
<tr>
<td>18</td>
<td>402.0535 **</td>
<td>402.1525</td>
</tr>
<tr>
<td>19</td>
<td>402.0565</td>
<td>402.1555</td>
</tr>
<tr>
<td>20</td>
<td>402.0595</td>
<td>402.1585</td>
</tr>
<tr>
<td>21</td>
<td>402.0625</td>
<td>402.1615</td>
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<tr>
<td>22</td>
<td>402.0655</td>
<td>402.1645</td>
</tr>
<tr>
<td>23</td>
<td>402.0685</td>
<td>402.1675</td>
</tr>
<tr>
<td>24</td>
<td>402.0715</td>
<td>402.1705</td>
</tr>
<tr>
<td>25</td>
<td>402.0745</td>
<td>402.1735</td>
</tr>
<tr>
<td>26</td>
<td>402.0775</td>
<td>402.1765</td>
</tr>
<tr>
<td>27</td>
<td>402.0805</td>
<td>402.1795</td>
</tr>
<tr>
<td>28</td>
<td>402.0835</td>
<td>402.1825</td>
</tr>
<tr>
<td>29</td>
<td>402.0865</td>
<td>402.1855</td>
</tr>
<tr>
<td>30</td>
<td>402.0895</td>
<td>402.1885</td>
</tr>
<tr>
<td>31</td>
<td>402.0925</td>
<td>402.1915</td>
</tr>
<tr>
<td>32</td>
<td>402.0955</td>
<td>402.1945</td>
</tr>
<tr>
<td>33</td>
<td>402.0985</td>
<td>402.1975</td>
</tr>
</tbody>
</table>

* = reserved for alert mode
** = reserved for ASDAR monitoring
*** = reserved for link monitoring

Table 1.2 DCP Channel Frequency Allocation
1.6.5 Transmit Frequency Stability

The DCP transmitting carrier frequency shall be better than 1.5 ppm for temperature and aging combined.

The integrated phase noise on the transmit carrier shall be less than 3° rms when measured through a phase locked loop two-sided noise bandwidth (2BL) of 20 Hz and within 2 kHz.

1.6.6 Electromagnetic Interference

Any spurious DCP transmitter emissions, when measured with modulation, shall be down from the unmodulated carrier level by 60 dB (referred to a measurement bandwidth of 500 Hz).

1.6.7 DCP Reporting Time

In order to maintain a well regulated use of available DCP channel frequencies a system of slot allocation has been adopted. In this system a specific one minute message time slot or a sequence of one minute message time slots is allocated within a DCP channel. It is, therefore, imperative that a self-timed DCP transmits according to the agreed time slot, otherwise there will be conflict with transmissions from neighbouring DCPs and data from both the erroneous and the neighbouring DCP will be lost or severely corrupted. In the case of alert DCPs, EUMETSAT will authorise use of a dedicated alert channel frequency and specify the repetition rate of the message (see below) to ensure a high probability of successful transmission of the message. There are, of course no fixed time slots for alert DCPs. The allocation of time slots and channel frequencies to all types of DCP is normally the responsibility of EUMETSAT and a formal registration and allocation procedure has been established for this purpose (see Section 1.7.3).

The DCP shall incorporate a “fail-safe” design feature in order that a malfunction of the equipment shall in no way cause continuous transmission (e.g. by removal of the supply voltage from the final power amplifier).

1.6.7.1 Self-timed DCP

For a self-timed DCP, and depending upon the application, the schedule of transmissions could range from several time slots per hour to one time slot per 24 hours. Each hour is normally divided into 40 time slots (see, however, Section 1.3.2) and each message must be completed within the given time slot. Since the maximum duration of a DCP message is one minute, 30 seconds is available to serve as a guard band between successive messages, in order to allow some margin for long-term drift of the DCP internal clock.

1.6.7.2 Alert DCP

In the case of an alert DCP, transmissions use a dedicated channel which is never used for self-timed DCPs. Although the duration of the message is limited to a maximum of 10 seconds, it is possible that two or more alert messages could overlap. In this case, as stated above, both messages would normally be lost. In order to reduce the risk of this occurrence, alert platforms repeat their messages several times at fixed intervals over a period of, for example, 10 to 20 minutes. The strategy for the number of repeats and their intervals depends upon the number of alert DCPs and the channel loading. These parameters are provided by EUMETSAT at the time of DCP admission.
1.6.7.3 Reference DCP

The reference DCP is a DCP transmission made from the EUMETSAT PGS. It has a specific data content that can be used to monitor for bit errors on the transmission channel. One transmission is made per hour on each of the operational DCP channels. These transmissions are made with address 162096C4. Details of the reference message contents can be found in Appendix C.

1.7 DCP DESIGN, CERTIFICATION AND ADMISSION

All DCPs have to be certified by the satellite operators for use with the DCS of Meteosat and all other geostationary meteorological satellites. Manufacturers requiring certification of a particular DCP for use solely with Meteosat should contact EUMETSAT for all the necessary information and documentation relating to DCP certification and DCS admission procedures. The certification of DCPs using the IDCS can be carried out by any of the geostationary meteorological satellite operators. Points of contact, with addresses, are given in Ref. 3 in Appendix E.

1.7.1 DCP Design

A DCP which is to operate in a wide range of environmental conditions with Meteosat and the other geostationary meteorological satellites requires careful design. Additionally, DCP operation must not disturb the operation of the satellite transponder or other DCP platforms using the system. Manufacturers should, in particular, pay special attention to the following critical features of DCP design:

- stability of RF frequency;
- stability of the clock used to initiate transmissions;
- safety measures to prevent transmission whenever the above features are incorrectly set;
- capability to operate in a very wide range of environmental conditions.

1.7.2 DCP Certification

Several manufacturers are now producing DCPs which are used for an increasing range of applications (a list of DCP equipment manufacturers can be obtained from EUMETSAT). Whenever a new or modified DCP is brought onto the market it must be certified, i.e. it must undergo a series of tests to ensure that it is both technically and operationally compatible with Meteosat and the other geostationary meteorological satellites.

For the purpose of certification, the DCP is defined as a DCP radio set and an antenna. The certification of DCP radio sets which will operate solely with Meteosat is performed by EUMETSAT.

Once a DCP has achieved type certification, it may be marketed without the need for further certification tests, provided the design is not altered in any way and that the DCP assembly as a whole
meets the specified performance standards. In the event that any modifications or design changes are made which might affect the performance of the equipment, a prototype, with full documentation of changes and modifications, must be submitted to EUMETSAT for testing and re-certification.

1.7.3 DCP Admission

Whilst the process of certification will establish the compatibility of the new DCP radio set design with the satellite, the process of admission formally establishes the support provided by the satellite operator to the operator(s) of the deployed DCP.

The objectives of certification and admission are clearly different, therefore, the application for either process are carried out totally independently, and possibly by separate agencies. Subject to acceptance of a particular model of DCP by the satellite operator, and an authorised use of the DCS channel frequencies by the DCP, the DCP operator will be allocated one or more time slots, channel frequency and an address to identify each DCP. For International DCPs, the user support also includes coordination of the admission into the IDCS with the other geostationary meteorological satellite operators.

Every DCP operator requesting admission to the DCS will be required to complete an admission form which requests full details of the DCP operator, the equipment to be used, the time slots required, the type of data to be transmitted and the preferred method of data distribution.

Furthermore, if the distribution of messages from the DCP requires use of the GTS, the applicant will be required to inform EUMETSAT of the appropriate bulletin header to be used.

**It should be noted that each DCP operator is responsible for obtaining any necessary transmitting or operator licences from their national PTT or other similar responsible agencies.**
PART 2 METEOSAT DCP RETRANSMISSION SYSTEM

2.1 INTRODUCTION

As stated earlier in this document, the primary method of relaying DCP messages was originally the GTS operated by the WMO. This method was complemented by the occasional use of telex relay in specially agreed cases and by the mailing of magnetic tapes or computer printout.

It soon became clear that these facilities would not satisfy all user requirements of the system. The main shortcomings were:

- Use of the GTS is limited to messages of general interest to meteorological services and all transmissions have to follow WMO coding and transmission procedures. Additionally, since there is normally only one access point to the GTS in each country, usually the National Meteorological Service, only a limited number of DCP users can, in practice, be connected to the GTS.

- The main disadvantage of DCP data distribution on public telex networks is the high real time workload, the low transmission rate and the complicated recharging of costs originating from this form of data distribution.

- Mailing of magnetic tapes or computer printout can only be accepted by users not requiring data in near-real time. This method of data distribution also involves relatively high manpower costs.

As a result of these shortcomings a new method of distribution was developed which would allow DCP users to receive DCP messages at any location within the Meteosat telecommunication field of view, in near real-time using a relatively low cost reception station. Furthermore, existing Meteosat SDUS (for WEFAX reception) stations can, with minor modification, be converted to a DCP reception station. This system is called the DCP Retransmission System (DRS) and is described in detail in the following sections.

Reference should also be made to the EUMETSAT document “Meteosat WEFAX Dissemination” (see Ref. 5 in Appendix E).
2.2 SYSTEM DESCRIPTION

Please refer back to Figure 1.2 for an overview of the total system.

DCP messages arriving at the Primary Ground Station are, by previous agreement with EUMETSAT, selected for retransmission through the satellite by being routed to a special processing unit at the station. Selection is performed on the basis of look-up tables of DCP addresses. All DCPs listed in these look-up tables have their data stored in a buffer and transmitted in time sharing mode as soon as possible after reception over one of the Meteosat image dissemination channels. Either of the channels could be used, but only one at a time. For the foreseeable future only dissemination channel A1 – used for WEFAX image dissemination (1691 MHz) – will be used for DCP retransmission.

The DCP messages are transmitted in the gap of 26.5 seconds between consecutive WEFAX formats. If there are no WEFAX formats being transmitted or satellite ranging activities are not in progress, the DCP messages could be continuously transmitted for a much longer period of time. There are at least 15 of these 26.5 second retransmission slots per hour and the transmission bit rate is 12500 bit/s.

2.3 DATA FORMAT

DCP messages transmitted by the DRS are packed as HDLC frames using the ‘DCP retransmission type’ of modulation as defined in Section 2.5. A label indicating the time of reception of the DCP message at the ground station is added to the information field of the retransmitted message. The HDLC frames of every stored message are chained and transmitted until the buffer is empty. After transmission of the complete contents of the DCP message buffer the modulation will switch back to ‘WEFAX type’. During this idle stage the carrier is frequency-modulated with the 2.4 kHz WEFAX subcarrier containing pseudonoise. Each time new DCP messages arrive in the gaps between WEFAX formats a new switch to the ‘DCP retransmission type’ of modulation will be performed. This procedure continues until the next WEFAX format starts.

A new WEFAX format will be delayed by up to a maximum of 500 msec to allow completion of the latest DCP transmission. Whenever there is an interruption in the flow of WEFAX formats (e.g. during breaks in dissemination and around local midnight during the eclipse periods) the DCP messages selected for retransmission are buffered and then automatically transmitted as soon as dissemination is resumed in the way described above.
2.4 HDLC FRAME STRUCTURE

The HDLC frame used for DCP data retransmission consists of the following fields:

<table>
<thead>
<tr>
<th>Opening flag</th>
<th>Address</th>
<th>Control</th>
<th>Information</th>
<th>Frame Check Sequence</th>
<th>Closing Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>01111110</td>
<td>11111111</td>
<td>8 bits</td>
<td>120 to 5312 bits</td>
<td>16 bits</td>
<td>01111110</td>
</tr>
</tbody>
</table>

Table 2.1 Structure of HDLC Frame for DCP Retransmission

The elements of the frame are:

**Opening flag**

To allow sufficient time for the bit synchroniser to acquire the bit clock, a sequence of 2048 continuous 8-bit flags (each set to 0111 1110) is transmitted prior to the first message frame in a transmission slot. This type of preamble is sent after each switch from ‘WEFAX type’ to ‘DCP retransmission type’ of modulation. The opening flag is not used between chained frames.

**Address**

This is a standard field in the HDLC procedure, but it is not used in DCP message retransmission. The field is always set to 1111 1111. **This should not be confused with the 31-bit BCH coded DCP address.**

**Control**

The first bit is always set to zero, the remainder are used as a frame counter. The least significant bit (LSB) is sent first.

**Information**

This field contains:

- timing information of data reception;
- one complete DCP report per HDLC frame;
- fill bits, to make up whole number of bytes.

The timing data are transmitted in BCD digits with the LSB first. The DCP messages are transmitted as received, but fill bits (zeros) are added to make up a whole number of bytes, following the address (one fill bit) and the End of Text (variable number of fill bits). The structure of the information field is shown in Table 2.2.

The information field contains one complete DCP message, as received at the Primary Ground Station, including the address and EOT, followed by fill bits to round up the total data to a whole number of bytes. The length of the information field can vary between 120 bits (15 bytes) to 5312 bits (664 bytes). Zeros are used as filling bits after the day units, the platform address and the EOT sequence.

It should be remembered that HDLC transmits the LSB first. However, in the convention adopted for describing the **Address** word of a DCP...
transmission, the MSB is transmitted first. This can lead to confusion when decoding messages retransmitted via the WEFAX channel. For example, the bit sequence in bytes 7 – 10, producing the hexadecimal dump of the address, should be reversed. Otherwise, a platform with hexadecimal address 265026B8 would incorrectly appear as 640A641D.

<table>
<thead>
<tr>
<th>Byte offset</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>x 100 day</td>
</tr>
<tr>
<td>1</td>
<td>x 1 day</td>
</tr>
<tr>
<td>2</td>
<td>x 10 hour</td>
</tr>
<tr>
<td>3</td>
<td>x 10 min</td>
</tr>
<tr>
<td>4</td>
<td>x 10 sec</td>
</tr>
<tr>
<td>5</td>
<td>x 100 msec</td>
</tr>
<tr>
<td>6</td>
<td>x 1 msec</td>
</tr>
<tr>
<td>7–10</td>
<td>DCP address</td>
</tr>
<tr>
<td>11–663 (max)</td>
<td>DCP message (variable) + fill bits to complete last line</td>
</tr>
</tbody>
</table>

Table 2.2 Information Field in HDLC Frame

**Frame check sequence** This field contains a check value computed from the bits contained in the **Address, Control** and **Information** fields. The generating polynomial is:

\[ G(X) = X^{16} + X^{12} + X^5 + 1 \]

Full details of the generating algorithm may be found in Ref. 4 in Appendix E.

**Closing flag** Identical to the opening flag, acts as the opening flag of the next frame.

**Premature termination of a frame** is indicated by the transmission of a short sequence of seven continuous 1-bits. In order to distinguish between sequences of six or seven 1-bits in the data and the flag or abort code, a 0-bit is inserted by the processor after all sequences of five adjacent 1-bits, except in the flag and abort codes.

The HDLC coding/decoding processor performs the following main tasks at the transmission site: formatting, flag, frame and check sequence generation, and zero insertion. The corresponding decode of the data stream at the user station is normally accomplished using standard large scale integrated circuits for HDLC.
2.5 MODULATION

In order to have compatible signals for both WEFAX and DCP retransmissions and hence a single receiver and demodulator for both signals at the user station, a pulse code modulated (PCM) signal is generated from a sine squared wave form with a sign according to the bit value. The signal is calculated as follows:

\[ S(t) = D(t) \sin^2(\pi f t) \]

where

- \( S(t) \) = PCM signal
- \( D(t) \) = ± (NRZ data signal)
- \( f \) = bit rate
- \( t \) = time.

Data signal transitions occur at the zeros of the sine squared wave form.

The signal is phase modulated on the RF carrier and is suitable for demodulation by a WEFAX receiver with slightly increased IF bandwidth. The recommended bandwidth of 30 kHz for WEFAX receivers should be increased to 37.5 kHz for DCP data reception.

Figure 2.1 shows the video result of demodulating the transmission signal. The upper graph shows the PCM signal as transmitted by the satellite for a set of eight bits: 0101 1110. The lower graph is the corresponding video signal output from the frequency discriminator.
Figure 2.1  PCM Signal and Video Signal
2.6 RECOMMENDATIONS ON THE PERFORMANCE OF A DRS RECEPTION STATION

The configuration of an SDUS modified to allow the capability for reception of DRS data is shown in Figure 2.2.

The full technical specification of the WEFAX SDUS can be found in EUMETSAT document “Meteosat WEFAX Dissemination” (Ref. 5 in Appendix E); however the most significant technical recommendations and specifications are repeated in the following paragraphs.

2.6.1 Front-end

As for an SDUS, the recommended $G/T$ ratio is $2.5 \text{ dBK}^{-1}$.

2.6.2 Bit Synchroniser/HDLC Processor

Typically, an input frequency of $137.5 \text{ MHz}$ is suitable. Since the possibility exists that DCP message retransmission may take place on either of the two Meteosat dissemination channels, it would be an advantage to already foresee two appropriate input frequencies. The recommended bandwidth is $37.5 \text{ kHz}$ and the bit rate is $12500 \text{ bit/s}$. 

Figure 2.2 DCP Receiving Station Configuration
Integrated bit synchroniser/HDLC processors suitable for use in DRS reception stations are available from several manufacturers.

### 2.6.3 Microcomputer

These days there is a wide selection of microcomputers and peripherals available at relatively low cost. For storage of DCP messages a hard disk is suitable as a mass storage facility. A DRS reception station running at full capacity would produce a maximum of about 500 kilobytes of data per hour, on the assumption that only the 26.5 second time gaps between consecutive WEFAX formats are used for retransmission.

The reader should note that the storage of continuous data retransmission, in longer time periods, would naturally require greater mass storage capability. A typical situation frequently occurs twice per year during the Spring and Autumn eclipse periods around local midnight when the satellite is in the earth’s shadow. Because of the need to conserve on-board power during this period which could last up to three hours, the dissemination of images and the retransmission of DCP messages is turned off. However, all DCP messages are still directly received and stored at the PGS, via the constant primary telecommunication channel from the satellite, until the end of the eclipse period when they are retransmitted as soon as possible and in a continuous stream.

Data input to the microcomputer could be performed either by the integration of the bit synchroniser/HDLC processor board into the system (i.e. the module would be plugged into the system bus) or via a standard communication link such as RS 232 from a separate bit synchroniser/HDLC processor unit to a microcomputer port.

The software should run under a simple real time monitor or a commercially available operating system. In any case, I/O drivers and output data formatting routines will be required. Other requirements will vary with the needs of the user.
Appendix A  Data Policy for the Use of DCP

1. DCP channels are available free of charge to National Meteorological Services of the EUMETSAT Member States*. The National Meteorological Services may use the channels for their own purposes.

2. DCP channels are also freely available for meteorological messages by the National Meteorological Services of non-EUMETSAT Member States, WMO and ECMWF if these messages are to be transmitted by the Global Telecommunication System of the WMO.

3. Geophysical and hydrological messages can be transmitted freely by National Meteorological Services of non-EUMETSAT Member States, WMO and ECMWF if they form part of WMO programmes.

4. Other users are charged in accordance with conditions and tariffs agreed by the EUMETSAT Council on a case by case basis.

5. In the case where demand is expected to exceed the availability of DCP channels, the EUMETSAT Council will review the above rules.

* EUMETSAT Member States:
Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom.
Appendix B  

Recommended Coding and Message Layout for GTS Messages

1. Data transmitted by the DCP will use the abridged International Alphabet No. 5 (IA5). See Table B.1 for its description. The MSB will be transmitted first and the odd-parity bit last.

2. See Ref. 2 in Appendix E for regulations on data contents.

3. Missing figures or letters in the code will be replaced by solidi (/). In case of additional groups the group indicator must always be present and only the rest of the group may be replaced by the solidus.

4. The data message may consist of one or several reports. Each report in the data message has to include code identifiers and date-time groups. For details, see Ref. 2 in Appendix E.

5. After the code and section identifiers, each group must contain 5 characters followed by <SP> to separate each two consecutive groups.

6. Every multiple of 66 characters (11 groups) must be followed by the standard separator <CR><CR><LF>. The last group must also be followed by this separator. Different codes inside the same message will be separated in the same way.

Notes:

- DCP reports will be grouped into bulletins according to their WMO code and following operator's indications. This includes generation of the correct header information which is extracted from the DCP characteristics information on computer.

- The time given to the bulletin header is the nearest standard time of observation to the time of reception in the telecommand and tracking station. In the absence of a standard observation time, the reception time is put into the bulletin header. (This does not apply to ASDAR reports, which are time-labelled.)

- For alert messages, as many bulletins as messages received will be disseminated, without regard to them being repetitions of each other.
### Table B.1  Approved Characters of the International Alphabet No. 5 for DCP Transmitters

<table>
<thead>
<tr>
<th>$b_7$</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b_6$</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$b_5$</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>$b_4$</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
</tr>
<tr>
<td>$b_3$</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>P</td>
</tr>
<tr>
<td>$b_2$</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>Q</td>
</tr>
<tr>
<td>$b_1$</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>R</td>
</tr>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
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Appendix C  Reference DCP Message

The following is an example of the reference message transmitted by EUMETSAT hourly on each operational DCP regional channel. The address and message contents are always as shown.

The message contents are displayed here as both ASCII characters and in hexadecimal form. Note that each pair of hex characters represents eight bits (i.e. a byte), one of which is the parity bit, whereas the ASCII interpretation ignores the parity bit. Any byte that does not correspond to an ASCII character, or that represents a character such as space or carriage return, is displayed here as a dot.

Address: 162096C4  Channel: R04
Timestamp: 98.019.13.38  Processing Timestamp: 98.019.13.36

ASCII DUMP  HEX DUMP

| 8 | LW4I...DOYH.W5 .0X.5.,.gm.Vq=v..b 3p?8a.a.+y2...JMQ/h V0[Aee..3.UO-dbz,j .s?7Drr0.c)I.Eti.MRb 8=t9;suol,s'L TYk, YKH.^D? R##..B...G >fk.$0",,$BKz..1.Z G=5s6.B.x.4Hd1.x\0 Z.UcM.H..efhwtk.-'r 2..O.y.rqK%.FyEs yX.qs$@:b:4.f)1\t 3:7E6B15F*\.u.eSc/j_pIqoJN...?#.s5M. @L.Raum..6C-c?b\{ @UI\0.o\d.Ed0<n0.mBj.6 AS..rst+5lVpyYIaG E5.98%,.Rc[\1.<!Fx_ R'1]ZD3..n.unN]\." .at)3u-FzV2R!Wu/(t( we'..."y.6...&..p)6:..51vG.<-P>*". 2QLx..w'.va50...F9 9z..].f+8<,d'sv"Z.\ 3)Bq-.NX.VC</D.0.- "yJ 7..wW.n.Mp..z*?c=k.IIP+z.TzT;2.G. .C0HG[M..H..T].x\{ .MpKX.x.'Ph.._...\6. {.F.O."M.I0#/.}n. 3."Vr9p0{GMC.c.o:IT8 .C '.'i1".X.Lu.Q.%. {N.\3Ww&HF8)JL.1.5

FC 0F 38 FC 8E 7C CC D7 34 49 00 81 44 30 59 48 85 D7 B5
0D 30 D8 0C B5 8E FD 88 E7 6D 01 85 56 F1 3D 69 90 89 62
3B F0 B8 3F 61 B4 0B AB 79 DA 04 91 0C 34 CA CD 01 AF E8
D6 30 5B C1 E5 65 25 07 9F B3 17 D5 3E E4 E2 FA 96 10 4A
8D F3 37 C4 72 F2 B0 1B E3 7D 49 81 C5 74 69 11 CD 52 62
B8 3D E8 D4 B9 3B 73 75 6F 8A 6C 84 D3 A7 CC 54 F9 19 EB
59 CB 48 87 5E D5 BF A0 D2 A3 DE 95 9D 38 FE 07 1C 7E 47
3E E6 6B 9A 24 80 40 22 98 2C A4 C2 EB DA 06 18 6C 86 5A
C7 7E C4 F3 B6 80 42 AB B8 9E 34 C8 44 B1 1D 78 DC 9F 30
DA 85 D5 3C 6D 82 48 06 1A E5 E6 E8 57 74 6B 98 AD E0 F2
B2 92 83 CF D9 8B 6A 1F 71 71 7D 4B 08 A5 C6 F9 1B 62 39
79 D8 8D F1 BE A4 C0 62 BA B4 88 66 29 31 DC 1E 74 EA DC
9D B9 BA 37 45 36 CE E2 99 53 66 AA FC 8C F5 AC 65 A4 43 AF
EA 5F 50 E9 51 EF CA 4E 1C FF 03 0E BE 23 1F F3 35 4D 12
40 20 11 4C 16 52 E1 75 6D 03 0C 36 43 AD 63 3F E2 79 5B
40 A1 55 7C 4F 1A 64 A2 D8 0E 3C EE 4F 18 ED C2 6A 9E 36
41 24 03 8D 72 73 F4 2B BA 35 CC 56 70 79 59 C1 E7 EC
45 B5 0F B9 B8 BE 25 84 52 E3 FC OD B1 9C 3E CC E6 78 5F
52 60 31 5D 5A 44 B3 94 18 6E 0F 3A 75 EE CE 5C DD 9B 22
1B E1 F4 29 33 55 7E C6 7A D6 32 D2 A1 57 F5 AF B8 A4 A8
77 65 27 8E FF 01 87 DF 91 8F F9 9A 26 09 20 90 26 0B
A9 F0 BA B6 01 06 9B A1 D6 B1 F1 BC 2D A0 D2 A4 BE 27
0D 32 51 6C 07 1E F7 27 8C 76 61 35 4F 9B 20 92 81 46 B9
39 FA 15 DD 1A 66 2B B8 BC AC E4 E0 73 F6 A2 87 5C 5C
DF 12 42 A9 71 FE 86 58 4E 1E 76 63 BC 2F 29 B0 98 2E 2D
A2 59 4A 0C B7 07 9D 3A 77 67 AE EE 4D 91 8D 70 FA 94 99
2A 3F 63 3D 6B 19 E9 D0 AB FA 17 54 7A D4 BB B2 13 C7 FF
80 C3 EF C8 C7 7C 4D 93 04 10 48 04 93 85 54 78 5D DB 00
83 CD 50 EB DE 8F 7E DE 16 50 68 15 DF 93 06 99 28 B6 03
8F FB 13 46 BB B0 9A A7 4D 10 C9 40 A3 DC 1C FD 8A 6E 0D
B3 15 5C 5E 56 72 F0 39 7B 51 ED 43 2E AE 6F 09 A1 D4 38
7F 43 2C 27 0F BB 31 DE 97 14 58 4C 97 16 D1 2C 25 86 DB
83 4E 9D BB 33 57 F7 A6 C8 46 38 7D CA 4C 95 9F B1 9E B5
## Appendix D  Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AMDAR</td>
<td>Aircraft Meteorological Data Relay</td>
</tr>
<tr>
<td>ASAP</td>
<td>Automated Shipboard Aerological Programme</td>
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<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange, also International Alphabet No. 5, standardised in ISO 646.</td>
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<tr>
<td>ASDAR</td>
<td>Aircraft to Satellite Data Relay</td>
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<tr>
<td>BCD</td>
<td>Binary Coded Decimal, which represents every decimal digit by four bits.</td>
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<tr>
<td>BCH</td>
<td>Bose-Chaudhuri-Hocquenghem code for the generation of DCP addresses, which enables error detection and correction on the reception site.</td>
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<tr>
<td>bps</td>
<td>bits per second</td>
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<tr>
<td>CGMS</td>
<td>Coordination Group for Meteorological Satellites</td>
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<tr>
<td>CLS</td>
<td>Collecte Localisation Satellites</td>
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<tr>
<td>dB</td>
<td>decibel</td>
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<tr>
<td>DCP</td>
<td>Data Collection Platform</td>
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<tr>
<td>DCS</td>
<td>Data Collection System</td>
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<tr>
<td>DRS</td>
<td>DCP Retransmission System</td>
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<tr>
<td>ECMWF</td>
<td>European Centre for Medium-Range Weather Forecasts</td>
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<tr>
<td>EOT</td>
<td>End of Text or Transmission</td>
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<tr>
<td>ESOC</td>
<td>European Space Operations Centre</td>
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<tr>
<td>EUMETSAT</td>
<td>European Organisation for the Exploitation of Meteorological Satellites</td>
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<tr>
<td>FTB</td>
<td>First Transmitted Bit</td>
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<tr>
<td>G/T</td>
<td>Gain-to-Temperature ratio</td>
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<tr>
<td>GTS</td>
<td>Global Telecommunication System</td>
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<tr>
<td>HDLC</td>
<td>High-level Data Link Control frame, as in ISO 3309</td>
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<tr>
<td>IA5</td>
<td>International Alphabet No. 5</td>
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<tr>
<td>IDCS</td>
<td>International Data Collection System</td>
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<tr>
<td>IF</td>
<td>Intermediate Frequency</td>
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<td>I/O</td>
<td>Input/Output</td>
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<tr>
<td>ISO</td>
<td>International Standards Organization</td>
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<tr>
<td>ITU</td>
<td>International Telecommunication Union, which sets international communications standards</td>
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<tr>
<td>kHz</td>
<td>kiloHertz (one thousand cycles per second)</td>
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<td>LAPB</td>
<td>Link Access Procedure - Balanced</td>
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<tr>
<td>LSB</td>
<td>Least Significant Bit</td>
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<tr>
<td>LSD</td>
<td>Least Significant Digit. A digit consists of four bits.</td>
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<td>LTB</td>
<td>Last Transmitted Bit</td>
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<tr>
<td>MCC</td>
<td>Mission Control Centre</td>
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<tr>
<td>MHz</td>
<td>MegaHertz (one million cycles per second)</td>
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<tr>
<td>MLS</td>
<td>Maximal Linear Sequence</td>
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<td>MSB</td>
<td>Most Significant Bit</td>
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<td>Most Significant Digit</td>
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<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration (USA)</td>
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<td>NRZ</td>
<td>Non-Return to Zero</td>
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<td>PCM</td>
<td>Pulse Code Modulation</td>
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<td>Primary Data User Station</td>
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<td>PGS</td>
<td>Primary Ground Station</td>
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<td>parts per million</td>
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<td>Post Telephone and Telegraph administration</td>
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<td>Radio Frequency</td>
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<td>Regional Telecommunications Hub</td>
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<td>Shipboard Environmental Data Acquisition System</td>
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<td>Split Phase Level</td>
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<td>UHF</td>
<td>Ultra High Frequency</td>
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<td>WEFAX</td>
<td>Weather Facsimile (analogue image dissemination)</td>
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<td>WMO</td>
<td>World Meteorological Organization</td>
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Appendix E References


