GUIDE TO THE DIRECT READOUT ACQUISITION AND RELAY SYSTEM FOR LOW EARTH ORBIT SATELLITE DATA (DRARS)

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## CONTENTS

1. **INTRODUCTION** .................................................................................................................. 4
   1.1. PURPOSE AND SCOPE .................................................................................................. 4
   1.2. STRUCTURE OF THE DOCUMENT .............................................................................. 4
   1.3. APPLICABLE DOCUMENTS ......................................................................................... 5
   1.4. REFERENCE DOCUMENTS ......................................................................................... 5

2. **ORGANIZATION AND FUNCTIONS OF THE DRARS** ................................................. 5
   2.1. OVERVIEW OF THE DRARS ..................................................................................... 5
   2.2. JUSTIFICATION OF THE DRARS .............................................................................. 5
   2.3. DRARS COMPONENTS ............................................................................................... 6
   2.4. HIGH-LEVEL SERVICE SPECIFICATIONS ................................................................. 7
   2.5. DRARS NETWORK IMPLEMENTATION ....................................................................... 9
   2.6. QUALITY OF SERVICE .............................................................................................. 9

3. **OVERALL DRARS STANDARDS AND RECOMMENDED PRACTICES** ..................... 11
   3.1. INTRODUCTION ........................................................................................................ 11
   3.2. PRODUCT PROCESSING (COMMON ASPECTS) ......................................................... 12
   3.3. PRODUCT CODING AND FORMAT (COMMON ASPECTS) ......................................... 14
   3.4. DRARS PRODUCTS REGISTRATION AND DISCOVERY ........................................... 16
   3.5. PRODUCT DISTRIBUTION ........................................................................................ 17
   3.6. OPERATIONS ............................................................................................................ 18
   3.7. PUBLICATION OF SERVICE INFORMATION ........................................................... 19

4. **STANDARDS FOR SPECIFIC DRARS SERVICES** ...................................................... 19
   4.1. IR/MW SOUNDING SERVICE .................................................................................... 19
   4.2. IR/VIS IMAGING SERVICE ....................................................................................... 20
   4.3. HYPERSPECTRAL IR SOUNDING SERVICE .............................................................. 21
   4.4. SCATTEROMETRY SERVICE ..................................................................................... 22

5. **CONCLUSION** ................................................................................................................. 23

ANNEXES ........................................................................................................................................ 24
A. EXTRACT OF THE MANUAL ON CODES: BUFR MESSAGES - (BUFR EDITION 4) ......................... 24
B. EXTRACT OF THE MANUAL ON THE GTS, ATTACHMENT II-5, TABLE C3 .......................... 26
C. EXTRACT OF THE MANUAL ON CODES: EXTRACT OF COMMON CODE TABLE C-13 ....... 27
D. DETAILED GUIDANCE FOR FORMATTING OF DRARS MESSAGES ................................. 28
E. EXISTING AND REQUESTED CODE VALUES FOR INSTRUMENTS USED BY DRARS ....... 32
F. PRODUCT IDENTIFIER CONVENTION FOR DRARS PRODUCT FILENAMES .................. 33
G. GLOSSARY ............................................................................................................................ 34
H. TERMS OF REFERENCE OF THE RARS IMPLEMENTATION GROUP (V1. 16/03/2007) ....... 36
I. REGIONAL NETWORK MANAGERS AND OPERATIONAL POINTS OF CONTACT ..... 37
J. PROCEDURE FOR ADDING/MODIFYING A STATION IN THE DRARS NETWORK .......... 38
1. INTRODUCTION

1.1. PURPOSE AND SCOPE

[Note: The name DRARS is not yet frozen. It would be nice to have a name that can be declined regionally and by service.]

The purpose of this Guide is to define the minimum standards applicable to the Direct Readout Acquisition and Relay System for LEO satellite data (DRARS) and to provide guidance for implementing these standards.

In the present Guide, the verb "shall" is used when referring to the required standards, and "should" when referring to recommended practices, with the understanding that the standards are not an obligation of WMO Members but are applied on a voluntary basis by WMO Members willing to contribute to DRARS.

The aims of these standards are twofold:

- To help ensure that the data provided by each particular DRARS regional network can be used operationally to meet user requirements as recorded in the WIGOS Information Resource;
- To facilitate inter-regional data exchange and interoperability around the globe, with a particular focus on ensuring the global consistency of the DRARS datasets.

The present Guide replaces the existing RARS Operators Standards (v.2, 26/11/2008) with a view to consolidate the updates and additions made to these initial standards, to expand their scope to accommodate new sensor data and ensure interoperability with the NOAA Direct Broadcast Real Time Network as discussed within CGMS, and to take into account the WMO Information System.

This Guide is primarily directed to the DRARS station operators and coordinating entities. It also contains provisions for consideration by providers of processing software and by satellite operators. Furthermore, it can be a useful reference for the users of DRARS products.

1.2. STRUCTURE OF THE DOCUMENT

The Guide consists of the following sections:

Section 1: introduction;
Section 2: defines the DRARS components and addresses the overall coordination
Section 3: contains common standards applicable across all DRARS regional networks;
Section 4: contains specific standards applicable to each DRARS service
Section 5: conclusions.
Annexes: contain ancillary information which is provided separately for easier reference and to facilitate updating.
1.3. APPLICABLE DOCUMENTS

[AD.2]: WMO Manual on the GTS (WMO Publication No. 386)
[AD.3]: WMO Manual on GDPFS (WMO Publication No. 485)

1.4. REFERENCE DOCUMENTS

[RD.1] Statements of Guidance for GNWP and HRNWP
[RD.3]: RARS Network Status and Plan
[RD.4]: RARS Coding Summary
(http://www.wmo.int/pages/prog/sat/documents/RARS_Coding-summary.xls)

2. ORGANIZATION AND FUNCTIONS OF THE DRARS

2.1. OVERVIEW OF THE DRARS

The aim of the DRARS is to provide near real-time access to near-global data from Low Earth Orbit (LEO) satellites, in order to meet in a cost-efficient manner the timeliness requirements of regional and global Numerical Weather Prediction (NWP) and of other applications.

The DRARS comprises the following functions:

- Reception and acquisition of satellite Direct Broadcast signals at local DRARS stations
- Processing of the acquired data into products
- Near-real time delivery of products
- Performance monitoring and quality control
- User information
- Coordination and planning.

2.2. JUSTIFICATION OF THE DRARS

Access to LEO data is normally relying on data dump at one Command and Data Acquisition (CDA) station, which allows retrieving complete orbit data, however with a data latency resulting of on-board data storage between the time of acquisition and the time when the data is dumped to the CDA. This on-board storage can be reduced roughly by two when two high-latitude CDAs are used, one in the North and the other in the South, but further reduction requires a whole network of mid- or low latitude stations distributed around the globe, which involves high ground infrastructure costs and a highly complex scheduling of data storage and dumps.
When satellites have a Direct Readout (or Direct Broadcast) capability, which is the case of most LEO meteorological satellites, an alternative data access route is the Direct Readout acquisition from a local ground station, which allows real-time acquisition, albeit with coverage limited to the portion of orbit within the area of visibility of the local station.

The Direct Readout Acquisition and Relay System for LEO satellite data overcomes this limitation in offering a cost-efficient trade-off between coverage and timeliness. It coordinates data acquisition through a globally distributed network of local Direct Readout stations, their processing in accordance with agreed standards, and their rapid delivery to the global user community through appropriate telecommunication systems.

[Note: we can refer to http://www.wmo.int/pages/prog/sat/rars_en.php or other more detailed documents]

2.3. DRARS COMPONENTS

The DRARS is composed of several regional or sub-regional networks of receiving stations. Table 1 contains the list of DRARS regional or sub-regional networks and coordinating centers. The list of stations contributing to these networks is provided in R.D. 3.

<table>
<thead>
<tr>
<th>Regional Network</th>
<th>Regional coordination</th>
<th>Sub-regional network</th>
<th>Sub-regional coordination</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARS</td>
<td>EUMETSAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>BOM</td>
<td>Asia-Pacific North</td>
<td>JMA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asia-Pacific South</td>
<td>BoM</td>
</tr>
<tr>
<td>South America</td>
<td></td>
<td>South America/North</td>
<td>INPE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South America/South</td>
<td>SMN /CONAE (TBD)</td>
</tr>
<tr>
<td>DBRTN (1)</td>
<td>NOAA/CIMSS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) The DBRTN is implemented by NOAA/CIMSS in partnership with EUMETSAT and shares some functions with EARS.

A DRARS Coordinator is designated by each DRARS regional or sub-regional network. The role of the regional/sub-regional coordinators is to:

- Ensure coordination of the regional or sub-regional network, report to the DRARS Coordination Group, and contribute to the overall DARS network planning and coordination described in Section 2.4;
- Provide guidance to station operators for implementing new services, and oversee the validation procedures defined in Annex J.
- Ensure performance monitoring as defined in Section 2.6
- Maintain a website providing information as listed in Section 2.7.

A global monitoring centre is performing a systematic control of product consistency. This function is assumed by the EUMETSAT SAF-NWP, hosted by the Met Office (United Kingdom) for sounding data.

The list of coordinators is maintained by the WMO Secretariat and is available on line as Operational Information. [Note: at present it is here: http://www.wmo.int/pages/prog/sat/rars-implementation_en.php#RARScontacts]

Each DRARS regional or sub-regional network contributes to one or several DRARS “Services”. A DRARS Service is performing the Direct Readout Acquisition and Relay of a certain category of satellite data. Table 2 lists the DRARS services (current and potential).

**TABLE 2**

<table>
<thead>
<tr>
<th>Categories of Services</th>
<th>Services (Instruments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR/MW sounding</td>
<td>ATOVS (AMSU-A, MHS, HIRS), ATMS, VASS (MWTS/2, MWHS/2, IRAS)</td>
</tr>
<tr>
<td>IR/VIS imaging</td>
<td>VIIRS, AVHRR, MERSI</td>
</tr>
<tr>
<td>HiRes IR sounding</td>
<td>CrIIS, IASI, HIRAS, AIRS</td>
</tr>
<tr>
<td>Scatterometry</td>
<td>ASCAT, Wind RAD</td>
</tr>
<tr>
<td>MW imagery</td>
<td>MWRI</td>
</tr>
</tbody>
</table>

[Note: Availability of Wind RAD and MWRI processing packages has not been confirmed.]

### 2.4. HIGH-LEVEL SERVICE SPECIFICATIONS

The DRARS Service Specifications are determined with the aim to respond to user requirements of WMO Application Areas, as recorded in OSCAR [RD.2]. For example, the requirements of Global NWP (http://www.wmo-sat.info/oscar/applicationareas/view/1) and High-Resolution NWP (http://www.wmo-sat.info/oscar/applicationareas/view/2) require for atmospheric temperature, humidity profiles and wind vector at sea surface, a timeliness of less than 6 to 15 min as a goal and 30 min as breakthrough. The DRARS specifications
represent the agreed commitment by DRARS Operators to contribute to meeting these requirements, taking into account the technical capabilities and resource constraints. Table 3 below summarizes the operational service specification for each DRARS Service.

[Note: these specs should be validated in consultation with users]

### TABLE 3

<table>
<thead>
<tr>
<th>Service</th>
<th>Driving Application</th>
<th>Products</th>
<th>Data latency goal/threshold</th>
<th>Availability</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR/MW sounding</td>
<td>Global and High-Resolution NWP</td>
<td>L1 brightness temperatures (or radiances ?)</td>
<td>20 min/30 min</td>
<td>95%</td>
<td>90%</td>
</tr>
<tr>
<td>IR/VIS imaging</td>
<td>Nowcasting</td>
<td>L1 radiance/reflectivity</td>
<td>15 min/15 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HiRes IR sounding</td>
<td>Global and High-Resolution NWP</td>
<td>Level 1 radiances and PC scores</td>
<td>20 min/30 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scatterometry</td>
<td>NWP, Nowcasting and Ocean applications</td>
<td>backscatter cross-sections</td>
<td>20 min/30 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MW imagery</td>
<td>NWP, Nowcasting,</td>
<td>Level 1 Brightness temperatures</td>
<td>20 min/30 min</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data latency is defined here as the maximum time elapsed between observation time (sensor time) and the availability on the WIS core network to be satisfied by at least 90% of the data. When an orbit pass is processed as a single file, the time is counted from the beginning of the pass.

The availability rate, which is an indicator of the target uptime for a DRARS station when there is no special operational constraint (i.e. not considering particularly remote sites such as Antarctic stations) is defined here as the percentage of days where the station is operating normally. The number of passes acquired depends on local factors (including the station latitude and the scheduling priorities) and cannot be fixed as a high-level specification, but is monitored (e.g. on a monthly basis) as a performance criterion.

[Note: The availability is defined here for an individual station. It can be more relevant for users to consider the availability at the network level, taking into account the combined availability of overlapping stations.]

The coverage is defined here as the percentage of the Earth’s surface (between 82° S and 82° N) above which the signal can be acquired from a satellite. This is calculated in merging the areas of visibility of the local stations contributing to the service. As an order of magnitude, an isolated station (not overlapping with the area of visibility of another station) without mask contributes to the global coverage by about 4%.
2.5. DRARS NETWORK IMPLEMENTATION

The Secretariat and all DRARS Network Coordinators strive to ensure smooth operation of the DRARS Services across all regional networks, to plan expansion of DRARS, to review the priorities and to take any appropriate measure to meet evolving user requirements. The regional/subregional Coordinators identify candidate stations and negotiate agreements with Station Operators with a view to expand the network and fill gaps when necessary.

This coordination is achieved through the DRARS Coordination Group, the Terms of Reference of which are provided in Annex H.

The WMO Secretariat maintains a list of DRARS contributing stations associated to each regional or sub-regional node with the status and plans of the different services [AD.4], based on the reports from DRARS Network Coordinators. This allows monitoring the coverage of the respective DRARS services.

The procedure contained in Annex J describes the steps to be followed for adding a station to the DRARS network, modifying its status, or removing it from the DRARS.

2.6. QUALITY OF SERVICE

2.6.1. Quality assurance

In order to help ensure that the service provided is of an appropriate quality, the DRARS Operator shall:

- utilize an appropriate system for the tracking and resolution of operational anomalies;
- ensure that all operations and maintenance staff are appropriately trained;
- ensure that appropriate provisions are in place to protect against unauthorised access to the DRARS equipment (from both physical, and network security points of view).
- ensure that the maintenance approach (e.g. levels of redundancy, spares holdings, maintenance contracts and maintenance team size) is consistent with meeting the stated service availability targets (see section 2.3);
- ensure that adequate arrangements are in place to monitor the satisfactory performance of the service (supported by the availability of validated operational and maintenance procedures).

2.6.2. Quality control

Each DRARS regional Coordinating entity shall implement appropriate quality control measures to monitor the integrity of RARS data formats that are disseminated, their length and timeliness.

The regional/subregional coordinators:

- Coordinate (manage?) the near-real time monitoring function
- Maintain the list of operational points of contacts of individual station operators
- Overall performance monitoring (incl. implementation of the standards)
- For instance: check that proper software versions are used on each station
- Ensure an operational Point of contact for resolving anomalies.

A global monitoring is performed by the EUMETSAT NWP SAF to assess the consistency of DRARS data with the global data and their timeliness. The results of this monitoring are sent to the operators and statistics are published on line.

### 2.6.3. Anomaly reports and other user feedback

Each DRARS Station operator and each DRARS Coordinating entity shall designate an Operational Point of Contact to be contacted in case of operational problems.

The contact details of Operational Points of Contact of each regional/sub-regional network will be posted on the DRARS regional network web site to allow the users to report operational problems. Depending on the nature of the problem, the DRARS coordinating entity will contact the relevant DRARS station operator, and/or the relevant WIS or GTS focal point, and/or the global monitoring unit (EUMETSAT SAF-NWP at Met Office).

Each DRARS operator should implement appropriate User Feedback Management processes in order to properly track and manage the resolution of problems, including notification of the providers of pre-processing software packages.

Each provider of a pre-processing software package, should implement software anomaly management processes, for fast resolution of software problems that affect the end-users.

### 2.7. PUBLICATION OF SERVICE INFORMATION

[Note: do we need a coordinated global communications mechanism such as a list-server or email system, to send RARS news, along the lines of what NOAA/NESDIS does to support all operational users and keep them up to date with system changes etc (e.g. AAPP S/W releases)?]

[Do we need such detailed information ?]

In order to keep users informed about the service, the DRARS regional or sub-regional Coordinating entity maintains a web-site which containing an up-to-date description of the service, including:

- for each Service, the instruments and satellites from which data is collected;
- the coordinates of the collection stations that form part of the DRARS data collection network, together with the associated geographical coverage maps;
- the processing software version that is used to generate the products (the version used locally at the stations shall be identical to the version used centrally);
- the target timeliness and target availability of the service,
- details of the data distribution mechanism and any associated user reception equipment requirements (e.g., for receiving data from a satellite direct broadcast system);
- file naming and structure;
- the administrative procedures to be followed by a user to gain access to the data;
- a link to the scheduling priorities (including any instrument/satellite priorities);
- operational points of contact of the Coordinating entity allowing users to report problems with the service (including email addresses and telephone numbers);

When this information is available for individual stations:
- planned acquisition schedule with a 3-day horizon;
- acquired passes in the last 24 hour period compared to the planned acquisition schedule (referenced to the planned acquisition schedule);
- long-term planning information that may affect the service in the future (e.g., planned outages, upgrade of software version, etc.).
- quality monitoring results

3. OVERALL DRARS STANDARDS AND RECOMMENDED PRACTICES

3.1. INTRODUCTION

These standards and recommended practices cover aspects of DRARS operations that are not specific to a particular service and should apply for any regional network contributing to the overall DRARS network. The standards are mandatory and are only defined in areas that affect the interoperability of DRARS regional networks, the access to and the utilization of DRARS products, and the interface to the WMO Information System (WIS). On the other aspects, some practices are recommended or indicated as guidance, but the actual implementation can be defined in an optimal manner by each DRARS regional network.

The standards are expressed with the auxiliary verb “shall”, while the recommended practices and guidance are expressed with the auxiliary verbs “should” or “can”.

A DRARS operator is defined as the managing entity responsible for providing an end-to-end service within a particular region (i.e., with responsibility for data collection from the HRPT stations, processing, dissemination of the products to users and inter-regional data exchange). If responsibility for the implementation of these functions is shared between several parties, then it is the responsibility of the lead entity (i.e., the DRARS operator) to ensure that all the involved parties comply with the relevant parts of this standard.
Overall DRARS standards and recommended practices are defined in the following areas:

- Product processing and product format.
- Product registration and distribution
- Quality of service
- Operations and maintenance including anomaly processing
- Publication of service Information
- DRARS network coordination

3.2. PRODUCT PROCESSING (COMMON ASPECTS)

3.2.1. Processing Level

Any products exchanged inter-regionally shall be at level 1, unless otherwise specified for the specific service.

Level 1 is understood to be radiances, reflectances or brightness temperatures on original instrument grid and geolocation data.

Processing to level 1, and BUFR encoding, can be done at the regional centre, or locally at the receiving station location.

If processing to level 1 is done locally, then the station sub-centre ID would nominally be that coordinated by the organisation responsible for the local receiving station; instead of a sub-centre ID defined/coordinated regionally. If the local station processes to level 1c, but does not do the BUFR format conversion, then the DRARS regional centre will be responsible for the BUFR format conversion and for ensuring that the appropriate local centre and sub-centre information is inserted.

3.2.2. Product Processing Packages

DRARS Operators shall use agreed processing packages and agreed auxiliary input data such as orbit information in order to ensure that the processed products are fully consistent with the corresponding global data sets pre-processed by the respective satellite operators.

The suite of processing packages to be used by DRARS is illustrated below and is detailed in the sections of this document addressing specific services. The list of software processing packages and organizations responsible for maintaining them is provided in the following tables. Note that other software packages may be used for specific services, e.g. ASCAT, but are not generally available.

[Note: these tables will eventually be moved to an Annex or to an “Operational Information” ]
<table>
<thead>
<tr>
<th>Package</th>
<th>RARS Service</th>
<th>Provider</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAPP</td>
<td>ATOVS, AVHRR</td>
<td>NWP SAF</td>
<td></td>
</tr>
<tr>
<td>OPS-LRS</td>
<td>IASI</td>
<td>NWP SAF</td>
<td>Released as an optional part of AAPP.</td>
</tr>
<tr>
<td>CSPP</td>
<td>ATMS, CrIS, VIIRS</td>
<td>SSEC, UW-Madison</td>
<td></td>
</tr>
<tr>
<td>FY3L1PP</td>
<td>VASS, MERSI</td>
<td>CMA</td>
<td></td>
</tr>
<tr>
<td>IMAPP</td>
<td>AIRS, Aqua AMSU</td>
<td>SSEC, UW-Madison</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Package</th>
<th>RARS Service</th>
<th>Provider</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAPP</td>
<td>ATOVS, ATMS, CrIS, VASS</td>
<td>NWP SAF</td>
<td>Requires ECMWF BUFR library</td>
</tr>
<tr>
<td>IMAPP</td>
<td>AIRS, Aqua AMSU</td>
<td>SSEC, UW-Madison</td>
<td></td>
</tr>
<tr>
<td>CVIIRS</td>
<td>VIIRS</td>
<td>EUMETSAT</td>
<td>Converts between VIIRS SDR and Compact VIIRS SDR</td>
</tr>
</tbody>
</table>

[Note: where should such a list be maintained? This one is probably not specific enough: http://www.wmo.int/pages/prog/sat/processingtools_en.php]
Orbital elements shall be updated at least once per day, from the following sources:

**Metop**: [http://oiswww.eumetsat.org/metopTLEs/html/](http://oiswww.eumetsat.org/metopTLEs/html/) or the Multi-Mission Administration Messages contained in the Metop HKTM L0 files.


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### 3.3. PRODUCT CODING AND FORMAT (COMMON ASPECTS)

#### 3.3.1. Data exchange format

A “DRARS product” is the result of the processing of the data acquired by one station, from one satellite pass, from one instrument. All DRARS products exchanged inter-regionally shall be in the agreed format described in Section 4 for the relevant service. Three levels of formatting are considered here: BUFR message, Meteorological Bulletins, and files.

For each satellite pass and each instrument (with the exception of imagery products), DRARS products are encoded in BUFR messages. Because of the BUFR message size limitation, several BUFR messages are needed to encode one product. The number of BUFR messages needed for one product depends on the instrument and the duration of the satellite pass.

An Abbreviated Heading is assigned to each BUFR message to form a “Meteorological Bulletin”. The structure of the heading is described in “Explanation of Data Designators T1T2A1A2ii CCCC YYGGgg BBB (WMO No 386, Vol I, Part II, 2.3.2.2/Attachment II-5)”.
The different Bulletins composing a product have all the same headings, with the exception of the number "ii" which differentiates the individual Bulletins of the same product.

DRARS production centres can submit products to the GTS either directly as Meteorological Bulletins, or embedded in files. These files shall follow the file naming convention:

\texttt{pflag\_productidentifier\_oflag\_originator\_yyyyMMddhhmmss\_[freeformat].type[.compression]}

(Note: More explanations on “Accumulating messages into files can be found in the Manual on the GTS (WMO N°386 Vol.1, Part II, Attachment II-15, as of page 158)

In summary, a DRARS product shall be comprised of a series of BUFR encoded messages, which shall each be included in a bulletin, which should all be embedded in one file.

The BUFR identification section, the abbreviated heading and the file name shall be defined in accordance with the RARS Coding Summary [AD.3], which is posted on the DRARS website: \url{http://www.wmo.int/pages/prog/sat/documents/RARS\_Coding-summary.xls}.

For instance the file naming convention for DRARS product files is to use “pflag=w”, “product identifier= country-organization-station,instrument,rars+satellite+station”, and “freeformat=[AAPPfilename]”. As a consequence, DRARS product file names are as follows: \texttt{w\_country-organization-station\_instrument\_rars\_satellite\_station\_c\_CCCC\_yyyyMMddhhmmss\_AAPPfilename\_bufr.bin}.

### 3.3.2. Encoding of Section 1 of the RARS BUFR Message

Annex A contains a full description of Section 1 (Identification) of the BUFR Message. In order to facilitate identification of BUFR messages containing DRARS products, the three fields below shall be used as explained here:

- Octets 5-6: Identification of Originating/Generating Centre;
- Octets 7-8: Identification of Originating/Generating Sub-centre;
- Octet 11-12: International Data Category and Sub-category.

**Octets 5-6 of Section 1: Identification of Originating/Generating Centre**

The ID of the Originating/Generating Centre should be that of the centre responsible for the processing to level 1.

**Octets 7-8 of Section 1: Identification of Originating/Generating Sub-centre**

The ID of the Originating/Generating Sub-centre shall be used to indicate the receiving station that receives the data.

If processing to level 1c is done locally at the station site, then the station sub-centre ID would nominally be that coordinated by the organisation responsible for the station; instead of a sub-centre ID defined/coordinated regionally.

If the local station processes to level 1c, but does not do the BUFR format conversion, then the RARS regional centre will be responsible for the BUFR format conversion and for ensuring that the appropriate local centre and sub-centre information is inserted.

**Octet 11-12 of Section 1: International Data Category and Sub-category**
The data category indicated in Octet 11 is defined by BUFR Code Table A which gives “3” for satellite vertical sounding data, “12” for satellite surface data, “21” for satellite radiance data and “101” for satellite image data. Subcategories of these categories are defined by Common Code Table C-13 of the WMO Manual on Codes for several instruments (AMSU-A, AMSU-B, HIRS, MHS, IASI, SSMI.ASCAT, CrIS, ATMS, VIIRS) or for generic types of instruments (IR sounding, Hyperspectral sounding, MW sounding, radio-occultation) (see Annex C).

Octet 12 of section 1 shall be populated using the appropriate sub-category, which reflects the instrument or the instrument category.

[Note: Annex C shows several possibilities, for instance MHS data can be described as “MHS” (003-6) or as “MW temperature/humidity sounding” (003-40), CrIS can be described by “CrIS” (21-5) or by “Hyperspectral temperature/humidity sounding” (003-30). An harmonized approach should be defined]

[Note: do we need to address the BUFR encoding of the other sections? This BUFR encoding is complicated but it is normally done by the pre-processing software.]

### 3.4. DRARS PRODUCTS REGISTRATION AND DISCOVERY

#### 3.4.1. WIS discovery metadata

In order to make the DRARS products discoverable in the WMO Information System (WIS) they shall be registered in the WIS with a metadata entry as described in (…). This enables any WMO Member to be aware of the availability of these products through the WIS catalogue and, if interested, to request them from the relevant WIS centre, i.e. a Global Information System Centres (GISC) or Data Collection and Production Centre (DCPC).

[Note: details on metadata will be provided and discussed at the meeting].

#### 3.4.2. Recording in Vol.C1

In addition, since the WIS is not yet fully implemented worldwide, it is recalled that the Abbreviated Headings of Meteorological Bulletins are recorded in the Catalogue of Meteorological Bulletins (WMO Publication No.9, Vol.C1). This enables any WMO Member to be aware of the availability of these bulletins and, if interested, to request them from the relevant Regional Telecommunication Hub (RTH). However, when DRARS products are embedded in “files” they are not systematically recorded in Vol. C1. In order to make the DRARS products more easily discoverable, it is recommended to record the DRARS bulletins in Vol.C1 even if embedded in a file.

The procedure for recording Meteorological Bulletins is described in:
http://www.wmo.int/pages/prog/www/ois/Operational_Information/VolC1_en.html under “UPDATING PROCEDURES AND METHODS OF NOTIFYING THE WMO SECRETARIAT OF AMENDMENTS / ADVANCED NOTIFICATIONS”. The WMCs and RTHs on the Main Telecommunication Network (MTN) shall maintain Vol. C1 as regards bulletins issued from the zone for which they are responsible. The format to record a bulletin is described in:
Table 4 provides guidance to complete the fields 9-15 of this record.

### TABLE 4

<table>
<thead>
<tr>
<th>Field N°</th>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Category</td>
<td>“E” (Essential data/products)</td>
</tr>
<tr>
<td>10</td>
<td>TTAAii</td>
<td>(Indicate TTAAii as defined by the DRARS coding)</td>
</tr>
<tr>
<td>11</td>
<td>CCCC</td>
<td>(Indicate CCCC as defined by the DRARS coding)</td>
</tr>
<tr>
<td>12</td>
<td>CodeFor</td>
<td>“FM 94-XIV”</td>
</tr>
<tr>
<td>13</td>
<td>TimeGroup</td>
<td>&quot;AS AVAILABLE&quot;</td>
</tr>
<tr>
<td>14</td>
<td>Content</td>
<td>“RARS”</td>
</tr>
<tr>
<td>15</td>
<td>Remarks</td>
<td>“TRANSMITTED AS A FILE”</td>
</tr>
</tbody>
</table>

#### 3.5. PRODUCT DISTRIBUTION

The DRARS regional networks shall strive to make DRARS products available to the global users community and in particular to the NWP centres worldwide, through the WMO Information System.

The recommended route for DRARS data access within a region is to be defined at the regional level in consultation between the GISC/DCPC and the DRARS regional nodes taking into account the level of connectivity of the main regional users.

Inter-regional data exchange shall be implemented between regional nodes and GISCs, taking into account the recommendations of the APSDEU-NAEDEX groups, which keeps under review the requirements of NWP centres for inter-regional exchange of satellite data.

It will be the matter of a trade-off between the benefit provided by additional data and the resulting load on the telecommunications. While the primary distribution means will be the GTS (or WIS/RMDCN), the use of a satellite broadcast service such as EUMETCast or CMACast or Internet ….is an advantage for users with limited GTS connectivity. A schematic illustration of the telecommunication scheme is provided in Figure 1.
- DRARS stations with direct access to a core WIS node (GISC or DCPC) should directly inject into the WIS (e.g. Kyose/Tokyo, Crib Point/Melbourne)
- DRARS station with GTS access should directly inject into the GTS (e.g. New Delhi)
- DRARS station with no GTS/WIS access should send their products either to a GTS or WIS core node via FTP (e.g. Maupuia to Melbourne, Cordoba to Buenos Aires, Cachoeira Paulista to Brasilia, Jincheon to Seoul)
- As an alternative, DRARS stations which are part of a coordinated regional/subregional network should send their products to the regional/subregional node that will send the whole DRARS product package to a GTS hub/GISC/DCPC (e.g. EARS stations concentrated by EUMETSAT via VPN, before being sent to Offenbach hub; Natal, Cuiaba via Cachoeira Paulista, before being sent to Brasilia hub).

[Note: the distribution mode should be specified in the service-specific provisions]

3.6. OPERATIONS

3.6.1. Satellite acquisition scheduling priorities

Satellite acquisition scheduling priorities are established by the DRARS Coordination Group considering:

- Availability and timeliness of global data
- Equatorial Crossing Time diversity
- Instrument health
- DB signal quality
- Ability of NWP to assimilate instruments

The scheduling priorities are reviewed annually or when needed. The current priorities are recorded in an Operational Information maintained on the WMO website (Ref: …)

[Note: Provisionally, the 2015 priorities are listed in the Table below]

**DRARS scheduling priorities (Updated in March 2015)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Metop-B</td>
<td></td>
</tr>
<tr>
<td>Suomi NPP</td>
<td></td>
</tr>
</tbody>
</table>

### 4. STANDARDS FOR SPECIFIC DRARS SERVICES

These standards and best practices are applicable to the provision of individual DRARS services. The DRARS services are defined in terms of groups of equivalent or similar instruments, potentially flying on different satellites. A particular DRARS operator may only provide a subset of the defined services. Currently the scope of the overall DRARS includes the services listed in Table 2.

The areas covered by these standards are service-specific aspects of product processing, formats, quality control and monitoring.

#### 4.1. IR/MW SOUNDOING SERVICE

This service is provided for the ATOVS suite of instruments flying on NOAA/POES and EUMETSAT/Metop satellites as well as from equivalent instruments flying on CMA/FY-3 and NOAA/Suomi-NPP satellites.

##### 4.1.1. Product Processing Software

To ensure global consistency of the DRARS dataset, the DRARS operator shall make use of the AAPP (ATOVS and AVHRR Pre-processing Package) software for product processing for the ATOVS suite of instruments, of CSPP for ATMS and of the FY-3 L0/L1 pre-processing software package for MWTS, MWHS and IRAS.

The AAPP package is supplied and maintained by the EUMETSAT’s Numerical Weather Prediction Satellite Application Facility (NWP SAF). The package is freely available (subject to the signing of a licence agreement) and the process for obtaining the package is fully described on the NWP SAF AAPP web pages that are linked from [http://www.nwpsaf.eu](http://www.nwpsaf.eu).
General background information on the AAPP software is also available on this web-page. The version of the AAPP software to be used shall be the latest release as defined on the AAPP release web-page.

For changes affecting the data output, this latest release shall be implemented operationally within 1 month of release by the NWP SAF, otherwise the latest release shall be implemented operationally within 3 months.

For Suomi-NPP ATMS, The product processing shall be performed by AAPP and CSPP software. CSPP performs Level 1 processing which delivers Sensor Data Records (SDR) in HDF5 format for ATMS. AAPP has been updated to ingest these SDRs, and BUFR encoding. CSPP can be downloaded from: http://cimss.ssec.wisc.edu/cspp/

FY-3 pre-processing software: FY-3 data are pre-processed by the FY3L0/L1pp software packages distributed by CMA, see http://satellite.cma.gov.cn/portalsite/ “Tools”.

AAPP can ingest the SDRs of MWTS, MWHS and IRAS, and can BUFR encode them.

4.1.2. Processing Level

Any products exchanged inter-regionally shall be at level 1c (brightness temperatures)

4.1.3. Quality Checking and Quality Flags

The pre-processing software includes quality checking, and any products distributed shall include quality flags.

4.1.4. Product Quality Monitoring

Routine monitoring of DRARS IR/MW sounding data quality is performed by the NWP SAF. Monitoring results are available on the “Monitoring reports” section of the NWP SAF web site http://www.nwpsaf.eu.

4.2. IR/VIS IMAGING SERVICE

4.2.1. Product Processing Software

TBD

4.2.2. Processing Level

The processing level shall be either raw HRPT (NOAA POES / Metop) or at the level of radiances/reflectivities (VIIRS).
The orbit pass shall be segmented to enable on-the-fly transmission of product segments in order to ensure low latency and to facilitate handling of large data sets.

As it is important to provide seamless imagery (without missing lines or overlap) the acquisition schedules of the local stations shall be coordinated and where feasible the acquisition source shall be switched from one station to the next one at a defined imagery line.

Data compression is critical; efficient compression procedures shall be used.


Note: Guidance should be given, e.g. based on lessons learnt from EARS and DBRTN

### 4.2.3. Quality Checking and Quality Flags

The pre-processing software includes quality checking, and any products distributed shall include quality flags.

### 4.2.4. Product Quality Monitoring

TBD

### 4.3. Hyperspectral IR Sounding Service

#### 4.3.1. Product Processing Software

For IASI EUMETSAT has implemented at each station a computer running AAPP together with the IASI Level 1 processor (OPS-LRS). Both AAPP and OPS-LRS are distributed by the NWP SAF (http://www.nwpsaf.org/) and are freely available to any interested user. It was stressed that AAPP requires Metop Level 0 as input (Note: If not already delivered by the receiving station, the Level 0 can be generated by the “Metopizer” freeware available from EUMETSAT: http://www.eumetsat.int/website/home/Data/DataDelivery/SupportSoftwareandTools/index.html.

For Suomi-NPP CrIS, the product processing shall be performed by AAPP and CSPP software. CSPP performs Level 1 processing which delivers Sensor Data Records (SDR) in HDF5 format for ATMS, CrIS and VIIRS instruments. AAPP has been updated to ingest these SDRs, perform CrIS channel selection, and BUFR encoding. CSPP can be downloaded from: http://cimss.ssec.wisc.edu/cspp/

#### 4.3.2. Processing Level

Any products exchanged inter-regionally shall be at channel subset of level 1 radiances, optionally supplemented with Principal Component Scores that allow a reconstruction of the full spectra with minimal loss of information. The definition of the set of selected channels for each of the hyperspectral sounders as well as the selection of the appropriate PC score representation is performed by the agencies, in consultation with users, according to the following table.
### 4.3.3. Quality Checking and Quality Flags

The processing software includes quality checking, and any products distributed shall include quality flags.

*Action: Check if all quality flags in the native sounder products formats are transferred to the BUFR formatted product*

### 4.3.4. Product Quality Monitoring

TBD

---

**Table: PC Score Selection and Apodization**

<table>
<thead>
<tr>
<th>Service</th>
<th>Channel selection responsible</th>
<th>PC score selection responsible</th>
<th>Apodization applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>IASI</td>
<td>EUMETSAT</td>
<td>EUMETSAT</td>
<td>Yes</td>
</tr>
<tr>
<td>CrIS</td>
<td>NOAA</td>
<td>TBD</td>
<td>Yes</td>
</tr>
<tr>
<td>HIRAS</td>
<td>CMA</td>
<td>TBD</td>
<td>Yes</td>
</tr>
<tr>
<td>AIRS</td>
<td>NOAA</td>
<td>N.A.</td>
<td>No</td>
</tr>
</tbody>
</table>

---

### 4.4. SCATTEROMETRY SERVICE

This service is currently provided by the EUMETSAT EARS network for the ASCAT instrument flying on Metop-A/B

#### 4.4.1. Product Processing Software

*Note: Check with EUM the processing employed for ASCAT*

#### 4.4.2. Processing Level

Any products exchanged inter-regionally shall be at level 1 (backscatter cross-sections) or at level 2 (winds)

#### 4.4.3. Quality Checking and Quality Flags

The pre-processing software includes quality checking, and any products distributed shall include quality flags.

*Note: Reference?*

#### 4.4.4. Product Quality Monitoring

TBD
5. CONCLUSION

The requirements contained in this document contain the standards to be followed by DRARS Operators to:

- ensure that an appropriate level of service is provided regionally;
- facilitate the inter-regional exchange of DRARS data;
- ensure the global consistency of the DRARS datasets.
The octets of a BUFR message are grouped in sections:

<table>
<thead>
<tr>
<th>Section</th>
<th>Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Indicator section</td>
<td>Indicator section “BUFR”, length of message, BUFR edition number</td>
</tr>
<tr>
<td>1</td>
<td>Identification section</td>
<td>Length of section, identification of the message</td>
</tr>
<tr>
<td>2</td>
<td>Optional section</td>
<td>Length of section and additional items for local use by automatic data processing centres</td>
</tr>
<tr>
<td>3</td>
<td>Data description</td>
<td>Length of section, number of data subsets, data category flag, data compression flag and a collection of descriptors which define the form and content of individual data elements</td>
</tr>
<tr>
<td>4</td>
<td>Data section</td>
<td>Length of section and binary data</td>
</tr>
<tr>
<td>5</td>
<td>End section</td>
<td>’7777’</td>
</tr>
</tbody>
</table>

Section 1 — Identification section for BUFR edition 4

Octet No. | Contents                                                                                                                                 |
----------|------------------------------------------------------------------------------------------------------------------------------------------|
1–3       | Length of section                                                                                                                        |
4        | BUFR master table (zero if standard WMO FM 94 BUFR tables are used — see Note (2))                                                      |
5-6      | Identification of originating/generating centre (see Common Code Table C-11)                                                             |
7-8      | Identification of originating/generating sub-centre (allocated by originating/generating Centre- see Common Code Table C-12)
Update sequence number (zero for original BUFR messages; incremented for updates)

Bit 1 =0 No optional section
=1 Optional section follows
Bit 2-8 Set to zero (reserved)

Data Category (Table A)

International data sub-category (See Common Table C-13 – see Note (3))

Local data sub-category (defined locally by automatic data processing (ADP) centres – see Note (3))

Version number of master table used - see Notes (2) and (5)

Version number of local tables used to augment master table in use – see Note (2)

Year (4 digits) | Month | Day | Most typical time for the BUFR message content – see Note (4) | Hour | Minute | Second |

Optional for local use by ADP centres
B. EXTRACT OF THE MANUAL ON THE GTS, ATTACHMENT II-5, TABLE C3

(See:
http://www.wmo.int/pages/prog/www/ois/Operational_Information/Publications/WMO_386/AHLsymbols/TableDefinitions.htm)

Data Designators in Abbreviated Headings
Geographical area designator A1
(when T1= D, G, H, O, PQ, T, X or Y) and
geographical area designator A2 (when T1=I or J)

Instructions for the proper application of the data type designator

1. The designator specified in this table should be used to the greatest extent possible to indicate the geographical area of the data contained within the text of the bulletin.

2. Where the geographical area of the data does not correspond exactly with the designator, the designator for the area most approximating that of the data may be used.

3. When the table does not contain a suitable designator for the geographical area, an alphabetic designator which is not assigned in the table should be introduced and the WMO Secretariat notified.

<table>
<thead>
<tr>
<th>Designator</th>
<th>Geographical Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0° - 90°W northern hemisphere</td>
</tr>
<tr>
<td>B</td>
<td>90°W - 180° northern hemisphere</td>
</tr>
<tr>
<td>C</td>
<td>180° - 90°E northern hemisphere</td>
</tr>
<tr>
<td>D</td>
<td>90°E - 0° northern hemisphere</td>
</tr>
<tr>
<td>E</td>
<td>0° - 90°W tropical belt</td>
</tr>
<tr>
<td>F</td>
<td>90°W - 180° tropical belt</td>
</tr>
<tr>
<td>G</td>
<td>180° - 90°E tropical belt</td>
</tr>
<tr>
<td>H</td>
<td>90°E - 0° tropical belt</td>
</tr>
<tr>
<td>I</td>
<td>0° - 90°W southern hemisphere</td>
</tr>
<tr>
<td>J</td>
<td>90°W - 180° southern hemisphere</td>
</tr>
<tr>
<td>K</td>
<td>180° - 90°E southern hemisphere</td>
</tr>
<tr>
<td>L</td>
<td>90°E - 0° southern hemisphere</td>
</tr>
<tr>
<td>N</td>
<td>Northern hemisphere</td>
</tr>
<tr>
<td>S</td>
<td>Southern hemisphere</td>
</tr>
<tr>
<td>T</td>
<td>45°W - 180° northern hemisphere</td>
</tr>
<tr>
<td>X</td>
<td>Global Area (area not definable)</td>
</tr>
</tbody>
</table>
## C. EXTRACT OF THE MANUAL ON CODES: EXTRACT OF COMMON CODE TABLE C-13

Link to **Current version:**

http://www.wmo.int/pages/prog/www/WMOCodes/WMO306_v12/LatestVERSION/WMO306_v12_CommonTable_en.docx

<table>
<thead>
<tr>
<th>Data categories</th>
<th>International data sub-categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUFR Edition 4 Octet 11 in Section 1</td>
<td>BUFR Edition 4 Octet 12 in Section 1</td>
</tr>
<tr>
<td><strong>Code figure</strong></td>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>3</td>
<td>Vertical soundings (satellite)</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Surface data (satellite)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Radiances (satellite measured)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>Image data (satellite)</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
D. DETAILED GUIDANCE FOR FORMATTING OF DRARS MESSAGES

1. Format Conversion
In order to ensure that all DRARS products are entirely equivalent, it is important that all DRARS operators use the same implementation of the agreed formats, for instance, for BUFR the same globally defined BUFR Table D sequence descriptors (also known as templates see [AD.1]) shall be used. These templates are embedded within the BUFR tables, which along with the conversion software will be released together with the service specific processing software. All DRARS Operators shall make use of this, or equivalent BUFR conversion software for format conversion.

2. Filenames, Bulletin Headings and BUFR Message Encoding
DRARS standards apply to the following three aspects:

- Filenames;
- Bulletin headings;
- BUFR message encoding.

From the perspective of information “wrapping”, these three aspects address different levels:

- Harmonization of BUFR message encoding is at the lowest level and focuses on Section 1 of the BUFR Message (the section dealing with identification issues - see Appendix A) and focuses purely on BUFR message encoding;

- Harmonization of the abbreviated bulletin headings is at the level above BUFR message encoding. The bulletin heading information is used by Regional Telecommunication Hubs (RTHs) to organize the routing of the messages over the GTS. The bulletin heading is not generally used by users of the BUFR messages to interpret the information; as all the necessary information to decode the BUFR message is contained within the actual BUFR message (in combination with the associated Code Tables - see the WMO Manual on Codes). Hence there is some duplication of information between section 1 of the BUFR message and the bulletin headings (albeit with different representations);

As the GTS evolves within the framework of WIS, and the focus progressively shifts from bulletins to files, it is anticipated that this issue will assume less relevance. However, for the time being, bulletins remain a much-used communication mechanism within the GTS, and harmonization of bulletin headings is required within the DRARS network;

- Harmonization of filenames could be considered as the highest-level objective, as DRARS files could typically contain bulletins that include DRARS BUFR messages.

a) Filenames
I) DRARS data files shall follow the GTS file-naming convention (with pflag=W) (see [AD.2]);

ii) A metadata file (which would generally be static) shall be associated with each DRARS data file.

So, for files containing only DRARS data, the filename structure should be of the form:

W_productidentifier_oflag_originator_yyyyMMddhhmmss[_freeformat].type[.compression]

Where:

- **productidentifier** is a variable length field that describes the nature of the data in the file. It consists of 2 parts; a “static part” and an “optional part” – which is not used in the context of DRARS.

The “static part” is the product description and consists of:

<location indicator>, <data designator>, <free description>

Where <location indicator> defines the producer: Country, Organization and the Production Centre

**Example:** for Brazil <location indicator> could be “br-INPE-cp”

Where <data designator> specifies the type of data with reference to the categories and sub-categories defined in the Common Table C-13 of the Manual on Codes, with “+” used to indicate composite data.

the <data designator> should be the instrument name without a separator and should be selected from one of the following: AMSUA, AMSUB, HIRS, MHS, IASI or ASCAT.

Where <free description> should be used to indicate satellite and originating HRPT station, and should be preceded by “DRARS”.

**Example:** for data from NOAA-17 from Cachoeira Paulista the <free description> should read “DRARS+NOAA17+cpt”.

-oflag – at this time the only admissible value of oflag is “C” – indicating that the <originator> field will be decoded as a standard CCCC country code (and the use of the CCCC value in filenames and bulletins should be consistent).

-originator is a variable length field containing information that states where the file originated from (and is decoded according to the value of <oflag>)

**Example:** “SBBR” for Brasilia Airport
yyyMMddhhmmss is a fixed length date and time stamp field. The interpretation of this field should be in accordance with the standard rules set for specific data description and types.

[_freeformat] in the context of DRARS should be “_(AAPP filename)_bufr”. This usage needs to shared with users of DRARS data.

type in the context of DRARS this value would typically be set to “bin” to indicate file containing data encoded in a WMO binary code form such as BUFR.

So a typical filename for AMSU-A data from NOAA17 provided by CPTEC/INPE in Brazil, from the HRPT station in Cachoeira Paulista, could be:

W_br-INPE-CP,AMSUA,RARS+NOAA17+cpt_C_SBBR_20110701090858_(AAPP filename)_bufr.bin

b) Bulletin Headings

The abbreviated bulletin heading for DRARS data, has the form:

T1T2A1A2iiCCCCYYGGgg(BBB)

Where:

- T1T2 should be set to “IN”;
- A1A2ii: A1 identifies the instrument (i.e. A=AMSU-A, B=AMSU-B, H=HIRS, M=MHS…..). Harmonisation of instrument identifiers in the bulletin heading and the filename is desirable (i.e. the value of A1 in the bulletin heading and the <data designator> value in the filename should be harmonised).
- A2 is the geographic area designator - as per Table C3 of the Manual on the GTS (see Appendix B). Concerning the value of A2, a Regional Indicator or a Global Indicator (“X”) can be used, depending on the most appropriate characterisation of the coverage. Where meaningful, the use of regional indicators is encouraged;
- “ii” is used when an operator issues two or more bulletins with the same values T1T2A1A2CCCC - in such cases values of ii are used to make the bulletins unique - the default is ii=01
- CCCC is the international four-letter location indicator of the station or centre originating or compiling the bulletin (as defined in WMO-No 9, Volume C1 - Catalogue of Meteorological Bulletins) and, where relevant, should be consistent with the value of CCCC used in the filename;
- YYGGgg is the international date-time group
- BBB is used for the addition, correction or amendment of an already issued bulletin.

Example: Bulletin headings from Cordoba:

INAI01 SACR YYGGgg (for AMSU-A data)
INBI01 SACR YYGGgg (for AMSU-B data)
INHI01 SACR YYGGgg (for HIRS data)
INMI01 SACR YYGGgg (for MHS data)

Example: Bulletin headings from Marambio:

INAI01 SAWB YYGGgg (for AMSU-A data)
INBI01 SAWB YYGGgg (for AMSU-B data)
INHI01 SAWB YYGGgg (for HIRS data)
INMI01 SAWB YYGGgg (for MHS data)
### E. EXISTING AND REQUESTED CODE VALUES FOR INSTRUMENTS USED BY DRARS

**GTS Headings**  \( T_1, T_2, A_1, A_2 \)

From the Manual on the GTS, WMO No. 386 Vol. 1 ([http://wis.wmo.int/gts-manual](http://wis.wmo.int/gts-manual))

<table>
<thead>
<tr>
<th>Header</th>
<th>With ( T_1, T_2 = \text{IN} )</th>
<th>Level 1 sounding products</th>
</tr>
</thead>
<tbody>
<tr>
<td>“A₁”</td>
<td>( A ) AMSU-A ( B ) AMSU-B ( H ) HIRS ( M ) MHS</td>
<td>Existing code values</td>
</tr>
<tr>
<td></td>
<td>With ( T_1, T_2 = \text{IN} )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( C ) CrIS (selected channels) ( I ) IRAS ( J ) HIRAS ( K ) MWHS/MWHS-2 ( Q ) IASI (PC scores) ( S ) ATMS ( T ) MWTS/MWTS-2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With ( T_1, T_2 = \text{IE} )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( A ) AMSU-A/METOP ( D ) IASI L2 products ( H ) HIRS/METOP ( M ) MHS/METOP ( Q ) IASI (PC scores)</td>
<td>For information only. Used by EUMETSAT with ( T_2 = \text{E} ) for products from EUMETSAT satellites.</td>
</tr>
</tbody>
</table>
### F. PRODUCT IDENTIFIER CONVENTION FOR DRARS PRODUCT FILENAMES

<table>
<thead>
<tr>
<th>Filenames</th>
<th>Data designator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(w_productidentifier_oflag-originator_yyyyMMddhhmmss[_freeformat].type[.compression])</td>
<td>product identifier</td>
<td>DRARS convention: indicate the satellite in the data designator part of the product identifier</td>
</tr>
<tr>
<td></td>
<td>IASI</td>
<td>= iasi</td>
</tr>
<tr>
<td></td>
<td>CrIS</td>
<td>= cris</td>
</tr>
<tr>
<td></td>
<td>ATMS</td>
<td>= atms</td>
</tr>
<tr>
<td></td>
<td>MWTS</td>
<td>= mwts</td>
</tr>
<tr>
<td></td>
<td>MWHS</td>
<td>= mwhs</td>
</tr>
<tr>
<td></td>
<td>IRAS</td>
<td>= iras</td>
</tr>
<tr>
<td></td>
<td>HIRAS</td>
<td>= hiras</td>
</tr>
<tr>
<td></td>
<td>Part of the Free description part</td>
<td>DRARS convention: indicate “RARS” + a satellite identifier + a station ID in the free description part of DRARS product files:</td>
</tr>
<tr>
<td></td>
<td>noaaxx</td>
<td></td>
</tr>
<tr>
<td></td>
<td>metopa</td>
<td></td>
</tr>
<tr>
<td></td>
<td>metopb</td>
<td></td>
</tr>
<tr>
<td></td>
<td>npp</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fy3a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fy3b</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fy3c</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fy3d</td>
<td></td>
</tr>
<tr>
<td></td>
<td>jpss1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>jpss2</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** the convention indicates “rars” not “drars”]

**Note:** More explanations on “Accumulating messages into files can be found in the Manual on the GTS (WMO N°386) Vol.1, Part II, Attachment II-15, as of page 158]
## G. GLOSSARY

<table>
<thead>
<tr>
<th><strong>DRARS:</strong></th>
<th>Direct Readout Acquisition and Relay System for LEO Satellite Data. It is a system based on the concept of RARS, but expanded to address a broader range of data and products, and a variety of formats and protocols while complying with a set of standards and best practices which are described in the present guide.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RARS:</strong></td>
<td>Regional ATOVS Retransmission Service. It is an arrangement among HRPT station operators to acquire, pre-process, and share satellite sounding data from ATOVS instrument package aboard NOAA and METOP satellites, in near-real time, in accordance with agreed standards, in support of NWP.</td>
</tr>
<tr>
<td><strong>DRARS Station:</strong></td>
<td>Facility including a Direct Readout station that acquires the data</td>
</tr>
<tr>
<td><strong>DRARS Operator</strong></td>
<td>Organization responsible for data acquisition and pre-processing</td>
</tr>
<tr>
<td><strong>DRARS Regional node</strong></td>
<td>Regional coordinator in charge of providing technical guidance to operators, monitoring the timeliness, and maintaining on line information for users, for a regional component of the global DRARS network</td>
</tr>
<tr>
<td><strong>DRARS Monitoring centre</strong></td>
<td>Organization in charge of DRARS product quality monitoring at the global scale (Met Office/SAF NWP, UK)</td>
</tr>
<tr>
<td><strong>CDA</strong></td>
<td>Command and Data Acquisition station, major ground facility of a Low Earth Orbit satellite programme</td>
</tr>
<tr>
<td><strong>RTH</strong></td>
<td>Regional Telecommunication Hub of the Global Telecommunication System (GTS)</td>
</tr>
</tbody>
</table>
WMO Space Programme Office, within the WMO Observing and Information Systems Department (OBS/SAT)

**OPS-LRS:** IASI “Operation Software for Local Reception Station”, which processes IASI instrument data from Level 0 (raw instrument data) through to level 1c (calibrated, geolocated, Gaussian-apodised radiances). OPS-LRS is provided by EUMETSAT through the NWP SAF as part of the AAPP deliverable.

**CCSDS:** Consultative Committee for Space Data Systems (http://public.ccsds.org/default.aspx); “CCSDS” also designates the data format standard defined by this committee.

**CCSDS to L0:** the conversion from CCSDS to EPS level 0 is generally included in the receiving station software. It is also available from EUMETSAT as part of the « Metopizer » software.

**RDR:** Raw Data Record

**SDR:** Sensor Data Record

**CSPP:** Community Satellite Processing Package provided by NOAA through the University of Wisconsin for Direct Broadcast users.

**RT-STPS:** Real-time Software Telemetry Processing System, a generalized CCSDS data processing package that ingests telemetry data from a spacecraft transmission in real-time, performs multi-mission protocol processing, and produces output to a file or TCP/IP socket. RT-STPS is provided by the NASA Direct Readout Laboratory.
H. TERMS OF REFERENCE OF THE RARS IMPLEMENTATION GROUP (V1. 16/03/2007)

[Note: this Annex contains the RARS Implementation Group ToR established in 2007. To be discussed and updated, e.g. how should this Group report to WMO (CBS through OPAG-ISS?) and inform external entities (CGMS, ITSC,..) as more Services will be included?]

1. A DRARS Coordination Group is established by the WMO Space Programme in order to support the development and implementation of the Direct Readout and Relay System for LEO Satellite data.

2. Building on the model of the EUMETSAT ATOVS Retransmission Service (EARS) the goal of the global RARS network is to improve availability and timeliness of critical polar-orbiting satellite data from the global domain through the collection and redistribution of data sets acquired from multiple receiving stations that are coordinated and inter-connected. The WMO Space Programme is pursuing RARS activities as part of the Integrated Global Data Dissemination Service (IGDDS) project.

3. The objective of the RARS Implementation Group is to co-ordinate and facilitate:
   - Establishment of new RARS to expand the RARS network towards global coverage;
   - Inter-regional data exchange of RARS data;
   - Standardization in the areas of e.g:
     - product processing software usage;
     - product formats;
     - quality-tagging of data;
     - service management.
   - Ensuring consistency with the IGDDS concept
   - Expansion of data types to be retransmitted as part of the global RARS network
   - Reviewing the RARS concept to ensure it fulfills regional and global requirements for improved timeliness of critical LEO data

4. The RARS Implementation Group shall be composed of technical experts designated by organizations contributing to the global RARS network, planning or considering to contribute to it, and of supporting staff from the WMO Space Programme.

5. The RARS Implementation group meets nominally once a year and report on its activities to CGMS and WMO

   [Include task to review the priorities ]

6. Unless otherwise agreed, the RARS Implementation group will cease its activities when its objectives will be completed or handed over to a new structure ensuring operational coordination of activities in the longer term.
## I. REGIONAL NETWORK MANAGERS AND OPERATIONAL POINTS OF CONTACT

<table>
<thead>
<tr>
<th>Regional Network</th>
<th>Regional Node</th>
<th>Network Manager</th>
<th>Operational Point of Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARS</td>
<td>EUMETSAT</td>
<td>Anders Soerensen</td>
<td><a href="mailto:anders.soerensen@eumetsat.int">anders.soerensen@eumetsat.int</a></td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>BOM</td>
<td>Anthony Rea</td>
<td><a href="mailto:a.rea@bom.gov.au">a.rea@bom.gov.au</a></td>
</tr>
<tr>
<td>South America</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>NOAA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub-regional network</th>
<th>Sub-regional Node</th>
<th>Network Manager</th>
<th>Operational Point of Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia-Pacific North</td>
<td>JMA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South America/North</td>
<td>INPE</td>
<td>Sergio Pereira</td>
<td><a href="mailto:sergio.pereira@cptec.inpe.br">sergio.pereira@cptec.inpe.br</a></td>
</tr>
<tr>
<td>South America/South</td>
<td>SMN Argentina</td>
<td>Gloria Pujol</td>
<td><a href="mailto:gpujol@smn.gov.ar">gpujol@smn.gov.ar</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Global DRARS Network</th>
<th>Coordination</th>
<th>WMO DRARS coordination</th>
<th>Global monitoring by NWP-SAF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WMO</td>
<td>Jérôme Lafeuille</td>
<td>Nigel Atkinson</td>
</tr>
</tbody>
</table>
J. PROCEDURE FOR ADDING/MODIFYING A STATION IN THE DRARS NETWORK

The purpose of this procedure is to guide the station operator on the steps to be followed when including a new station in the DRARS network, or modifying the operation mode of a station, ensuring appropriate coordination and information of all parties involved.

The following steps shall be followed for adding a new station:

**Step 1:** The Station Operator (or the regional/subregional coordinator) informs the WMO Space Programme Office (WMOSP) of the WMO Secretariat of the characteristics of the new DRARS station:

- Latitude and Longitude of the station (in degrees, with decimals)
- Name of the station
- Three-letter abbreviated name
- Centre administratively responsible for this station
- Identifier of the centre in Common Code Table (CCT) C-1/C-11 (if available)
- Identifier of the station as sub-centre of this centre in CCT C-12 (if available)
- RTH/GISC which will transmit the data over the GTS/WIS Core Network
- CCCC identifier of this RTH/GISC
- DRARS Services which will be supported by the station.

**Step 2:** If the Centre is not yet identified in CCT C-11, or if the station is not yet identified in CCT C-12 as a sub-centre of this centre, the operator requests the addition of a code for the centre and/or the sub-centre in the relevant Common Code Tables. The procedure for amending the tables is to send a request from the Permanent Representative (PR) to the Secretary-General, or from the focal point for codes and data representation matters of the country/territory to the WMO Secretariat (OBS/WIS/DRMM with copy to OBS/SAT). The procedures for amending the tables are initiated after each update implementation in May and November.

**Step 3:** The Operator implements the operational processes for acquisition, pre-processing, processing, coding and routing of DRARS products in accordance with the applicable DRARS standards defined in Sections 3 and 4.

**Step 4:** The Station operator sends file samples by FTP for validation during a minimum test period of one week [*Note: Duration to be confirmed]*

- To the RTH in charge of transmitting the data into the GTS (if different from the Operator)
- To the relevant DRARS regional coordinating center
• To the DRARS monitoring centre.

**Step 5:** The RTH, the Regional Coordinator check the consistency with DRARS conventions and regularity of the data. The Global DRARS Monitoring centre checks the consistency with global data. They interact as appropriate with the Station Operator until full compliance is demonstrated.

**Step 6:** Once the test is successful, the Operator:

- Informs the WMO Space Programme Office of the planned start of the routine dissemination, and of any change to the bulletin headings and file naming (if relevant)
- Requests the responsible RTH Focal Point in an appropriate manner so that the Focal Point can update relevant parts of the Vol. C1 with respect to the new bulletins at least two months in advance. A/N (advanced notification) of Vol. C1 will be released to WMO Members.
- Updates the discovery metadata record to share with the responsible DCPCs or GISCs

**Step 7:** The PR of the Operator's country/territory or the regional/subregional coordinator informs the WMO Secretariat of changes to the DRARS operation and provides input for inclusion of an announcement in the WWW Operational Newsletter; the Secretariat, updates the DRARS documentation accordingly and takes any other appropriate action to inform the satellite community.

In case of modification or termination of a DRARS station operation, the Operator informs the Space Programme Office of any change of status of the station, for instance if an additional DRARS Service is ready to be implemented at the station. The production associated with the new Service is implemented following Steps 3 to 7 above.

If a Service is cancelled, or the overall operation of a station is terminated, the Operator:

- informs the WMO Space Programme Office of the planned termination
- records the end of the bulletins in Vol. C1
- deletes the discovery metadata record.

The WMO Space Programme Office updates the DRARS documentation accordingly.

[Note: Check how the procedure applies, and whether it is meaningful, when station data are aggregated and processed centrally as is done by NOAA DBRTN. Since the observation is performed by the spacecraft – not the station- we don’t necessarily need the station-level details. Traceability is necessary, but the procedure should be simple to facilitate contributions]