WORLD METEOROLOGICAL ORGANIZATION
_____

COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON SATELLITE UTILIZATION AND PRODUCTS

EIGHTH SESSION

GENEVA, SWITZERLAND, 14-17 APRIL 2014

ET-SUP-8/Doc. 6.3.1
(7.IV.2014)
_____

ITEM: 6

Original: ENGLISH

REGIONAL ATOVS RETRANSMISSION SERVICES

Update on the RARS network status, procedures, and evolution

(Submitted by the Secretariat)

Summary and Purpose of Document

The scope of this document is to recall the concept of Regional ATOVS Retransmission Services (RARS), to provide an update on the status of the overall RARS network, the procedures – including e.g. coding convention – adopted to ensure consistency of RARS products, and ongoing developments including :

- Integration of several new RARS stations into the RARS/ATOVS network,
- Inclusion of advanced sounder data products from CrIS and IASI into the RARS operational procedures,
- Plans to replace the RARS Operators Standards by a Guide to the DRARS System, as part of the WMO Information System (WIS) documentation,
- Convergence with the NOAA Direct Broadcast Real Time Network (DBRTN) for NPP and JPSS.

ACTION PROPOSED

The eighth session is invited to note the information in this document and to provide feedback regarding the planned evolution of RARS including:

- renaming RARS the “Direct Readout Acquisition and Relay of Satellite Rata (DRARS)”
- developing a Guide to the DRARS System as part of WIS documentation
- striving to achieve interoperability and data sharing among the DRARS and the NOAA DBRTN initiative for NPP and JPSS.

_____

DISCUSSION

1. The RARS concept

Near-real time access to data from Low Earth orbit satellites, such as the constellation of sun-synchronous polar-orbiting meteorological satellites, poses a particular challenge because of the necessary trade-off between coverage and timeliness. On one hand, acquiring full-orbit data recorded aboard the satellite enables access to the global coverage, but with the drawback of data latency as data has to be stored until it can be dumped to a ground station. On the other hand, acquiring data by a Direct Readout station enables real-time access but coverage is limited to the acquisition area of the station and only provides data typically two to four times a day per satellite, during 10-15 minutes.

Implementing several stations enables to find a trade-off between coverage and timeliness: the latency of global orbit data can be significantly reduced through the use of several ground stations (e.g. an Antarctic station, or a whole “SafetyNet” as initially foreseen for the NPOESS programme), which reduces the on-board storage time between two consecutive data dumps; the coverage of Direct Readout acquisition can be extended through sharing data from several stations. The latter is the option taken in the Regional ATOVS Retransmission Service (RARS) concept illustrated in Fig.1, whose initial objective is to deliver satellite atmospheric sounding data from at least 90% of the globe, within 30 minutes from acquisition. This objective is driven by the Numerical weather Prediction requirements to ingest sounding data into regional or global NWP models with short cut-off. An additional feature of the RARS is the adoption of common practices by all RARS contributors in order to ensure consistency of the RARS products worldwide. This applies to data pre-processing, station identification, product coding, and filename definition.

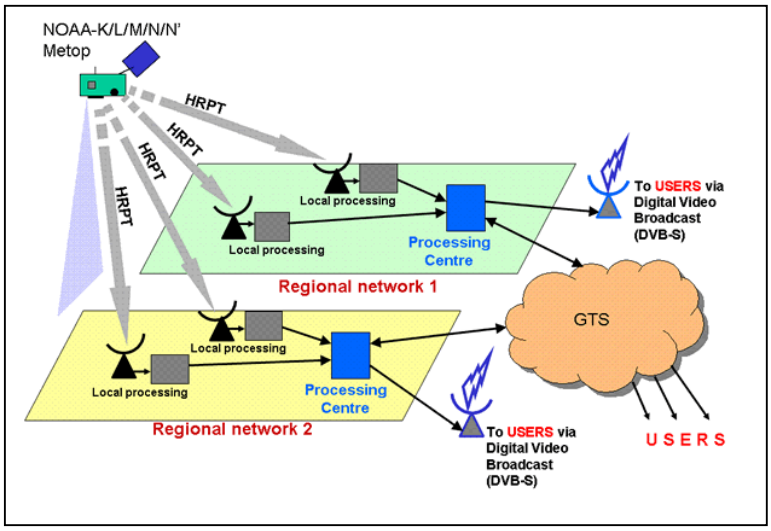


Fig.1 Schematic diagram of the RARS concept

2. RARS status

The global RARS network is comprised of three components:

- The EUMETSAT Advanced Retransmission System (EARS) managed by EUMETSAT covers mainly the European, central Asian and Atlantic areas and involves 18 stations from Canada, Denmark, France, Greece, Norway, Oman, Russian Federation, Spain and the USA;
- The Asia-Pacific RARS coordinated by the Bureau of Meteorology, Australia, with one telecommunications node in Melbourne and another in Tokyo, involves 16 stations from Australia, China, Japan, Republic of Korea, New Zealand and Singapore;
- The South America RARS with one coordination node in Argentina and another in Brazil, involves 6 stations from Argentina, Brazil, and Chile.

Currently, the RARS network involves 42 direct readout stations which altogether enable acquisition of satellite sounding data from around 80 % of the globe with a target of maximum 30-minute data latency. All 42 stations are relaying NOAA/POES ATOVS products, 24 of them are capable of relaying METOP/ATOVS products. EARS stations are also relaying IASI, CrIS and ATMS products on a pilot mode. Additional stations are being implemented and/or considered in order to fill residual gaps in the South Pacific and South Atlantic areas. The RARS initiative has nearly completed its first objective, in terms of both and quasi-global coverage (Fig.2 and Table 1) and timeliness (Fig. 3).

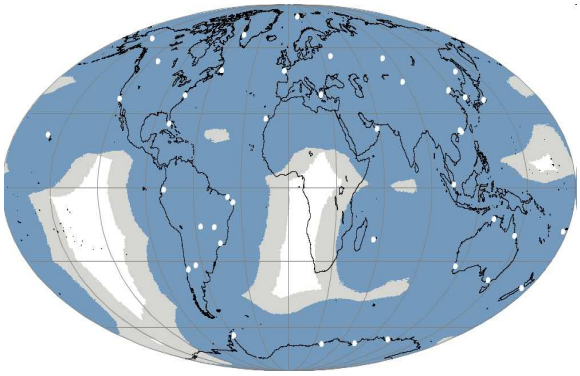


Fig. 2. Overall RARS network coverage area

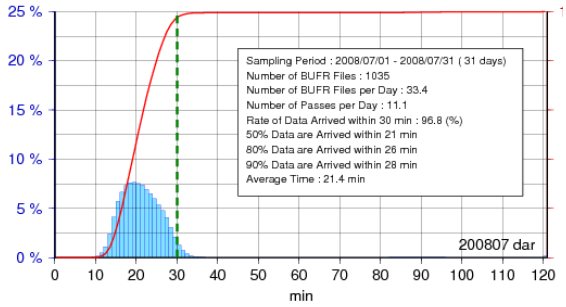


Fig. 3. Example of timeliness monitoring by the Tokyo node (time elapsed between observation and reception of each data set for a station in the Asia-Pacific network)

TABLE 1: CURRENT AND PLANNED NETWORK STATUS (MARCH 2014)

Regional component	Number of stations current (planned)	Fraction of global coverage
Europe/Atlantic	18 (19)	40% (41%)
Asia-Pacific	16 (19)	30% (36%)
South America	8 (9)	14% (17%)
Overall network	**42 (47)**	**77% (84%)**

Interoperability of the data sets from these different stations is ensured by standard practices regarding pre-processing software, data formats, coding, and distribution. First of all, for use in NWP, it is essential to ensure consistency of the data sets produced by the various individual stations, which entails the use of the same pre-processing software across the whole network. Moreover, common practices have been agreed as regards station identifiers, data format, BUFR data descriptors, GTS headings and filenames, quality monitoring and user information in order to facilitate data discovery, access and use. A global monitoring is performed to check the timeliness, integrity and consistency of the datasets. Different means are available to make RARS data globally available, either using rebroadcast by telecommunication satellite beams, or point-to-point telecommunication within the WIS, and/or FTP transfer from regional nodes to major user centres.

3. RARS procedures and best practices

The RARS best practices and conventions are summarized in the following project documents, which are available on the RARS pages of the WMO Space Programme web site (http://www.wmo.int/sat then select “Data access and use” then “RARS”):

- RARS network status (includes list of stations with coordinates and identifiers)
- RARS Coding Summary (includes entries for BUFR descriptors, GTS headings, and filenames)
- RARS Operators Standards (includes the requirements to be fulfilled by station operators)

4. Ongoing developments

4.1 From RARS to DRARS

The initial objective of the RARS was to ensure retransmission of ATOVS sounding data for regional NWP models. The RARS quickly extended its scope to the global level. The RARS is now entering a new phase with the redistribution (or relay) of advanced sounder products and may include further types of sensors in the future. In order to better reflect this new scope it is proposed to rename this initiative “Direct Readout Acquisition and Relay of Satellite Data” (DRARS).

4.2 Guide to the (D)RARS System

As the (D)RARS concept is increasingly attracting interest from the NWP community (within the ITWG), the CGMS (expanding the RARS is part of the CGMS High-Level Priority Plan), and WMO Constituent Bodies (CBS and Executive Council), it is necessary to publicize more broadly this project. It is thus planned to replace the RARS Operators Standards by an updated, more comprehensive, official, WMO Guide that will be part of the WMO Information System (WIS) documentation.

The draft outline of a “Guide to the DRARS system” is provided in Appendix A.

4.3 Network expansion

Three stations are currently in validation stage before being operationally included in the RARS:
- Tahiti (Meteo-France)
- Chennai and New Delhi (India Meteorological Department)

Furthermore, discussions are well advanced between the Directorate of Meteorology of Chile and CLS ARGOS for the implementation of a NOAA/POES and METOP receiving station on Easter Island.

Both Tahiti and Easter Island are very well located in the South Pacific to fill a current gap of the RARS network. The Chennai station will strengthen the coverage of the Indian Ocean.

4.4 Advanced sounders

A major ongoing development is to extend the RARS to the collection and retransmission of additional sensor data, in particular advanced hyperspectral infrared sounders. Since data volumes are orders of magnitude higher than for traditional sounders the network operation must be optimized by selecting stations with minimum overlap with each other, and by sampling the data through channel selection, data reduction and compression.

A roadmap was defined at the RARS meetings held in 2012 (ITSC-18/RARS Technical Subgroup, Toulouse, March 2012 and RARS ad-hoc meeting, Exeter, UK, 25-26 October 2012):
- RARS operators to implement METOP and NPP acquisition facilities (In good progress)
- EUMETSAT to develop a pilot service in its EARS project (Completed) to validate the software chain (See Fig.4) and the options regarding data selection and/or compression.
- The telecommunication impact was evaluated (See Appendix B) for discussion by the joint

APSDEU-NAEDEX meeting (Guangzhou, China, 26-28 May 2014) ;

- Data descriptors have been identified for this new data and communicated to the Inter-Programme Expert Team on Data Representation, Maintenance and Monitoring (IPET-DRMM) with a view of inclusion into the Manual on Codes and Manual on the GTS (See Appendix C);
- The advanced sounder service should be progressively implemented in the Asia-Pacific and South America network components, depending on the availability of acquisition systems and telecommunication capacity.

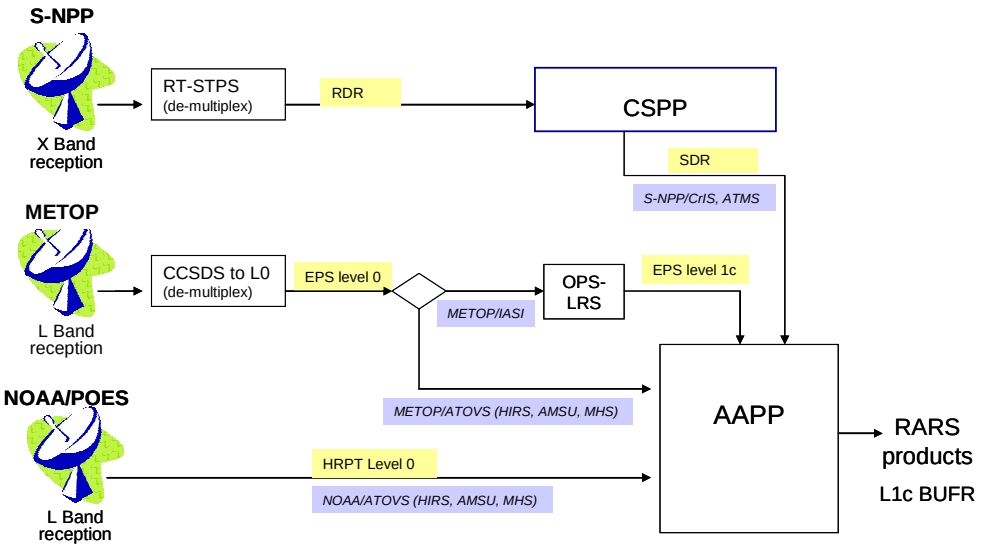


Fig. 4. RARS receiving and pre-processing chain schematics

4.5 Convergence with the NOAA DBRTN project

At the 41st meeting of CGMS, NOAA presented its Direct Broadcast Real Time Network (DBRTN) for Suomi-NPP and JPSS, which follows a concept similar to RARS although with different technical solutions. CGMS encouraged NOAA and WMO to seek convergence between these two projects. This issue was discussed with NOAA at the RARS Technical Subgroup of the 19th International TOVS Study Conference (ITSC-19, Jeju, Rep. of Korea, 26 March – 2 April 2014) where it was agreed to share the data collected by DBRTN and RARS and to seek full interoperability between these projects, the following action was agreed: "*The Space Science Engineering Centre (Univ. Wisconsin), NOAA, EUMETSAT, and WMO should coordinate on data formats, software versions, and latency requirements and come up with a plan to provide the DBRTN products for inclusion in RARS*." This development was strongly welcomed by the conference participants.

5. Conclusions

The RARS project has almost completed its initial objective. Heading now to a new phase, the "DRARS" is already in progress though facing important challenges. The opportunity to ensure data exchange and interoperability between RARS and the DBRTN project will benefit the whole community.

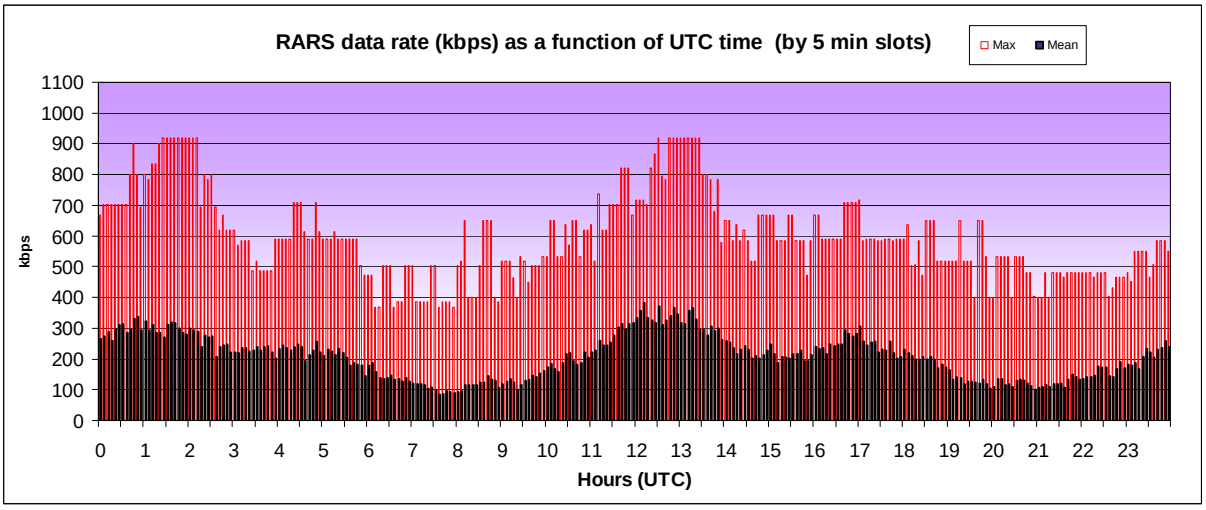
The ITSC-19 RARS Technical Sub-group recommended reactivating the RARS Implementation Group in order to efficiently monitor and guide these important developments.

_____

Draft outline of the “Guide to the DRARS system”

1. Scope
2. Definitions
3. Applicable documents
4. DRARS network structure
5. DRARS service specifications
    - 5.1 RARS data and products
    - 5.2 Pre-processing software
    - 5.3 Station identification
    - 5.4 Product formats (and data descriptors)
    - 5.5 Bulletins (and Abbreviated Headings)
    - 5.6 WIS files
    - 5.7 Timeliness
    - 5.8 Availability
    - 5.9 Quality monitoring
6. Recommended practices
    - 6.1 Quality monitoring
    - 6.2 User notification
7. Procedure for inclusion or termination of DRARS network stations
8. Appendices
    - DRARS points of contacts
    - DRARS stations identification
    - DRARS bulletin template
    - DRARS filename template

Estimation of global RARS data rates after inclusion of advanced sounder products



The diagram above displays the estimated data rates (peak and average), generated by the RARS network as a function of the time of the day, with the assumption of three spacecraft flying respectively on mid-morning, afternoon and early morning orbit, with hyperspectral sounders comparable to IASI, CrIS and HIRAS.

RARS coding elements for advanced sounders
(Subject to endorsement by CBS)

1. RARS coding summary

It is recalled that the RARS Coding Summary contains:

- Station coordinates
- BUFR description section elements:
  - Centre and sub-centre ID
  - Data category and sub-category
- GTS Abbreviated Heading $T_1T_2A_1A_2$ii CCCC YYGGgg (BBB)
  - Convention for T_1, T_2, A_1,
- Filename elements
  - w_countrycode-organization-station,instrument, rars+satellite+station_c_CCCC_yyyyMMddhhmmss_AAPPfilename_bufr.bin
- With examples and links to relevant WMO Manuals and Code Tables

2. BUFR Data sub-category for new instruments

- Hyperspectral IR= 30, Microwave sounder=40

3. GTS Abbreviated Headings: New entries for A_1 (with T_1T_2 = IN)

C : CrIS
Q : IASI
S : ATMS