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Reference User Readiness Project

SATURN

Agenda Item 10.7

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Reference User Readiness Project: Background

- To support and guide the population of the SATURN portal, WMO SP is preparing a Reference User Readiness Project
- The idea is to provide a generic timeline of user preparations activities for a new generation of satellites, and the associated timeline of deliverables from the satellite system development in support of these activities.
- The initial scope of SATURN is the new generation of GEO satellites, but the reference project definition is established in a generic manner, and therefore includes activities that only apply to LEO satellites.
- The Reference User Readiness Project has been drafted with the kind support of Richard Francis (EUMETSAT, formerly UKMO) and reviewed and commented by the SATURN points-of-contact (from JMA, CMA, NOAA, KMA and EUMETSAT).



Reference User Readiness Project: User Activities considered

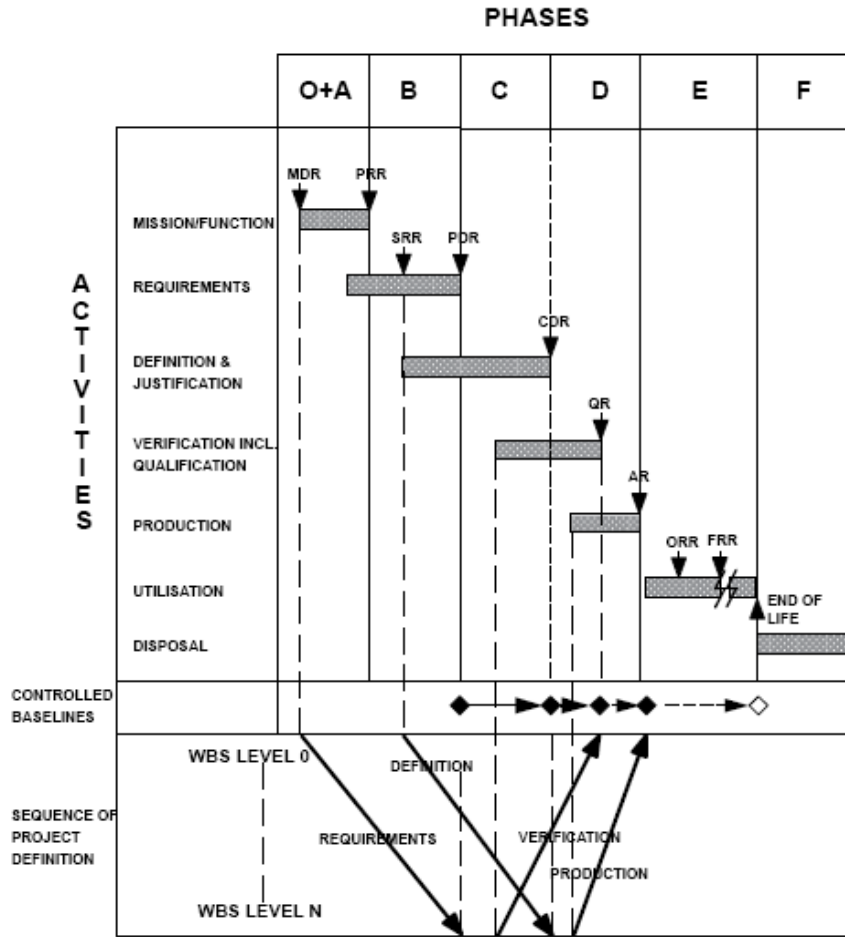
- **Budgeting and planning**
 - Budgeting of human resources and investments for preparations phase.
 - Total costs for operations
- **R&D**
 - NWP assimilation, development of tailored products
- **Data Handling upgrades**
 - Data Reception system, RMDCN, internal networks, short- and long-term storage, general IT infrastructure
- **Data Processing upgrades**
 - Local processing of direct broadcast data into L0 and L1 products
 - Transformation of received data into intermediate local formats for observations databases and archiving
 - Adaptation of NWP assimilation,
 - Local generation of higher-level products for specific application areas
 - Visualization tools, both for analysis by experts as well as for general forecasting



Reference User Readiness Project: User Activities considered

- **Training and Capacity Building**
 - High-level guidance for training in satellite meteorology is provided in the Strategy for the CGMS Virtual Laboratory for Education and Training in Satellite Meteorology.
 - Actual implementation of these guidelines in user organisations depend widely on capabilities of user organisations.
 - CB activities can take the form of regional collaborative projects like the RA-II WIGOS project, bilateral NMHS partnerships or major projects providing technical and scientific infrastructure and training for less developed WMO members (e.g. AMESD and MESA).
- **Contributions to Calibration/Validation**
 - Participation of NWP centres in instrument Cal/Val activities have become standard practice both for LEO and GEO satellites. Monitoring of FG-OBS departures for L1 products are an important contribution to the Cal/Val activities of satellite operators, and is at the same time very useful for preparing the operational assimilation of the L1 products.
 - Other specialized user organisations can also provide expertise and/or in-situ reference data to support Cal-Val activities.

Satellite System Development – typical lifecycle



- Phases shown according to ECSS, but typical for most projects
- System design finalized by end of phase C, the Critical Design Review is the final confirmation of the design.
- CDR is nominally 3 years before launch
- Full system delivered and accepted by end of Phase D, nominally 1 year before launch.
- Phase E is subdivided into
 - E1 (System Validation, Launch and commissioning)
 - E2 (routine operations)



Implications of Satellite Development Lifecycle for User Preparations

- The typical lifecycle is based on successive top-down refinement of system specifications, followed by bottom-up production and testing, and this generally does not correspond well to the timeline of user readiness projects and to the expectations of most users.
- All items made available to the user community before CDR will be based on system specifications and on prototyping
 - Example: Proxy Data (Initial versions based on instrument specifications)
- Only after system CDR (L-3y) will deliverables be based on real characteristics of the system (satellite and ground segment)
 - Example: Product Formats, Synthetic Data
- All items developed by system contractors will only become available after system acceptance (L-1y), unless specific contractual mechanisms are put in place to ensure earlier delivery
 - Example : L1 processing software
- Items provided by the satellite contractor will only become available after the on-ground testing of the instruments and only if contractual obligations for early delivery exist
 - Example: Full instrument characterisation (basis for final versions of proxy data)
- Note: The indicated timescales reflect actual experience from MSG and COMS, and the status and planning for Himawari-8, GOES-R and MTG.



Reference User Readiness Project: Deliverables from Satellite System Development

- **Instrument characterisation**
 - particularly critical for the adaptation of NWP assimilation of L1 data
- **Product specifications**
 - scientific specifications of the product algorithms,
 - detailed specification of formats for dissemination as well as on-demand requests
 - information on timeliness and expected data volumes, all for both L1 and L2 products.
- **Data access mechanism specifications**
 - specifications of mechanisms for direct broadcast (e.g. LRIT Mission Specific Implementation) and DVB-based dissemination
 - On-request (offline) access mechanisms
 - User registration process



Reference User Readiness Project: Deliverables from Satellite System Development

- **Test data and associated tools**
 - **Synthetic data:** No scientific value, but realistic sizes and formats. Used for user dataflow testing
 - **Proxy data:** Data simulated by forward Radiative Transfer Model (RTM) calculations. Proxy data are used to test processing and visualisation tools. It should be noted that as these data are produced based on NWP model data, they generally do not contain realistic spatial structure and temporal variability.
 - **Heritage data:** Actual data sets from relevant precursor instruments, i.e. 2.5 min data from Meteosat-10 for MTG-FCI, 1 min super rapid scanning data from GOES for GOES-R ABI or IASI/AIRS data for FY-4A GIIRS and MTG-IRS. Heritage data are used in early training on capabilities and application areas. It is also possible to use heritage data to construct test data similar to proxy data by adding RTM simulated data for channels to the ones present in heritage mission or by using interpolation in time and space.
 - **Pre-operational data:** Live data generated as part of the commissioning activities, but before full validation has been completed.
 - All categories of test should be delivered with appropriate software tools for utilisation



Reference User Readiness Project: Deliverables from Satellite System Development

- **Software**
 - L1 pre-processing software, required during including decompression if required
- **Operations plans and schedules**
 - Fly-out plan for overall satellite programme, including planning for launches, orbital positions and end-of-life dates, including information about overlap with existing operational satellites
 - Routine operations schedule, include areas of coverage for flexible scanning operational scenarios and process for scenario switching, e.g. activating of Super Rapid Scanning operations for severe storms and tropical cyclone tracking.
 - If appropriate, conditions for user inputs into the operations schedule (e.g. requests for special mode operations)
 - Planning for routine spacecraft maintenance activities, like orbital manoeuvres, seasonal spacecraft reorientation (yaw-flip), instrument decontamination etc.
 - Schedules for activation of LEO direct broadcast where applicable.
 - Schedules for routine dissemination for both direct broadcast and re-broadcast via telecommunications satellites.
- **Communication channels**
 - 2-way communications channels to the user community
 - Provision of general and specific information
 - Information inquiries and provide feedback during the preparations phase
 - Routine user support starting in the commissioning phase.
 - Exploit Regional satellite user coordination mechanisms (such as the Coordination Group on Satellite Data Requirements for Region III and IV; RAIDEG), regional user conferences (such as the Asia-Oceania Meteorological Satellite Users Conference) and training events (such as the GOES-R Event Week)



Reference User Readiness Project: Timeline

L-5y (years) -> L-4y	Ground Development Phase C	Segment	Initiation of NMHS user readiness Project. Initiation of cooperative projects addressing needs of less developed WMO members.	Overall specifications of user segment, including high-level definition of migration path from existing user segment. Preliminary schedule for deliverables to users
L-4y -> L-3y	System Review	Critical Design	Identification of drivers for investment and running cost. Planning and allocation of human resources and budgets for investments and running costs. Establish prioritized data requirements, as clear priorities for current and future products allow the best preparations to be made for establishing data access and delivery capabilities. Initial training on capabilities for trainers and decision makers.	General description of NRT dissemination mechanisms. Detailed specifications of L2 and L1 products to be available at start of operations (Day-1 products). Heritage test data. Plans for evolution of products after start of operations (Day-2 products).
L-3y -> L-2y	System Production On-ground characterization instruments	of	Design of new reception system. Design of comms network changes, including GTS/RMDCN capacity. Design of new data handling and processing functions. Training on specific application areas, based on proxy data.	Specifications of instruments performance. Proxy test data Detailed specifications of NRT dissemination mechanisms. Detailed specifications of Direct Broadcast mechanisms, including frequency and signal characteristics. General description of offline data access. Data/product volume estimates. Data/product format definitions. Data access conditions (e.g. licensing, key units, etc). L1 pre-processing software. Establish and use 2-way communication channels for user inquiries



Reference User Readiness Project: Timeline

L-2y -> L-1y	Ground acceptance	System	Procurement, installation and acceptance testing of systems. Software design for data processing, including NWP ingest.	Synthetic test data Continuous periods test dissemination of synthetic test data. Long-term operations plan. Planning for data exchange to serve global community.
L-1y -> L-6m	Flight readiness of satellite		End-user training (forecasters)	Start of regular updating of plans for launch and commissioning.
L-6m -> L	Operational Validation and preparations	System Launch	Data processing software testing (using proxy data). Technical training on reception systems and other system elements. Data acquisition system testing (using synthetic data).	Proxy data based on on-ground instrument characterization. User documentation for dissemination mechanisms and delivered software tools. Routine operations schedules.
L->L+6m	Satellite verification Commissioning of products	In-orbit L1	Full system and software testing (using pre-operational data). Support to operators CAL/VAL activities, in particular through NWP assimilation.	Early dissemination of un-validated L1 data. Early switch-on of Direct Broadcast Pre-operational L1 data dissemination. In flight characterization of instrument performance. Start of routine User Support
L+6m->L+2y	Commissioning of products	L2	Scientific data exploitation (iterative based on increased understanding of real data). Post-launch training based on real data. Declaration of user operational readiness	Operational L1 data dissemination, from both old and new satellites (as long as possible, but minimum until L+1y).



Reference User Readiness Project

- The reference user readiness project is a powerful tool for structuring the user readiness planning of the satellite operators
- The project timeline forms the basis for interactions with satellite operators regarding population of SATURN portal
- The timeline will be included in the SATURN portal
- Presentation to CGMS-42 is planned for discussion and potential endorsement by CGMS