SAVOIR Electronic Data Sheet Definition: Overview and Status

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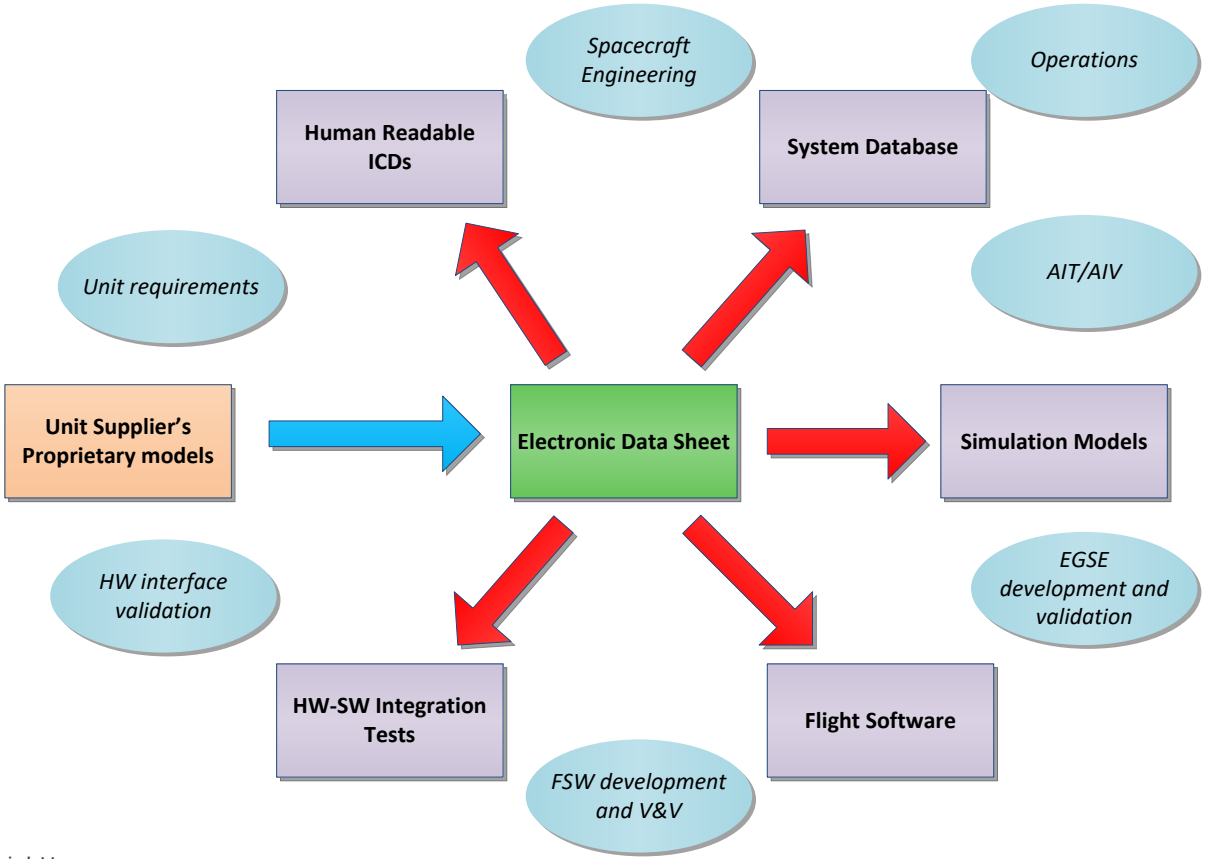
Electronic Data Sheets (EDS) – What is it?

- **Unambiguous machine readable interface specification for spacecraft avionics**
  - Sensors, actuators
  - Other units (PCDU, RTU, Solid State Mass Memory)
  - Instruments

- **Objective: Replace paper ICDs with standardized electronic format**
  - Initially communication/data handling (i.e. TM/TC ICD)
  - But gradually also electrical, thermal, mechanical

Electronic Data Sheets – Multiple Domains



EDS Overview – Key areas

1. **ESA's SAVOIR EDS Definition activity**
2. **CCSDS EDS WG**
3. **EDS use in Lunar Gateway**
4. **EDS use to create simulator models**

All areas are interconnected

- ESA's participation in CCSDS
- SAVOIR EDS feedback to CCSDS
- ESA's participation in Gateway (I-HAB, ESPRIT)
- Gateway's use cases in CCSDS

SAVOIR Electronic Data Sheet Definition

- **ESA GSTP activity**
- **Kicked off June 2018**
- **Consortium:**
  - SciSys (Prime)
  - Airbus DS (Toulouse)
  - OHB System (Bremen)
  - Thales Alenia Space (Cannes)

- **Duration: 18 months**

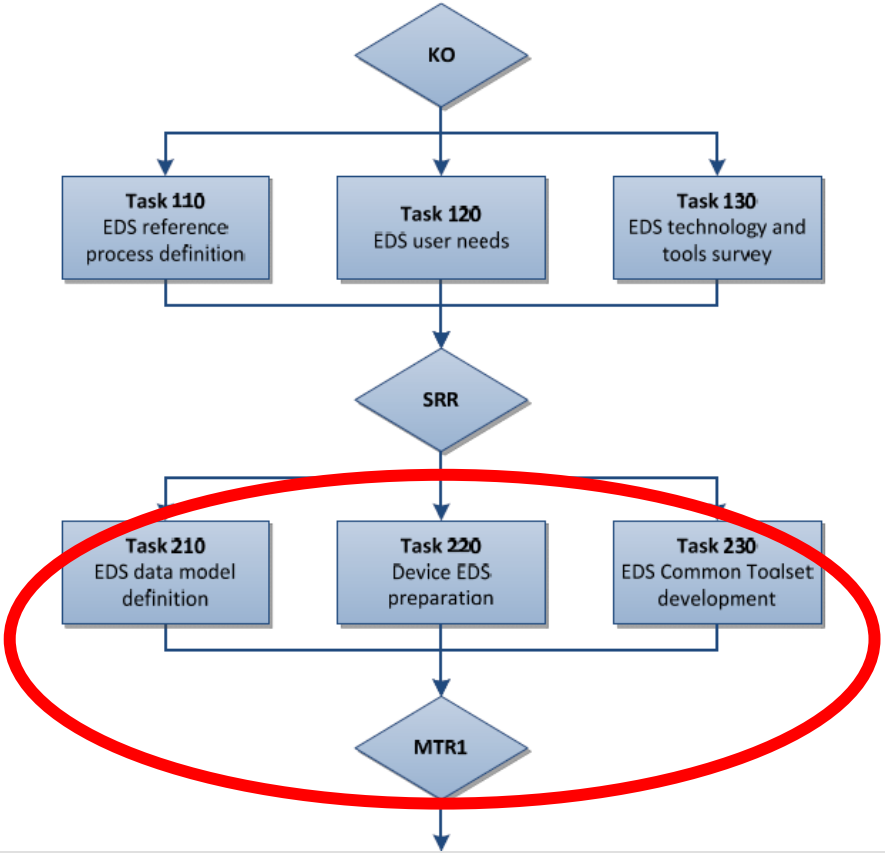
SAVOIR EDS Definition: Objectives

1. Specify user requirements covering current avionics development process and data exchange between primes and unit suppliers
2. Define the SAVOIR EDS data model
3. Assess the existing XML based exchange format developed in CCSDS
4. Develop SAVOIR EDS Common Toolset (SECT)
5. Develop multiple proof of concept prototypes reflecting various use cases
    - Involving different usage of EDS
    - Various types of units (sensors/actuators, PCDU, SSMM, RTU, etc.)
6. Propose a roadmap towards EDS adoption by European industry

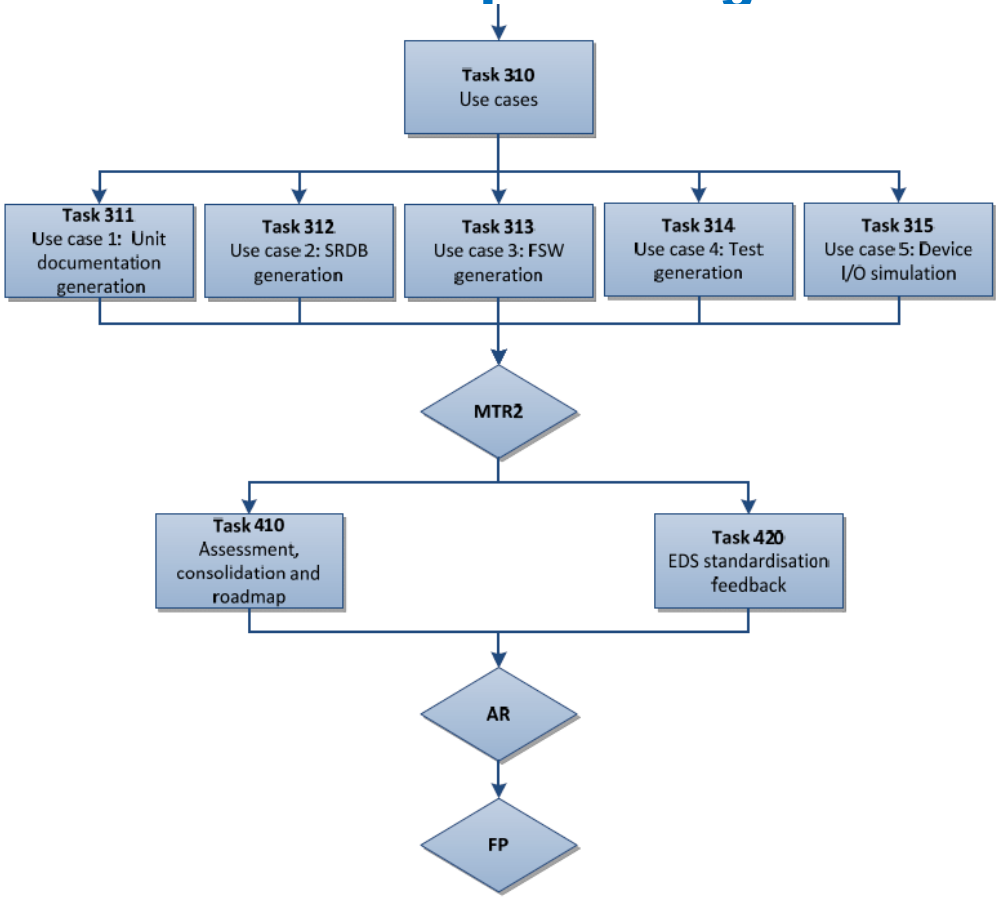
SAVOIR EDS Definition: Key Points

- Focused primarily on Data Handling and Electrical ICD
- SAVOIR EDS Data Model definition: The WHAT
  - CCSDS EDS defines WHAT+HOW (also format)
  - Also definition of ontology (CCSDS EDS Dictionary of Terms)
  - Hope is to find large overlap for TM/TC ICD
- Broader system-level view (beyond just data dictionary)
- A number of use cases and prototypes
  - Wide range of electronic units
  - Generation of documentation/code/system database/V&V/simulation artefacts
  - Experimenting with EDS together with nominal production engineering tools
- Feedback to standardisation (CCSDS, SAVOIR, ECSS ?)
- Proposing roadmap for EDS adoption
  - Steps to be taken by primes, unit suppliers, agencies

SAVOIR EDS Definition: Current status



SAVOIR EDS Definition: Upcoming Phase



SAVOIR EDS Definition: Planning

- **MTR1 ongoing**
  - **Key deliverables**
    - Conceptual domain model
    - EDS exchange format analysis
      - (XML has been selected)
    - SAVOIR EDS Common Tooling (SECT)
    - Draft EDS for prototypes
  - **Closeout planned for the end of November 2019**
- **Next phase: Experimentation (Q1-Q2/2019)**
  - 6 different units including SSMM, sensors, RIU, PCDU
  - 5 use cases including device I/O simulation, test and SRDB generation

CCSDS EDS: Current Status

- **XML Specification for Electronic Data Sheets Blue Book (876.0)**
  - Published early 2019
  - ESA & NASA main contributors (also for interoperability testing)
  - Focused on communication aspects (TM/TC ICD)
  - Applicable in Lunar Gateway (see next slide)
- **Plan for 2019 & 2020:**
  - **Publish "Electronic Data Sheets and Common Dictionary of Terms - Overview and Rationale" Green Book (870.1)**

    Key book providing rational to EDS

  - **Publish "Specification for Dictionary of Terms for Electronic Data Sheets for Onboard Components" (876.1)**

    Provides means to define and use agreed semantical information in EDS
- **Exchanges with SAVOIR EDS & Gateway**

Lunar Gateway: Use of EDS

- **EDS is in the list of applicable standards (ISwSIS)**
  - XML Specification for Electronic Data Sheets (CCSDS 876.0-R-2)
  - Dictionary of Terms for Electronic Data Sheets (CCSDS 876.1-R-2 draft)

- **Gateway data model and data dictionary**
  - EDS describes data model linked to data associated with the activities running on Gateway modules

- **Gateway specific extension of both the XML Spec and EDS DoT schemas**
  - Also data traffic description
  - The key motivation is interoperability (as opposed to SAVOIR EDS faster engineering process & MBSE & digital engineering, although clearly there are many common points)
  - Development of tools & reuse of existing ones: TTEPlan + XTCE + EDS + DoT => MagicDraw

Lunar Gateway – EDS Extensions

- **Extensions under consideration**
  - Deployment
  - Semantic attributes: Hosted by, Mounted to, Docked to
  - Physical location, coordinates
  - Tracking system when you unplug something
    - Worst case entered by crew
    - Also assets without computer (e.g. cables)
  - New items in Package (in addition to data types, interfaces and components)
    - Task (and subtypes: fitting with the timeline definition and planning)
  - Links to XTCE (XML Telemetric and Command Exchange, OMG & CCSDS)
  - Items to support TTE
- **Bottom line: It is time to start using EDS in real programmes**

EDS for Simulation and validation -- SEDS

Objective: Use EDS for simulating devices used in a simulator

- GSTP activity will develop tool - EDS compiler translating EDS XML sheet into a simulation model for the EMUBT simulator.
  - The SEDS compiler will be implemented using MLIR and LLVM
  - Use case will implement a number of EagleEye SVF sensor/actuator models in EDS XML.
- Demonstrate both EDS compiler and ontology mapping definitions with environmental simulation subsystem.

- EMUBT – SEDS KO in December 2019, 10 months duration.

MLIR: Multi-Level Intermediate Representation

Key Take-Aways

- **EDS: Unambiguous machine readable interface specification**
  - Standardised EDS to be delivered together with electronic units
  - The key thing is to standardize EDS contents and format
  - Tools to generate proprietary engineering artifacts and models
    - Software code, spacecraft database, tests, simulation models, …
- **Growing interest in space agencies & industry**
  - Making life easier (automatic flow of engineering data, inherent consistency, data validation)
  - Saving time/money/resources by reusing engineering data in standardized electronic format
  - Need to get unit suppliers involved
    - Such models already exist today but they are proprietary
    - Competitive advantage (provide units accompanied with unambiguous standardised electronic ICDs)
  - Achievable goal – general concept and technology ready
  - Evolution towards digital spacecraft engineering ongoing
- **EDS provide a great tool for interoperability**
  - Within the same spacecraft, spacecraft to spacecraft, system of multiple spacecraft

THANK YOU

Questions?

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