1 Appendix A: example of data managed by a hypothetical SRDB

In this appendix we detail the data of our hypothetical SimpleSAT SRDB. In our illustration, we use graphics or UML object diagrams in order not to associate our illustration to a specific SRDB. Additionally, we only show certain objects and certain attributes. We make abstraction of numerous details in order to keep the illustration understandable. We recall that our ultimate objective in this example is to populate and organize the SimpleSAT SRDB data that will be used to switch on the reaction wheel (RW) and to let the satellite operation manager check its temperature and its status.

1.0.1 OBHW data

First we illustrate the definition and management of OBHW data. More specifically, the SRDB will manage:

- The RW calibration $C00001$ that aims to transform Ohm to temperature as depicted in Figure 1.

C00001: calibration $calib_1$

Ohm	°C
40800	-55
71	150

Figure 1: Definition of Ohm to Degree Celcius calibration in the SRDB

- The RW port that could be used to obtain the temperature of the RW.
- The RIU port that could be used to connect RIU to RW.
- The RIU calibration $C00002$ that is used to transform raw values into Ohm as depicted in Figure 2.

C00002: calibration $calib_2$

Raw	Ohm
-2048	119
2048	250000

Figure 2: Definition of a raw to Ohm calibration in the SRDB

- The RIU telemetry parameter that aims to store the information received by the RIU port as depicted in Figure 3. At this level we cannot attach a calibration to this parameter because we do not know to which OBHW component the RIU will be connected.

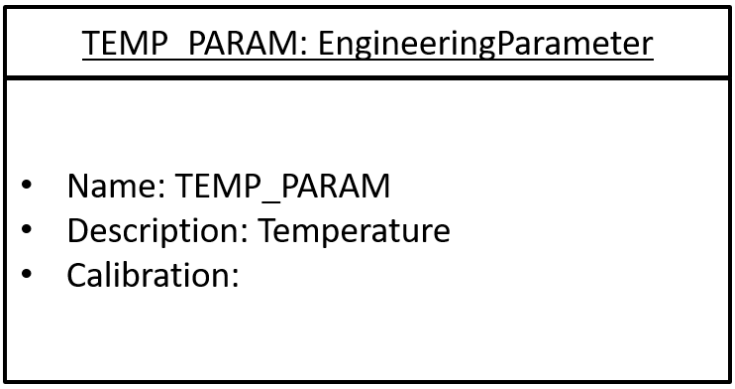

Figure 3: Definition of an RIU parameter that aims to hold temprature values

- The PCDU port that is used to switch on and off hardware components.
- The PCDU LCL's telemetry parameter that aims to store the status of the OBHW component that will be connected to the PCDU as depicted in Figure 4. At this level, this parameter is not attached to any calibration because the status text depends on the OBHW component connected to the PCDU.

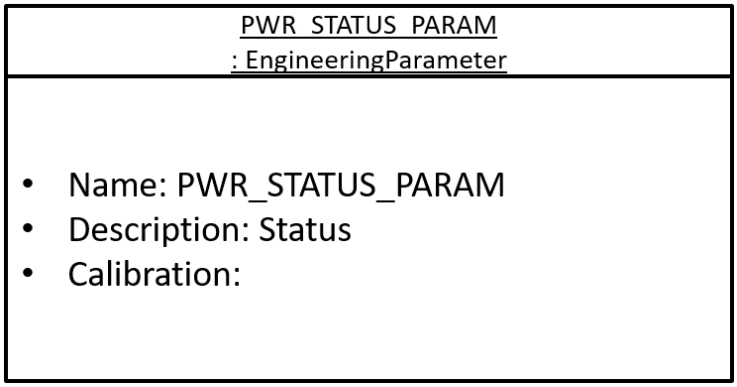

Figure 4: Definition of a PCDU parameter that aims to hold the status of the PCDU's LCL

- The PCDU calibration $C00000$ that would be used to transform PCDU's LCL raw boolean values into text as depicted in Figure 5.

C00000: calibration $calib_0$

Raw	Text
0	FALSE
1	TRUE

Figure 5: Definition of status raw-to-text calibration in the SRDB

- The definition of the Mil-Std-1553 packet that aims to command hardware as depicted in Figure 6. This constitutes the generic definition of (BC-to-RT) Mil-Std-1553 TC packets.

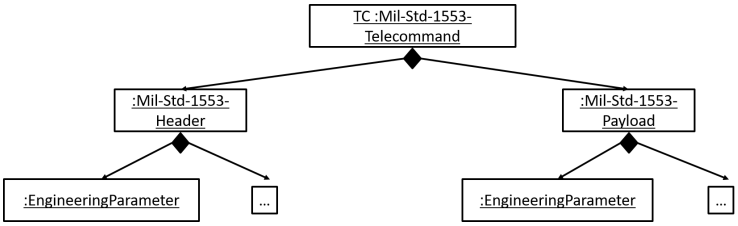

Figure 6: Definition of a generic Mil-Std-1553 TC packet in the SRDB along with its header and parameters

The list of data above constitutes the data objects required from OBHW to be able to switch on the RW and to measure its temperature via a CCS.

1.1 OBSW generic data

For OBSW data, the SRDB will manage:

- A TC packet of service 2 and subservice 1, which is used to embed Mil-Std-1553 TC packets, along with its parameters as depicted Figure 7. We highlight the parameter that aims to reference the definition of the Mil-Std-1553 TC packet that this service is expected to receive.

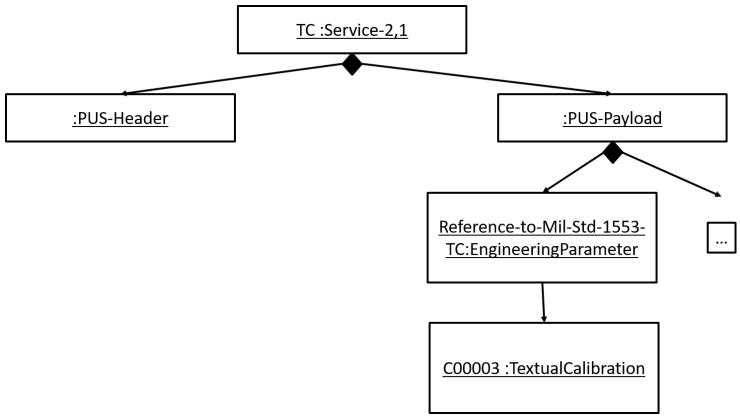

Figure 7: Definition of a generic service 2 TC packet along with its header, and inner parameters

- A textual calibration $C00003$ that would be associated with the parameter that will embed the Mil-Std-1553 TC packet in the service 2 TC definition. This calibration is depicted in Figure 8. At this stage this textual calibration is empty because the OBSW data is still generic and not missionized yet.

C00003: textual TC calibration

Hexadecimal encoding	Mil-Std-1553 TC
NA	NA

Figure 8: Definition of a calibration that associates text with the Mil-Std-1553 TC packet that could be embedded in the service 2 TC.

- A telemetry packet of service 1 and subservice 1 and its parameters as specified by the ECSS standard. This TM packet will be used to check that the TC of service 2 which will switch on the RW has been well-received on-board. The definition of the TM packet is depicted in Figure 9. We highlight one single parameter belonging to this TC that is the parameter whose value represents the identifier of the TC that will be received on-board.

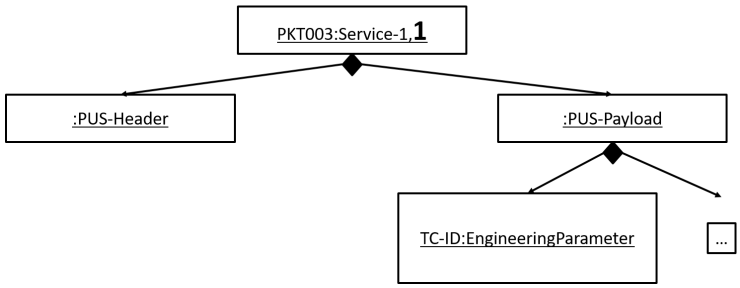

Figure 9: Definition of a TM 1,1 to confirm that the TC has been well received by the OBSW

- A telemetry packet of service 1 and subservice 7 and its parameters. This TM packet will be used to check that the TC of service 2 which will switch on the RW has been well-executed on-board. The definition of the TM packet is depicted in Figure 10. Here also, we highlight one single parameter belonging to this TC that is the parameter whose value represents the identifier of the TC that will be received on-board.

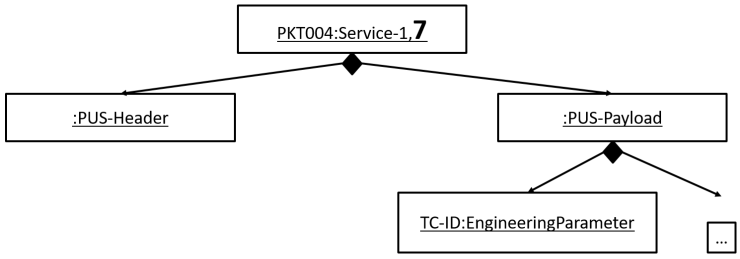

Figure 10: Definition of a TM 1,7 to confirm that the TC has been well executed by the OBSW

- An unsigned 32-bit engineering parameter that aims to contain the global status of an OBHW component as depicted by Figure 11. At this level, we do not know yet which OBHW component is concerned.

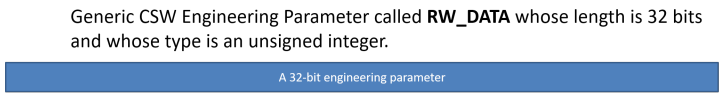

Figure 11: Definition of a generic 32-bit engineering parameter provided by the OBSW for RW data

1.2 Harness and OBSW missionized data

Missionizing the generic OBSW data and considering the harness will lead to the creation or the tailoring of the following objects in the SRDB:

- The connection of the RW with the RIU and the PCDU and the tailoring of the TMTC data to take into account this interconnection.
  - The creation of the connections between the RIU and the RW and between the PCDU and the RW.
  - The creation of the calibration $C00012$ that is the combination of $C00001$ and $C00002$. This calibration aims to transform a raw value in the temperature telemetry parameter of the RIU into a degree celcius value. The entries of this calibration are depicted in Figure fig:annex-rawtoTemp-calib.png.

C00012: calibration $calib_1 \circ calib_2$

Raw	°C
-2048	150
2048	-39

Figure 12: Definition of a raw to temperature calibration in the SRDB

  - The update of the parameter TEMP_PARAM of Figure fig:tempparamRaw to take into account the impact of the harness as depicted in Figure 13. We also update its name to make it compliant with the target CCS.

P00001:EngineeringParameter

- Name: **P00001**
- Description: Reaction Wheel Temperature
- Calibration:**C00012**

Figure 13: Tailoring of the RIU temperature to take into accoun the effect of the harness

– The update of the PCDU parameter of Figure 4 that aims to bring the status of the RW connected to the PCDU along with the calibration $C00000$ as depicted in Figure 14.

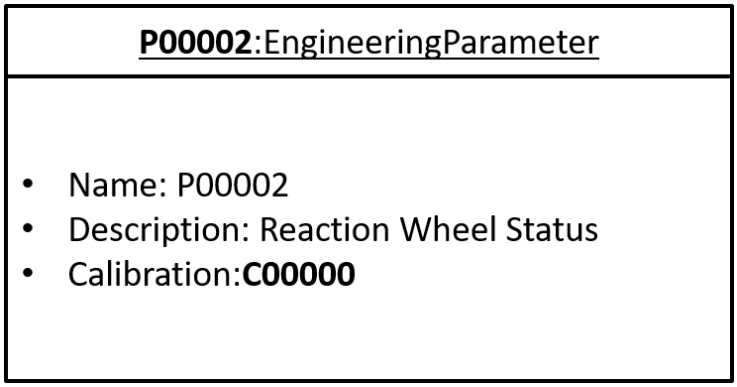

Figure 14: Tailoring of the PCDU status to take into accoun the effect of the harness

- The creation of an instance of the PCDU Mil-Std-1553 telecommand packet that aims to switch on the RW. In this TC instance, the values of the parameters of the TC packet are fixed as depicted in Figure 15.

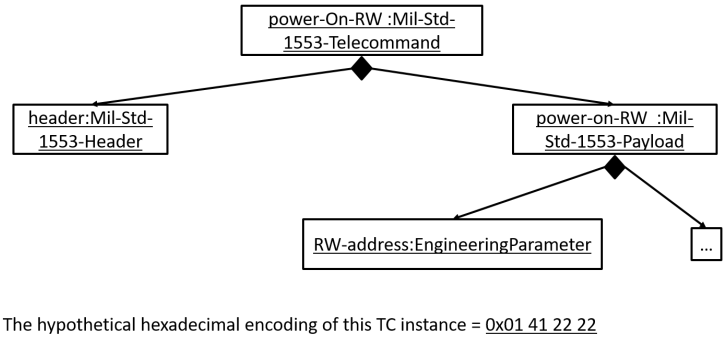

Figure 15: Definition of an instance of the Mil-Std-1553 TC packet to switch on the RW

- The update of the calibration $C00003$ of Figure 8 used by the service 2 TC in order to include the above Mil-Std-1553 TC instance. Figure 16 shows the content of that calibration after its tailoring.

C00003: textual TC calibration

Hexadecimal encoding	Mil-Std-1553 TC
0x01 41 22 22	Switch-ON-RW-N

Figure 16: Definition of a calibration that associates text with the Mil-Std-1553 TC packet instance that could be embedded in an instance of the service 2 TC.

- The creation of an instance of the service 2 TC that will be used by the satellite operation engineer to switch on the RW. The parameter that aims to embed the hexadecimal representation of the Mil-Std-1553 TC instance has been tailored to reference the calibration *C*00003 as depicted in Figure 17 and it will have the value *Switch-ON-RW-N*.

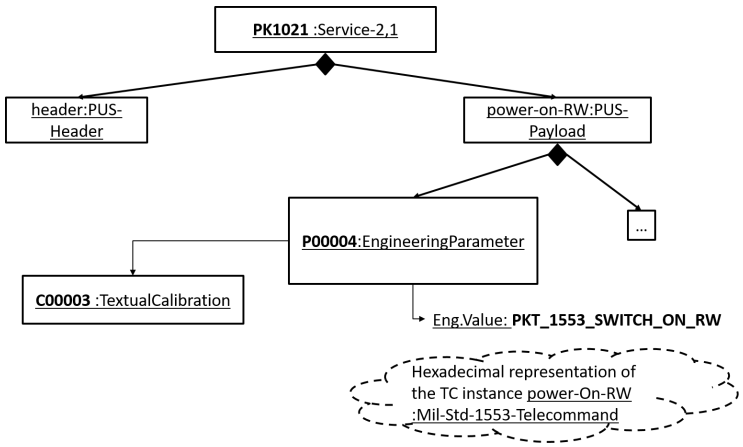

Figure 17: Definition of the TC instance of the service 2 by attaching the appropriate values to its parameters

- The decomposition and the renaming of the global RW status parameter into 3 parameters to handle the 3 pieces of information that this global RW status parameter will contains as depicted in Figure 18.

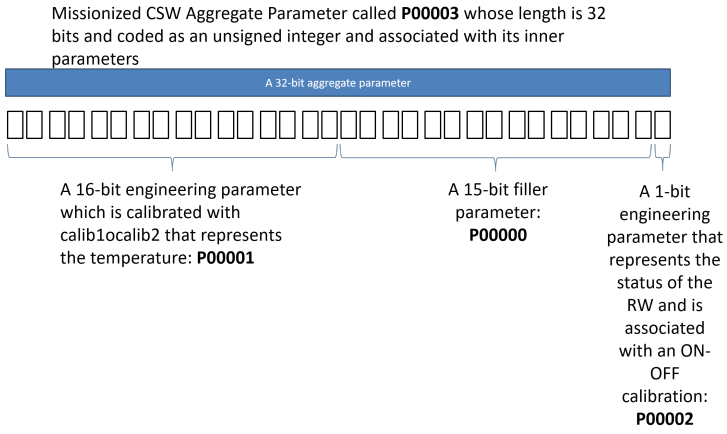

Figure 18: Missionization of the OBSW RW global status parameter

- The update of the PCDU RW status parameter with the calibration that shows the status of the RW textually as depicted in Figure 19. We also rename this parameter to make it CCS-compliant.

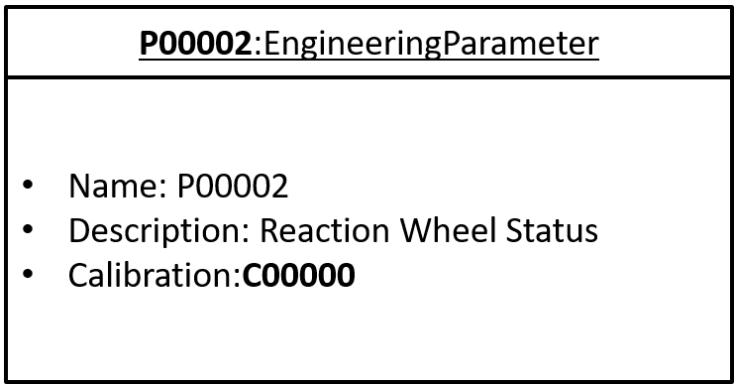

Figure 19: Missionization of the OBSW RW global status parameter

- The creation of the housekeeping TM packet (ECSS service 3 and subservice 25) that aims to bring to the CCS the global RW status parameter which is illustrated in Figure 18. The definition of this TM packet is depicted in Figure 20.

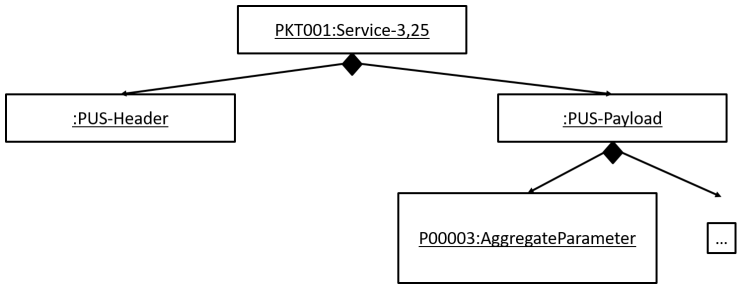

Figure 20: Missionization of the OBSW RW global status parameter

- The definition of the harness interfaces that connect the RIU and the PCDU to the RW.

At this level the harness impacts have been taken into account and the generic OBSW data has been missinized and is now specific to SimpleSAT.

1.3 Data of the as-built reaction wheel

In the SimpleSAT example, we suppose that there is an as-built RW whose calibration, which transforms ohm to temperature as, is slightly different from the definition of the calibration $C00001$, depicted in Figure 1, and defined in the RW ICD. We name this new calibration $CR0XYZ$. Its entries are depicted in Figure 21.

CR0XYZ : calibration $calib_1$

Ohm	°C
40800	-55.5
71	147

Figure 21: AS-built reaction wheel calibration