

IMA for Space: Development of Inflight Hosted Prototype Application

Final Presentation, Issue 2.1

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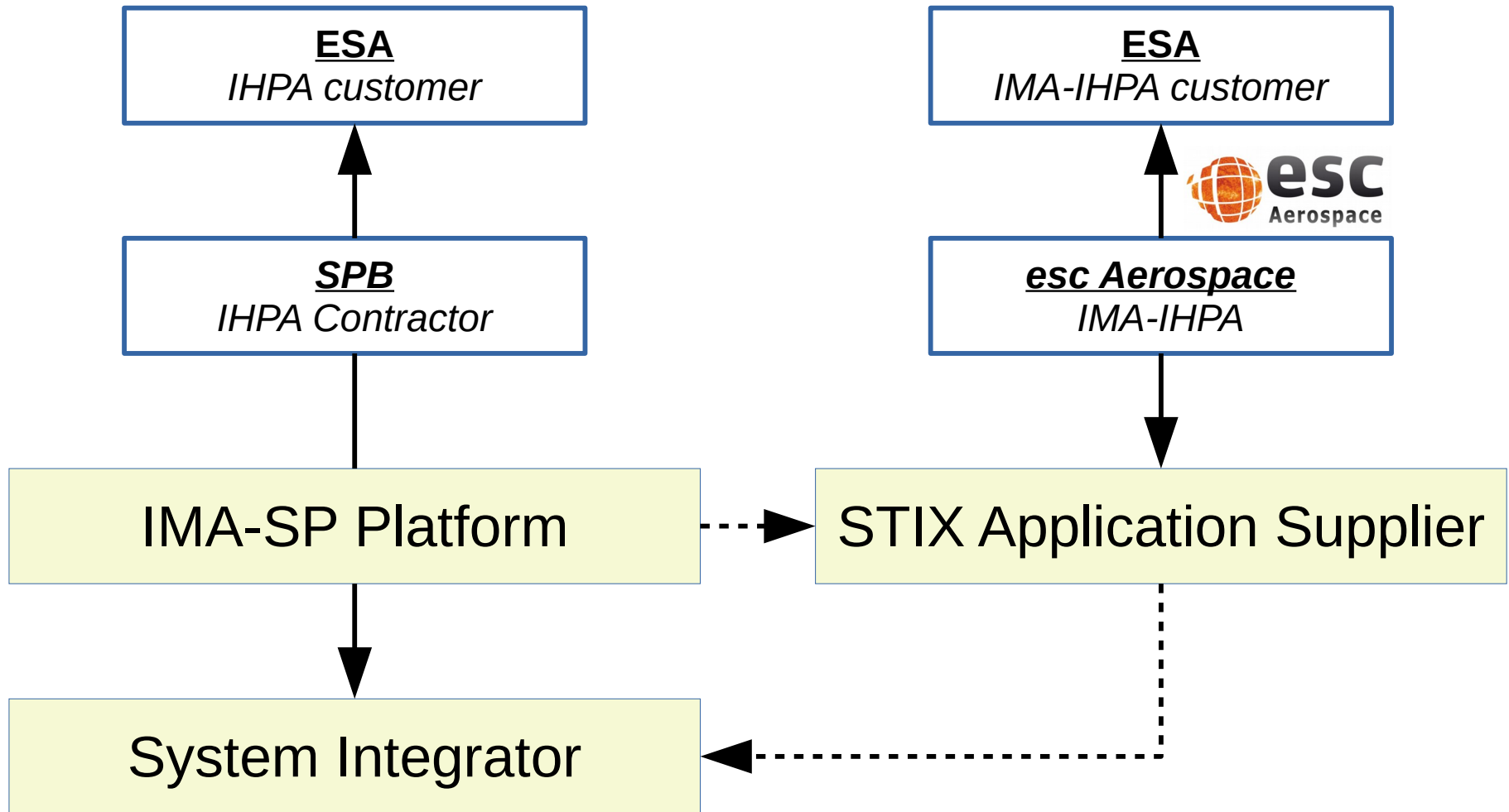
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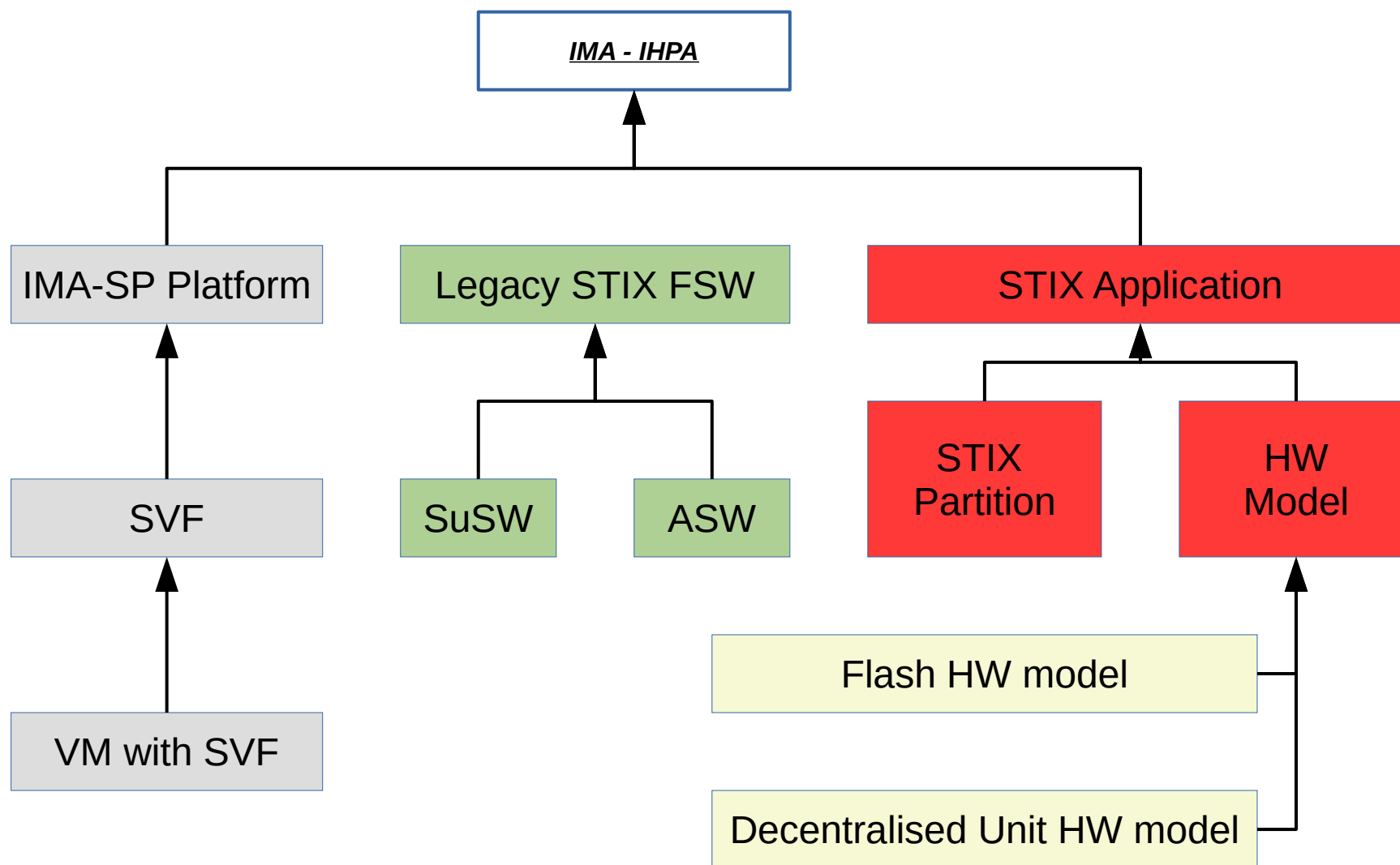
- 30 minutes presentation followed by 15 minutes Q/A
- Introduction
- IMA-SP Platform
- STIX Application
- Development
- Conclusion

Introduction



- Roles
 - System Architect (SA)
 - System Integrator (SI)
 - IMA-SP Platform Supplier (PS)
 - **Application Supplier (AS)**
- Note: **An APPLICATION** can be any of the following:
 - software
 - hardware
 - **hardware and software**

- Application Supplier (esc Aerospace, CZ) adapted legacy STIX payload software to a partition, which is executed on SVF environment of IMA-SP Platform provided by SpaceBel.
- The STIX payload is one out of ten payloads hosted on the Solar Orbiter probe, launched to study the Sun in February 2020.



IMA-SP Platform

Role	Supplier	Partitions	Note
System Architect	N/A	N/A	No System Architect role was executed in IHPA.
IMA-SP Platform	SPB	OBSM, CDHS	This shall be provided to Application Suppliers. The listed OBSM, CDHS are needed to enable independent development for each Application Supplier
Application Supplier #1	SPB	(OBSM, CDHS), ASW1	OBSM
Application Supplier #2	ESC	ASW2/STIX	-
System Integrator	SPB	OBSM, CDHS, ASW1, ASW2	-

- The CDHS and OBSM partitions are responsible for the Watchdog.
- The CDHS partitions is responsible for Watchdog kicking. This functionality is implemented in the scope of the System Manager of PROBA-2. In fact, there are several watchdogs in the PROBA-2 avionics. The CDMS partition kicks the watchdog the MPM (main processor module i.e. LEON2) cyclically. Note that the kicking of the MPM watchdog depends also on the raw battery voltage monitoring of the S/C. There is also a second watchdog located in the REM (reconfiguration electronic module) of the PROBA-2 avionic.
- The CDHS partition kicks the MPM and REM watchdogs if requested (there are telecommands to manage the configuration of the MPM/REM watchdog).
- Unless STIX wants to manage the MPM and REM watchdog, indicate that the full management of the MPM and REM watchdogs is performed by the CDHS partition.

- OBET is provided by IMA-SP Platform
- OBET can be read by partition (application)

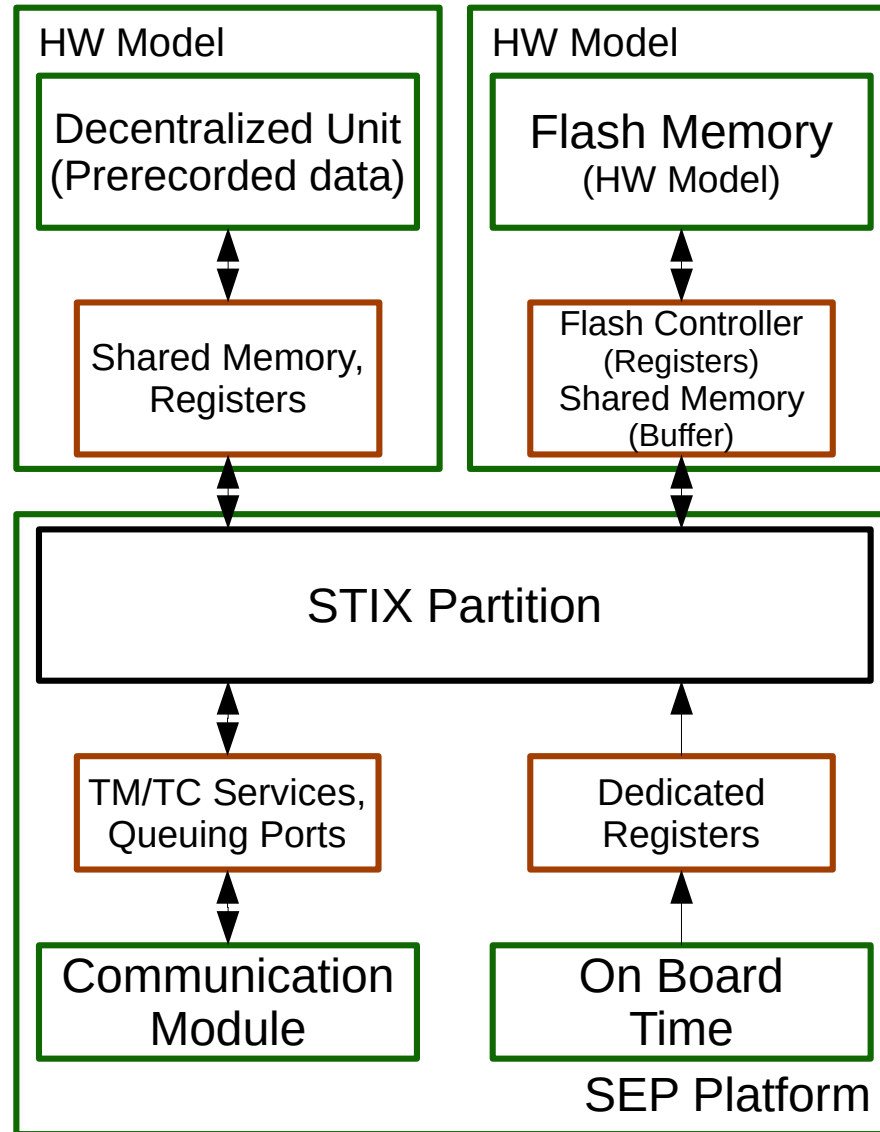
Memory Address	32-bit Register	Detail
0x2000 0018	ETCR	Elapsed Time Coarse Register
0x2000 001C	ETFR	Elapsed Time Time Register

- IMA provides the following interfaces
 - **Shared physical memory:** OBET can be implemented as hardware timer to which the R/W access will be granted to OBSM only. All remaining partitions have read-only access.
 - **Shared logical memory:** Logical memory access means that a partition is requesting read access from a virtual address, then a system partition can reply to this request by providing data. If this is possible, there will be still an overhead (in accessing real hardware). This option has no advantage to previous one.
 - **Sampling port,** which can be updated only when a partition time slot is not executed. In this case, jitter can be as high as time slot duration.
 - **Queuing port,** which is FIFO, thus there can be a non-constant jitter.

STIX Application

- STIX payload was selected
 - one (1) out of ten (10) payloads hosted on the Solar Orbiter probe
 - launched to study the Sun in February 2020.
- STIX payload
 - Hardware
 - Attenuator
 - Detector
 - Instrument Data Processing Unit (IDPU)
 - Large Archive Memory (16 GiB)
 - Software
 - SuSW
 - ASW

STIX Partition and Interfaces

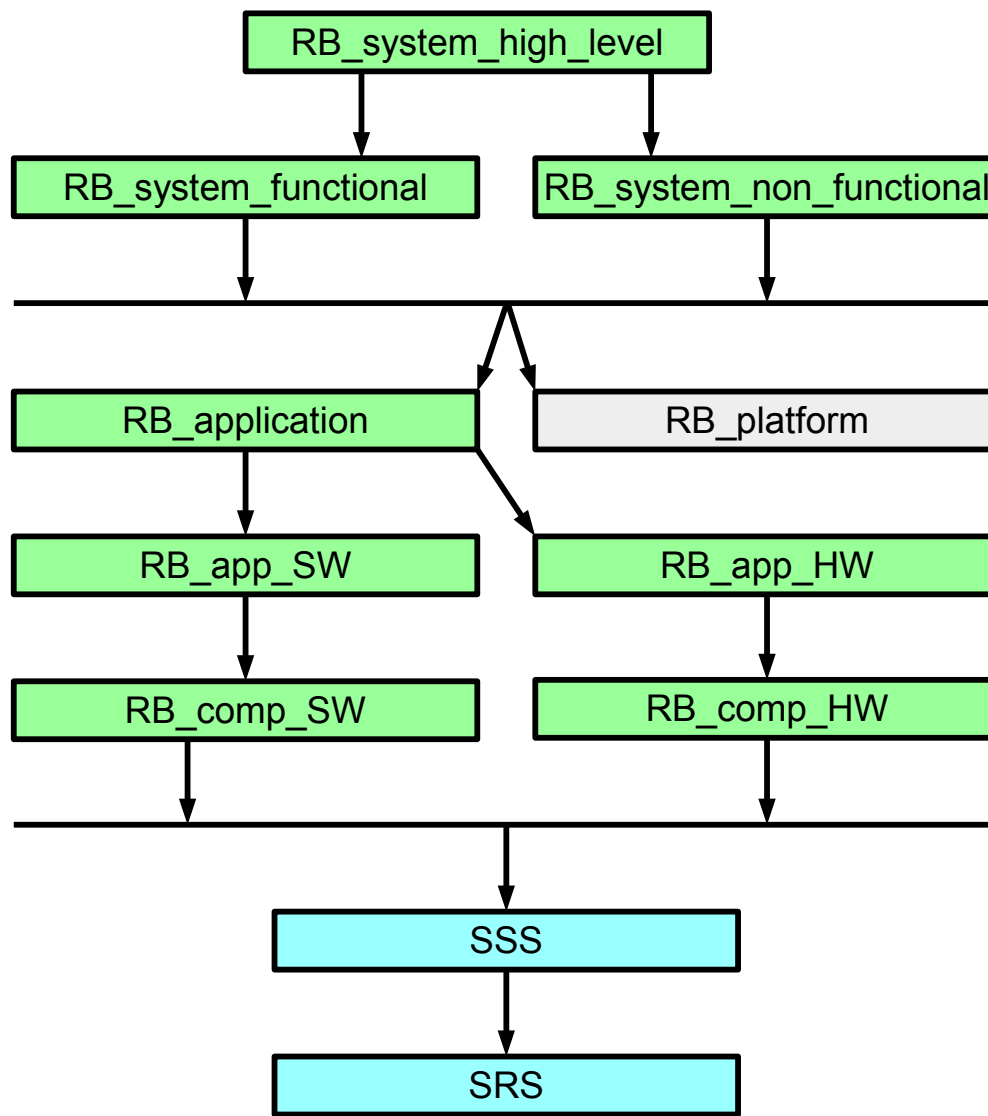


Memory type and content	Original STIX		STIX Partition Limits
	Size	ASW Use Estimate	
Internal FPGA RAM for data and code	4 kiB	N/A	N/A
External SDRAM for data and code	64 MiB	15 MiB	3 MiB
External SDRAM for rotating buffer	64 MiB	-	HW Model
Flash memory for each ASW image	4 MiB	< 800 kiB	< 800 kiB
Flash memory for archive	16 GiB	< 16 GiB	HW Model

Software item	CPU freq.	CPU Time for Mission	Total budget of Mission
Legacy STIX	10 MHz	100%	10 MHz
STIX Partition	50 MHz	12.5%	6.25 MHz

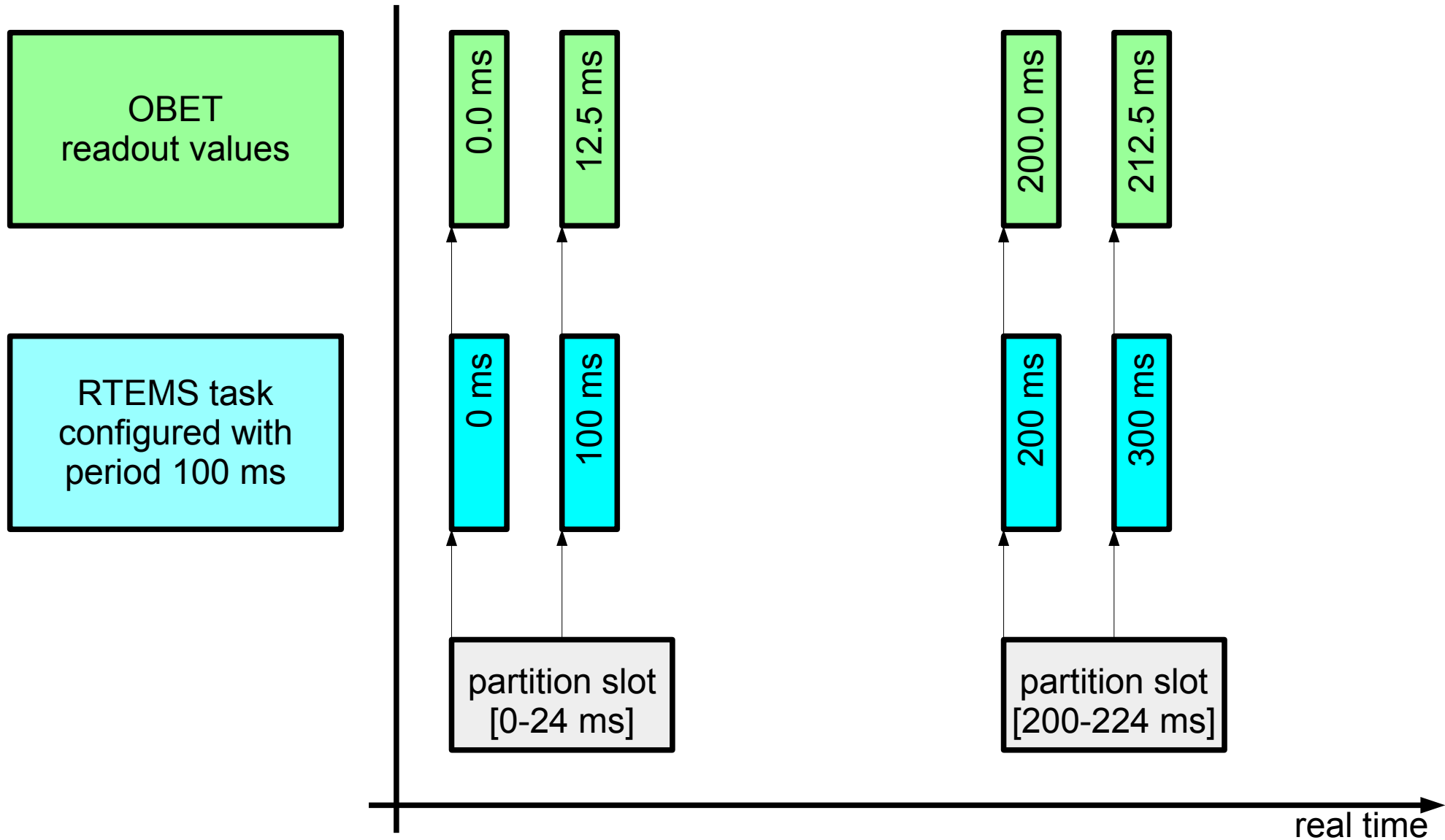
Development

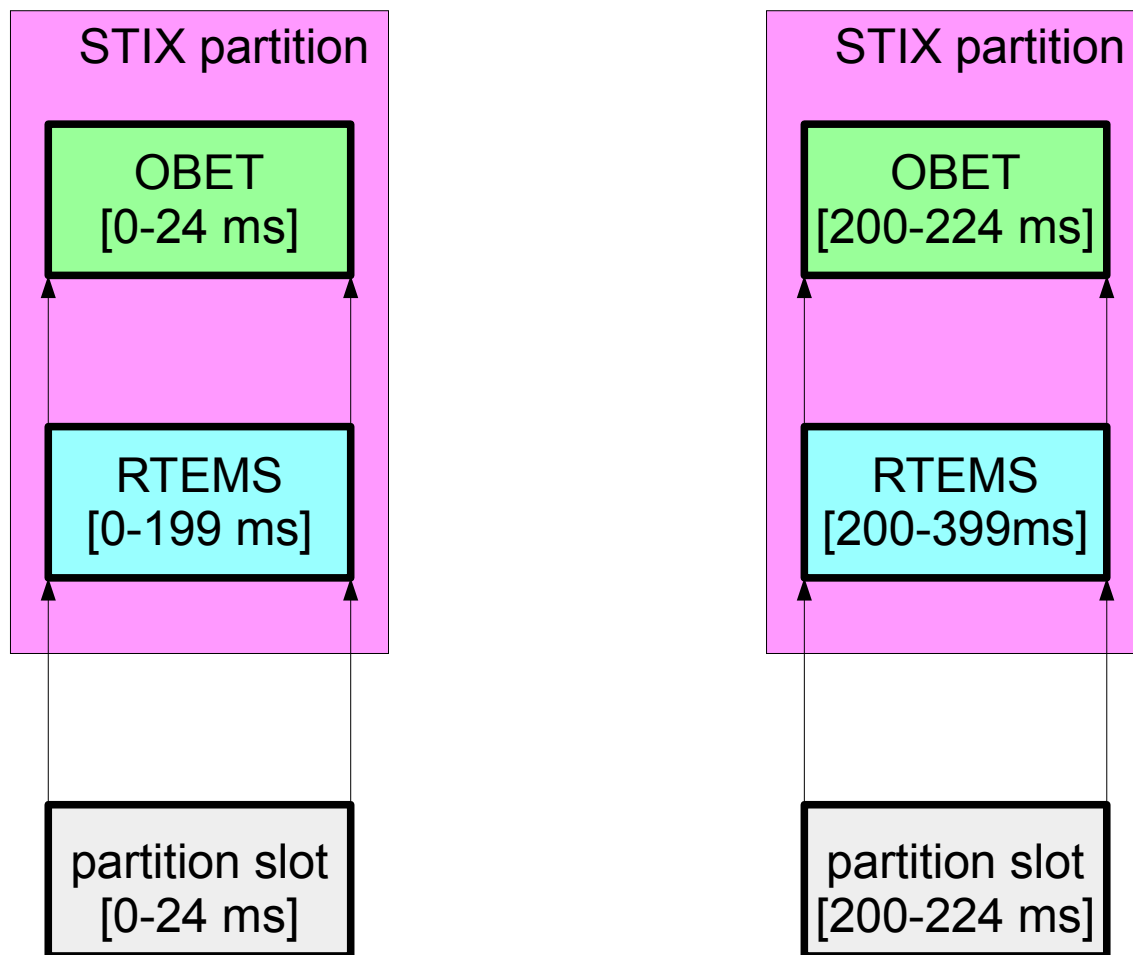
ECSS Review	IMA-SP Process
SRR	System Specification Component Reuse Analysis and Evaluation
PDR	Component Specification Partitioning and Resource Allocation System Feasibility Assessment
TRR	Procurement (reuse) Component Development
CDR	Unitary Partition Validation System Feasibility Assessment
QR	Partition Qualification
AR	System Integration System Acceptance



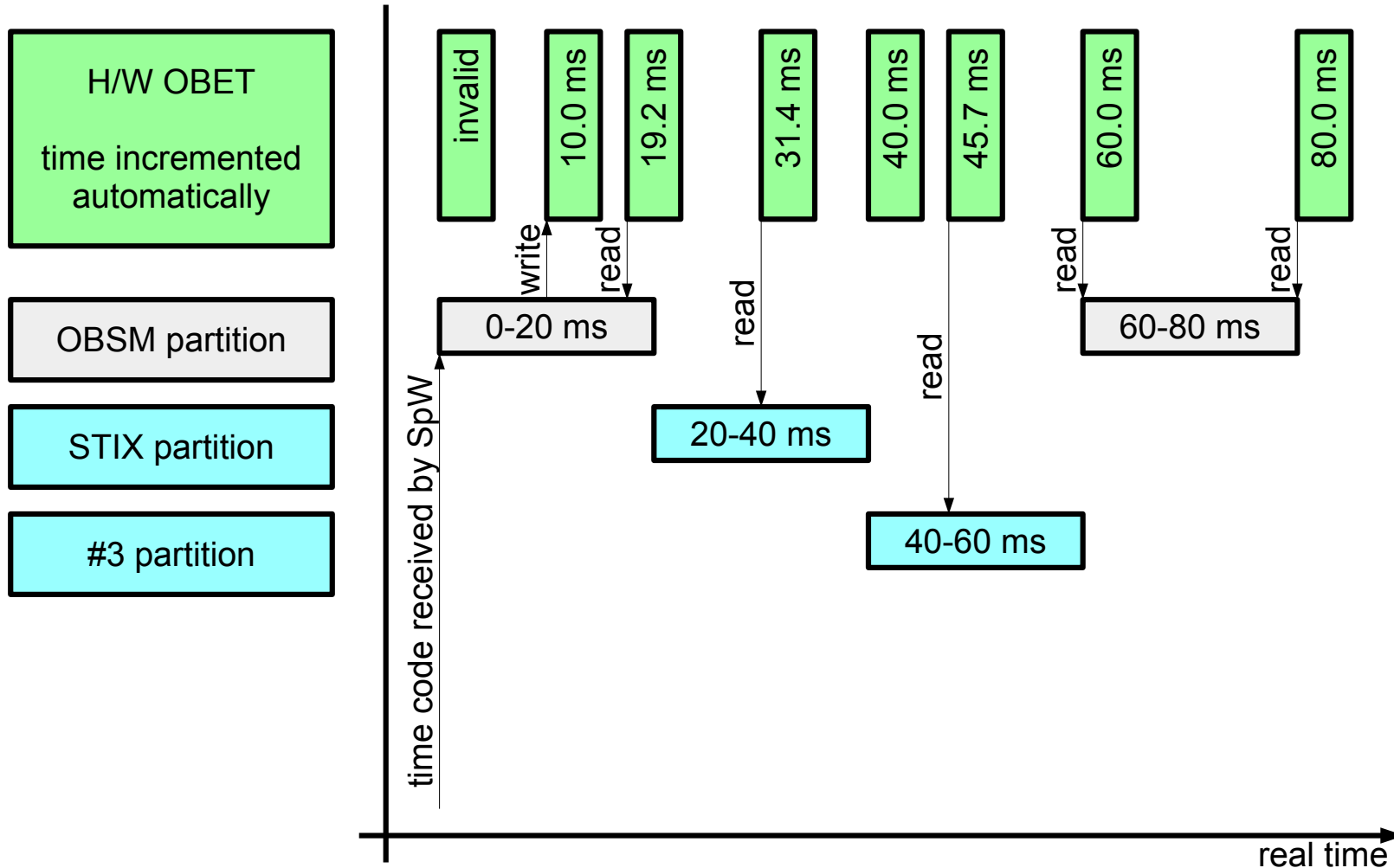
- Partitions

ID	Partition	Supplier	Purpose
P0	OBSM	SPB	IMA-SP Platform
P1	CDHS	SPB	IMA-SP Platform
P2	AOCS	SPB	AOCS Application Supplier (optional)
P3	ASW1	SPB	ASW1 Application Supplier (optional)
P4	ASW2/ STIX	ESC	Mission flight software for adapted STIX





- one (1) peripheral, three (3) partitions



Conclusion

- Application Supplier (ESC) adapted legacy STIX software to partition.
- Even the functionality could not be transferred fully (because of limited memory and CPU budget), new issues were identified related to the IMA-SP.
- All issues described in project shall be considered as input for risk management.
- The issues do not block to study IMA-SP itself and point to new topics which comes with IMA-SP.

THANK YOU!

time for any questions

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discussion

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