


I2-Hardware Compatibility Interface Specification

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1 Preamble

1.1 Purpose

SPT2CE-3515 - The I2 interface specification defines the compatibility between the Computing Platform Hardware (CPHW) and the virtualisation environment. In order to ensure direct hardware access and configuration management of computing environment hardware resources a Hypervisor Type 1 can be used. [ Open]

1.2 Intended Audience

SPT2CE-3516 - This document is intended for the key players shaping the future of rail, specifically **Infrastructure Managers, Railway Undertakings, CCS Suppliers, and Sector Organisations**. It should be noted, however, that **this list is not limited to the mentioned audience**; the content serves as a valuable resource for any professional, regulator, or partner working within the broader rail and transport ecosystem. [ Open]

1.3 Document Context

SPT2CE-3517 - This document defines the technical specifications CPHW designed to be used in the datacenters to host safe and non-safe applications. The document does not provides the exhaustive feature list for the CPHW but only the minimum features required.

Scope: This document is part of the CONEMP specification (comprising System Architecture, I2, I3 and Glossary).

[ Open]

1.4 Glossary


Term (Abbreviation)	Referenced
<p>Description</p> <p>Computing Environment (CEnv)</p> <p>A computing environment encompasses the hardware, software, network resources, and services that enable the deployment, operation, and management of applications or services. Computing environment includes the application execution environment and the computing platform.</p>	here...
<p>Computing Platform Hardware (CPHW)</p> <p>Physical Computing Elements and network hardware.</p>	here...
<p>Hardware Compatibility Interface (I2)</p> <p>The Hardware Compatibility Interface I2 (Interface 2) provides the compatibility requirements for the specific hardware used below, enabling easy replaceability of commercial of-the-shelf hardware procurable from a well-sized market of hardware vendors.</p> <p>Note: This is not really an interface, but rather a compatibility list of allowed hardware incl. CPU, memory, etc.</p>	here...
<p>Physical Computing Element (PCE)</p> <p>The Physical Computing Element refers to the physical device providing compute resources.</p>	here...


Term (Abbreviation)


Description

Referenced

2 General Overview

SPT2CE-3489 - The Computing platform Hardware could be based on non-SIL COTS components and does not perform any SIL safety functions. [ Open]


SPT2CE-3466 - As of today there are no functional application specific requirements defined for the CP hardware. For trackside deployments we do not expect any latency specific requirements that would necessitate specific network technologies such as TSN, however onboard deployments may pose stricter limitations. For the time being the aim is to stay neutral towards such specific technological needs. [ Open]

SPT2CE-3465 - For the CP we generally do not intend to specify any requirements towards the general form factor of computing hardware and such. We expect operators to have their own needs and requirements in this regard, if not bringing their own pool of COTS hardware. [ Open]


3 Technical Specifications


This chapter provides the technical specifications for the compatibility of CPHW to run Type 1 Hypervisor. This feature list is not exhaustive but only includes the minimum feature requirements.

3.1 Storage

SPT2CE-3390 - Type and size of the storage is defined by the needs of virtualisation software and FS. [ Open]

3.2 Memory


SPT2CE-3386 - Error Correction mechanism, such as ECC shall be supported for memory. [ Open]


SPT2CE-3388 - Type and size of the memory is defined by the needs of virtualisation software and FS. [ Open]

3.3 Processor

SPT2CE-2640 - CPU cores shall support the x86_64 or ARM64 ISA. [ Open]

SPT2CE-2639 - CPUs shall provide multiple cores. [ Open]


SPT2CE-2629 - The CPU shall have virtualisation extensions (e.g. Intel Virtualisation Technology, AMD-Virtualisation). [ Open]

SPT2CE-3393 - The CPU shall have an MMU. [ Open]

SPT2CE-3392 - The CPU shall have an IOMMU. [ Open]

SPT2CE-3480 - The CPU shall provide watchdog timers. [ Open]

3.4 Hardware Accelerator

SPT2CE-3494 - The Computing platform hardware may provide hardware accelerators. [ Open]

3.5 Network

SPT2CE-2628 - Ethernet based networks shall support VLAN. [👉 Open]

SPT2CE-3348 - Ethernet based networks shall support QoS, compliant to IEEE 802.3. [👉 Open]

SPT2CE-3399 - Ethernet based networks shall support at least 1Gbps per port, compliant to IEEE 802.3. [👉 Open]

SPT2CE-3398 - PCE shall provide multiple ethernet ports. [👉 Open]

3.6 Firmware

SPT2CE-3467 - All CP hardware shall include necessary firmware [👉 Open]

SPT2CE-3469 - PCE shall provide the capability to disable Hyper-Threading if the CPU features it. [👉 Open]

SPT2CE-3468 - PCE shall provide the capability to disable power management features (e.g. dynamic frequency scaling). [👉 Open]

SPT2CE-3481 - CP hardware shall support the execution of a built-in self-test mechanism. [👉 Open]

3.7 Power Supply

SPT2CE-2649 - The power supply system shall ensure the required availability of PCEs as defined by the system operator and also ensure independence (avoid single point of failure). [👉 Open]


3.8 I/O Ports

SPT2CE-3394 - For the purpose of local maintenance, hardware may have dedicated maintenance ports (e.g. VGA, HDMI, USB). [👉 Open]

SPT2CE-3397 - For the purpose of remote maintenance, hardware may have an Integrated Platform Management Interface (IPMI) with a dedicated Ethernet port. [👉 Open]

SPT2CE-3470 - A PCE shall have either a local maintenance port, a remote maintenance port, or both. [👉 Open]

3.9 Security

SPT2CE-2651 - The PCE shall provide a secure boot function (UEFI settings, ARM Trust Zone). [ Open]


SPT2CE-2631 - The PCE shall provide a TPM 2.0 or later. [ Open]

3.10 Diagnostic interface


SPT2CE-3479 - The CP hardware shall provide diagnostics data about its components, for example:


- Network components
- Storage
- Temperatures
- Fans
- Power supplies
- Watchdog
- Tamper protection

[ Open]

SPT2CE-3482 - The CP hardware shall provide an interface to remotely update firmware. [ Open]


3.11 Other


SPT2CE-2632 - The PCE shall provide a system clock which shall drift at most +/-150ppm. [ Open]

SPT2CE-3471 - The PCE may support dedicated COTS hardware accelerators with IOMMU support. [ Open]


4 Additional aspects to consider


4.1 CPU Isolation

SPT2CE-3473 - If available, cache partitioning (e.g. Intel Resource Director Technology (RDT)) is desirable. [ Open]


SPT2CE-3472 - Trusted Execution Environment extensions (e.g. Intel Software Guard Extensions (SGX) or Arm TrustZone) are considered useful security mechanisms [ Open]

4.2 Memory Protection


SPT2CE-3474 - Trusted Execution Environment extensions (e.g. Intel Software Guard Extensions (SGX) or Arm TrustZone) are considered useful security mechanisms. [ Open]

SPT2CE-3475 - Second level address translation (e.g. Intel EPT, Arm Stage 2 Translation) are considered useful security mechanisms. [ Open]


4.3 Network Redundancy

SPT2CE-3476 - We expect the CP hardware to be operated in a networking environment that has redundant switches. [ Open]

4.4 Storage Reliability

SPT2CE-3478 - Hardware assisted mechanisms for storage reliability are considered useful (e.g. hardware RAID). [ Open]

5 Non-Functional Requirements

SPT2CE-3523 - CP hardware shall comply with the applicable railway standards for each type of application. The two main applications should be: central computing/datacenter and on board/mobile data center. [ Open]


5.1 Performance Metrics

SPT2CE-3483 - The performance provided by the COTS hardware needs to fulfill the performance demands of the functional systems hosted on it. This needs to be verified through testing for e.g.

- Execution determinism (as required by each FS)
- Latencies
- Jitter
- Memory Throughput
- I/O Throughput

[ Open]

5.2 Compliance and Testing

SPT2CE-3484 - A number of general purpose certifications (e.g. CE, FCC) need to be met for COTS hardware to be usable by operators at all. Environment specific additional certifications (e.g. EMI) may be relevant in different legislations, but also environments, such as onboard. [ Open]



SPT2CE-3485 - As in the CONEMP domain, we intend to give minimum hardware requirements, we consider compliance and testing is out of scope.

[ Open]

6 Reference

SPT2CE-3406 - References

[ Open]

No	Title	Status
1	System Architecture	In Review System Architecture 
2	I3 - Virtualisation Interface Specification	In Review I3 Interface  Description
3	System Analysis	Released https://rail-research.europa.eu/v1-release/