



OPEN

Compute Project

Base specification of Open Edge sleds for Telecom Infrastructure

1.1

Author: Lucas Ferreira, Hardware Architect, Nokia

Author: Samuli Toivola, Lead Hardware Architect, Nokia

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2. Compliance with OCP Tenets

2.1 Openness

The Open Edge is optimized for installation to edge sites. The Nokia AirFrame Open Edge 3U and 2U chassis have an open design and are OCP accepted products. The Nokia AirFrame Open Edge 1U and 2U Servers, and Fronthaul Gateway, have been previously contributed and are OCP inspired products. With these base specifications for the Open Edge sleds, Nokia invites the possibility of new contributions from the OCP community to the Open Edge platform, providing added solutions that other vendors can use to build open products.

2.2 Efficiency

The Open Edge is designed with the consideration of limited floor space, cooling capacity, and power feed capacity. These characteristics make it a recommended solution for edge and far-edge sites. This way, the Open Edge provides a fundamental solution to distributing computing capacity in the network and drive the implementation of Cloud RAN, Multi-access Edge Computing (MEC), as well as 5G. Through the base specification for Open Edge sleds, new solutions can be implemented to the platform, that could provide higher modularity and capacity.

2.3 Impact

Through the continuous development of the Open Edge platform the distribution of computing power can be enabled, promoting the development of edge cloud deployments. This would benefit the promotion of lower latency, bandwidth optimization, real time computing, increased scalability, higher network resilience, and optimized energy use.

2.4 Scale

This base specification provides the necessary information for the development of new solutions to Open Edge platform. Inviting the development of new Design and Product specifications to be applied to the Open Edge Sleds.

2.5 Sustainability

The Open Edge provides a compact and high-performance platform, with the use of ultra-small footprint sleds, that developed with a focus on high energy efficiency and low material utilization. The adoption of rugged environmental specifications enables the use of these systems with minimum site environmental control, promoting the responsible use of energy and space in edge locations.

3. Change Log

Date	Version #	Author	Description
14-Aug-23	0.1	Lucas Ferreira	First draft
08-Nov-23	1.0	Lucas Ferreira	First Version
12-Mar-24	1.1	Lucas Ferreira	Formatting changes

4. Scope

This document defines the base technical specifications for the Sleds used in Open Compute Project (OCP) Open Edge, which are applied in Telecom infrastructures. The sleds may include servers, switches, and peripherals, both in terms of accelerators, and as components that might be found in a high performance or disaggregated compute environment. This is especially relevant for the edge cloud infrastructure, essential for low latency reliable connections.

Nokia has contributed the open edge chassis as an OCP accepted product [1], and contributed to the 1U and 2U server sleds as OCP inspired products [2] [3], from the initial server release in 2018, as well as the OCP inspired AirFrame Open Edge Fronthaul Gateway (FHGW) [4].

With this base specification, Nokia also aims to ensure compatibility of future solutions with current systems, as telecom equipment are typically in service for long cycles.

5. Overview

There are significant opportunities for hardware open specifications in the market of telco infrastructure and especially in the edge cloud infrastructure, fundamental for 5G applications that depend on low latency and high reliability connections.

The telecom infrastructure space has different physical and environmental requirements than those found in common data centers spaces. Within the telco deployments there are two areas to be addressed: Outside Plant (OSP), and Central Office (CO).

Outside Plant includes Cell Sites, Street Cabinets, Remote Terminals, Fiber Distribution Hubs, huts, controlled environment vaults, and pole mounted equipment. While most of these locations have been discussed as potential locations for edge cloud deployments, one of them stands out among them: the cell site. Cell sites will need to be refreshed to support disaggregated cloud based 5G radio technology.

Central Office is a name applied to many kinds of buildings from serving offices, to main offices, to mobile telephone switching offices (MTSO). These are larger places - typically buildings - that conform to local regulations established for communications carriers.

Both OSP and CO space support 19" relay racks with standard rack unit (RU) mounting points. The typical spacing between rows of equipment is smaller than that found in data centers, and in small enclosures there is often no access to the rear of the rack. Most rack mounted data center servers are too long to fit these spaces.

Two other important differences between the telco space and traditional data centers are the environmental assumptions, and the safety regulations. Telco spaces are typically powered by -48V DC, with extended temperature and humidity ranges, need to survive shaking from earthquakes, and to be safe from electrical and fire hazards in ways that are different from typical data centers.

The size and application of Open Edge is suitable for a variety of telco applications, from Central Office to Outside Plant, and customer premises locations. Several basic requirements for these spaces are described in Telcordia GR-63 and GR-1089 for COs, CEVs, and Huts; and in GR-3108 for OSP cabinets, as well as CPE in telecom closets and other customer spaces.

One last fundamental difference is the expected service life. As telecom equipment are typically expected to be in service for longer cycles than data center equipment. This supports the definition of base specifications for the Open Edge sleds in the telecom infrastructure, ensuring the compatibility of future solutions with current systems.

In essence, the key specific requirements that must guide the design of Open Edge Sleds hardware are the limited floor space, the extended temperature range, the system scalability, the compatibility with varying types of power feed [5]. While also following essential OCP design principles, as vanity free design, tool-less maintenance, and centralized power feed.

6. Environmental Regulatory Compliance and Requirements

The Open Edge system can be applied in varying environments, where datacenter or central office-like conditions may not always be guaranteed. Environmental requirements are therefore set at a higher class than for typical datacenter server products. Also, seismic tolerance needs to be addressed. To meet all the key environmental and regulatory specifications, it is necessary to test an Open edge chassis including the sleds. This should be considered when configuring an Open edge system.

The main environmental regulatory compliance requirements are presented in Table 1.

Category	Requirement
Normal operating temperature range	From +5 C to +40 C [ETSI EN300 019-1-3 Class 3.2] [GR-63-CORE]
Short term operating temperature range	From -5 to +5 C and +40 to +50 C For equipment shelves: up to +55 C [GR-63-CORE]
Operating humidity	5% to 90% ETSI EN 300 019-1-3, Class 3.1
Seismic tolerance	Earthquake risk zone 4 [GR-63-CORE]
Safety	IEC 62368-1:2014 GR-1089-CORE (electrical safety, grounding, and bonding)
Fire resistance	GR-63-CORE (shelf level criteria)
EMC/EMI	EN300386, FCC CFR47 15 (class A), CISPR 32 (class A) and CISPR 35, GR-1089-CORE

Category	Requirement
Acoustic noise	GR-63-CORE (equipment room criteria) ETSI EN303 5-3 (Unattended telecom room)
Material conformity	2011/65/EU, Article 7b (RoHS) EN IEC 63000
Airborne contaminants	GR-63-CORE (Outdoor contaminants levels)

Table 1: Environmental and regulatory specifications of Open edge chassis and sleds

7. Physical Specifications

The Open Edge sleds must be compatible with the Open Edge chassis specification [5]. The sleds are half width, and two types are possible, 1U or 2U high, following the dimensions shown in Figure 1. The 3U Open Edge chassis supports up to five 1U sleds, while the 2U Open Edge chassis supports up to three 1U sleds. One 2U sled can be installed in place of two 1U sleds. The chassis management of the OE sleds and PSUs is done through a centralized rack management controller unit (RMC) via backplane. Additionally, the backplane provides the power feed to the sleds.

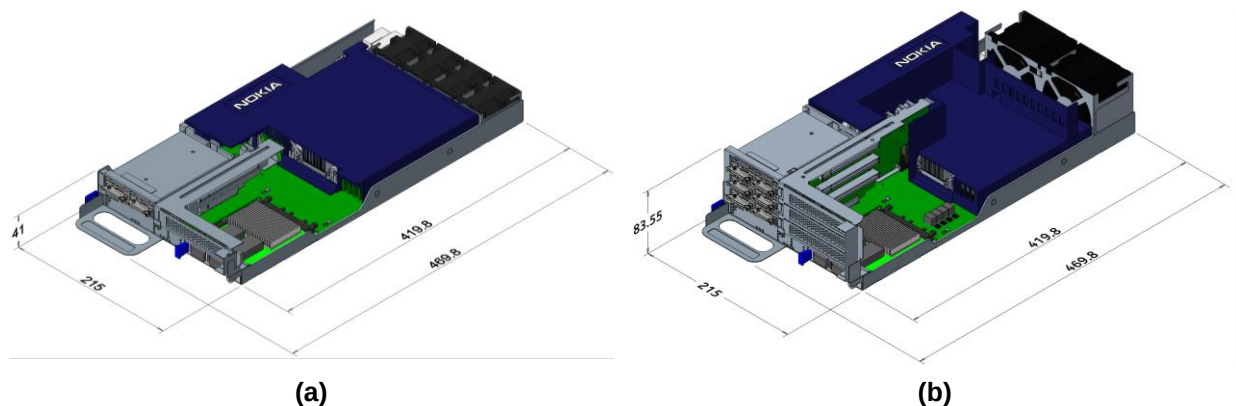


Figure 1: Open edge server sleds, (a) 1U and (b) 2U.

Following the requirement of limited access to the back of the racks, in the OE system all routine operations are done at the front side of the chassis, with all units (PSUs, RMC, and Sleds) being inserted and removed from the front, and all interfaces located in the front panel. The faceplate designs shown in Figure 1 are adapted to the particular design or device, and reinforcements for the removal handle as well as the handle itself may be modified to better accommodate ganged ports or dense front panel layouts - as long as there remains a reasonable way to remove the sleds from the chassis.

Sled designers should be aware that the Open Edge chassis is not restricted to the 2U or 3U heights, with both more and fewer bays than the existing specification being possible, through modification of the chassis height. The chassis depth however is specified to be 430 mm, though as the OE chassis has front cabling, there must be an additional 100 to 150 mm of space on the front side of the rack, with the practical minimum rack depth of 600 mm.

7.1 Mechanical

The OE sled base consists of a sheet metal tray with maximum dimensions of width 215 mm, depth (excluding the handle) of 427.5 mm, and height of 41 mm (1U) or 83.55 mm (2U). The sled base must include a handle, or equivalent mechanical interface to allow the easy removal from the chassis. Additionally, a release latch mechanism is required, providing the mechanical locking of the sliding movement between the sled and the chassis. Other key aspect of the sled design is the location of the backplane connectors and guide pin. It is critical from the point of view of system interoperability that these details are implemented according to the mechanical specifications of the sled.

While the mechanical dimensional specifications of the sled are presented above, the compatibility of the sleds is defined by the corresponding distances of the backplane connectors and of a guiding pin, that is used to provide alignment and reliable mating between the sled connectors and the chassis backplane connectors. The guiding pin is part of the chassis backplane, in which a Starconn D11402-200000-Z1 or equivalent type is used. The corresponding receptacle that must be part of the sled design is the Starconn D11403-000A00-Z1, or an equivalent type [6]. The assembly of the guiding pin and receptacle is presented in Figure 2. The sled power and signal connectors are presented in section 10.

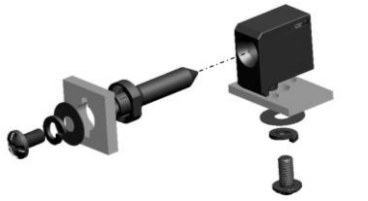


Figure 2: Guiding pin and sled receptacle. [6]

The mechanics of the sled latch may have different designs and configurations, as long as the mechanism is still compatible with the OE chassis slot, as presented in [5]. An example of the latching mechanism implementation is shown in Figure 3, this mechanism is composed by a flat spring fixed to the left side of the sled, working as a thumb latch, and operated with the sled handle. The dimensions of the latching fixture are presented in Figure 4, and any other mechanical latching implementation should be compatible with these.

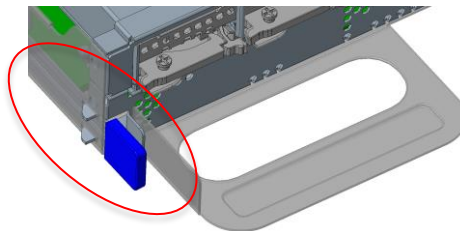


Figure 3: Latching mechanism for the Open Edge sled.



Figure 4: Basic latching dimensions for the OE sled, as viewed from the front of the sled tray (a), and in detail from the left side of the sled tray (b).

To keep the OE sleds horizontal during insertion and removal, the OE chassis presents guiding pins on the sides of the sled slots. Due to these guiding pins, the height of the sled edge in the rear side is limited to 29.25 mm. This area should also provide an even edge, without any cut-outs, up to 220 mm towards the front plate of the sled. On the front side, the height of the sled must fill the front opening, for the sake of providing proper EMC shielding. Therefore, the front height must be of 41 mm for the 1U OE sled, and 83.55 mm for the 2U sled. This height must be kept from the front panel to a minimum distance of 30.55 mm towards the rear of the sled. These specified dimensions are shown in Figure 5, from which the required dimensions are shown in green. The area marked as A (shown in blue), can be modified as required by the specific design, with the possibility of having cut-outs and a sled edge less than 29.25 mm high.

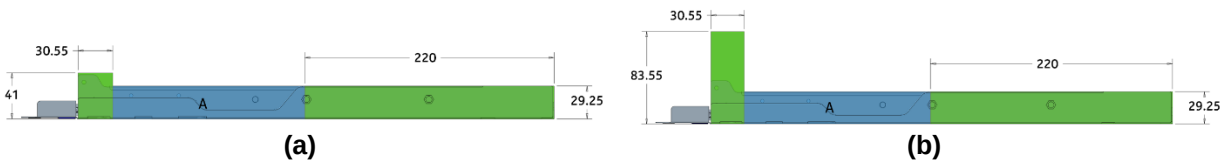


Figure 5: Open Edge required dimensions shown in green, for the 1U (a) and 2U (b) variants.

While the sled maximum dimensions are provided by the available space in the OE chassis, the actual mechanics must consider the precise positioning of the sled guiding pin and backplate connectors. This is critical from the point of view of system interoperability, although the system is design to accommodate some tolerances in the design, these features positions must be kept according to what is presented in [5], as shown in Figure 6.

In other respects, the sled tray may be freely designed mechanically, to meet other product requirements. Features such as the location of the circuit board support pillars, the fixing points for sub-assemblies, the front panel design, and the implementation of the sled handle, can be tailored to fit the different applications of the Open Edge sled.

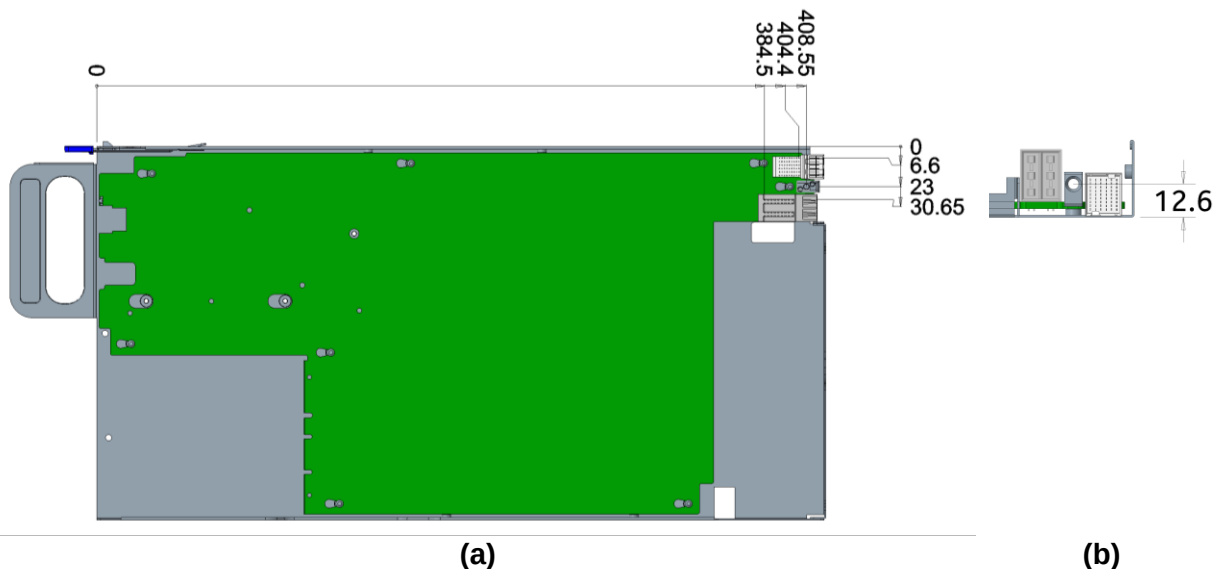


Figure 6: Position of the Open Edge sled connectors, with a top view of the sled (a), and detailed view of the back of the sled, showing the position of the guiding pin receptacle (b).

8. Electrical Requirements

The Open Edge sleds are powered by the Open Edge chassis through the backplane power connector (10.1.1). The specifications for the chassis power supplies (PSUs) are presented in [5], and include the support of both AC and DC variants. The chassis RMC is responsible for monitoring the PSUs, and backplane signals are also provided to indicate presence, activity, failure, and power loss from the PSUs to each sled.

The Open Edge sleds must have a nominal input voltage of 12.0 V DC, and the required power feed specifications are presented in Table 2.

	Nominal input voltage	Minimum operating input voltage	Maximum operating input voltage	Recommended maximum input current	Recommended overcurrent limit
1U Sled	12.0 V DC	10.8 V DC	13.2 V DC	46 A	75 A
2U Sled	12.0 V DC	10.8 V DC	13.2 V DC	74 A	78 A

Table 2: Power feed specifications for the Open Edge sleds.

The Open Edge sled design must allow the safe removal and insertion without disturbing the rest of the system. All sled designs shall have a hot-swap controller (HSC), which the main task is to provide power metering and control, including inrush current limiting during sled insertion and power-up, overcurrent protection, under voltage protection, and overvoltage protection.

The sled shall enable power capping of the device from different trigger sources. Each of these triggers can be disabled by the sled BMC. The BMC should also be able to trigger these events for debugging. The events shall include throttle signal driven by the Rack Manager, alert signal driven by the PSU, programmable threshold in Hot Swap Controller, and the test signal that allows BMC to assert power cap.

9. Thermal Design Requirements

Each sled must have its own and independent cooling control. A sled must be able to operate at full specified capacity within the specified environmental conditions, including operating temperature, humidity, and altitude.

The cooling control must adapt to the environmental conditions in a way that provides adequate cooling with minimum power consumption and acoustic noise. In fan cooled designs, the Open Edge sled must be able to tolerate failure of a single fan, or in the case of designs adopting dual rotor fans, the failure of a single fan rotor must be tolerated. In the case of failure, the fans must be replaceable, with proper procedure included in the product documentation.

At high or low temperatures, the sled must remain operational as long as possible. A thermal shutdown should be performed only when critical temperature levels of components are exceeded. A shutdown should not be performed based on sled's inlet temperature.

Depending on the site installation requirements, e.g. concerning hot/cold isle arrangements of the equipment room, the direction of cooling air through the Open edge chassis may need to be configured to be either from front to rear or from rear to front. The air flow direction of a sled should be selectable as a factory option. It is recommended that air flow direction is configurable also in the field, because sometimes the site requirements are not fully known at the time of ordering the HW.

The sled itself must be aware of the selected air flow direction and provide the information as a sensor value. When needed, the sled must automatically re-define the roles of sensors, e.g. inlet and outlet temperature sensors.

Typical Open edge sled designs may have hot-plug storage and networking interfaces in the front panel and the CPU and memories at the rear of the unit. Depending on air flow direction, components either get fresh or pre-heated cooling air. During sled development both air-flow directions shall be carefully evaluated.

Any limitations to sled configurations, performance or environmental conditions shall be stated by the sled supplier. These specifications shall be carefully considered in the particular case of the application of advanced cooling solutions, in which case deviations might be expected and proper specifications defined.

10. Interfaces

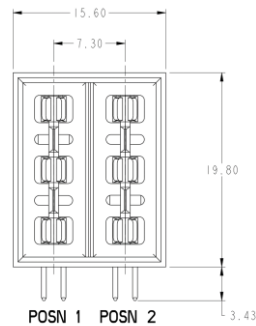
The connector interfaces for the mainboard in the Open Edge sled is dependent on the type of application, different designs may require different interface options. These may include PCIe® or Riser Card slots, OCP NICs, ComExpress Modules OCuLink connectors, and others. The detailed interface requirements need to be addressed at the Design specification level, with the proper designation done at the Product specification level. There are however common requirements for the Open Edge sled rear side connectivity.

10.1 Rear Side Power and I/O

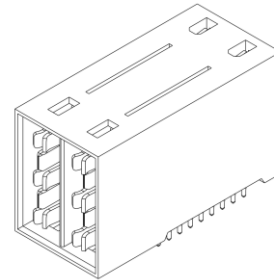
The Open Edge chassis backplane provides the power feed to the sleds and signaling between the sleds and RMC. There is one power connector and one signal connector for interfacing with each sled. Sled 1 has an additional power connector for possible future use. The backplane connects directly to the power distribution board via AirMax power and signal connectors. A detailed view of the backplane board is presented in [5].

10.1.1 Backplane power connector

The chassis backplane board distributes +12 V power to the sleds, the power feed capability is 400 W for a 1U sled and up to 700 W for a 2U sled. The power is fed through a high-power connector, in the sled the connector type must be the FCI 10078770-002LHLF, or equivalent, as shown in Figure 7. From the view presented in Figure 7.a, the POSN 1 pins are connected to the signal P12V_PSU, receiving + 12 VDC from the power feed, and POSN2 pins are connected to GND signal, being connected to the PSU ground.



(a)

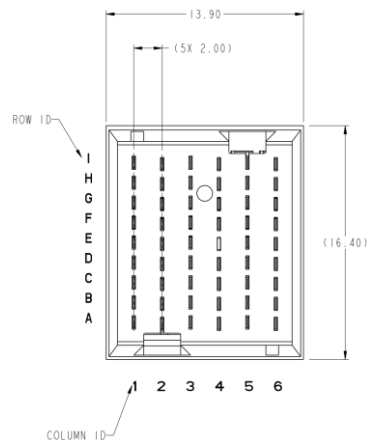


(b)

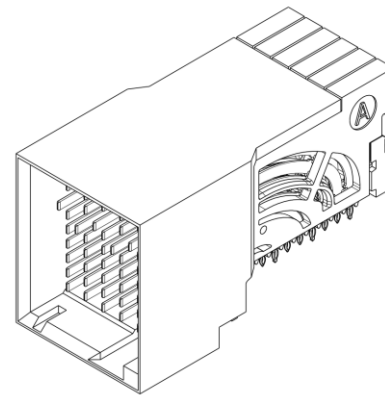
Figure 7: Backplane power connector fitted to the OE sled. [6]

10.1.2 Backplane signal connector

The signal connector between the sled and the backplane is a 6 x 9 pin AirMax VS2 connector, FCI 10124149-102LF, or equivalent. The backplane connector is shown in Figure 8, to which the pin assignments shown in Figure 8.a is mapped in Table 3. A detailed description of the signal types and functions is presented in 10.2.



(a)



(b)

Figure 8: Backplane signal connector, with the corresponding pin map (a). [7]

I	GND	LAN_SLED1_MDIN3	GND	NC	GND	PD_SLED1_PRSN_T_RETURN
H	LAN_SLED1_MDIN2	LAN_SLED1_MDIP3	FM_BMC_SLED1_READY_N	PD_SLED1_CHASSIS_INTRUSION	SMB_SLED_BUF_SDA	PD_BBU_A0
G	LAN_SLED1_MDIP2	GND	FM_RMC_GPIO_2	GND	SMB_SLED_BUF_SCL	GND
F	GND	NC	GND	NC	GND	FM_BBU_PRSN_T_N
E	LAN_SLED1_MDIN1	SB_SLED1_ADDR_2	FM_RMC_GPIO_1	NC	NC	SMB_BBU_ALERT_R_N
D	LAN_SLED1_MDIP1	GND	FM_RMC_GPIO_0	GND	NC	GND
C	GND	SB_SLED1_ADDR_1	GND	NC	GND	SMB_PMBUS_BBU_SDA
B	LAN_SLED1_MDIN0	SB_SLED1_ADDR_0	FM_SLED1_PRSN_T_N	NC	NC	SMB_PMBUS_BBU_SCL
A	LAN_SLED1_MDIP0	GND	IRQ_RMC_ALERT_N	GND	P3V3_SLED1	GND
	1	2	3	4	5	6

Table 3: Pin assignment of backplane signal connector.

10.2 Signal List

The description of the signals in the backplane connector is presented in Table 4.

Signal	Type	Description
SB_SLED1_ADDR_[2..0]	Input	Physical address from backplane to sled.
LAN_SLED1_MDIP[3..0]	Bidir	1000BASE-T between RMC and sled Magnetics are required on sled baseboard.
FM_RMC_GPIO_[2:0]	Input	General purpose I/O signals driven by RMC to all sled baseboards. The input circuit design on sled shall prevent leakage current flow from RMC, e.g. during sled hot plug. GPIO[2:0] are used to indicate the status and air flow direction of PSUs to sleds.
FM_BMC_SLED1_READY_N	Output	BMC status signal from sled to RMC. Active low. Open drain. The output circuit design on sled shall prevent leakage current flow from RMC, e.g. during sled hot plug.
FM_SLED1_PRSENT_N	Output	Sled presence status. Active low. The signal is used to inform RMC whether a sled is present in a slot.
PD_SLED1_PRSENT_RETURN	Input	Return signal for FM_SLED1_PRSENT_N. Connects to ground on backplane board, pulling FM_SLED1_PRSENT_N (or FM_BBU_PRSENT_N) low when sled is inserted to chassis.
IRQ_RMC_ALERT_N	Input	Alert signal from RMC to sleds (common to all sleds). Active low. Open drain. The purpose of the signal is to provide means to alert sleds e.g. in case of PSU failure or low input voltage.
PD_SLED1_CHASSIS_INTRUSION	Input	Signal used to detect removal of sled. Active high. Connects to GND in backplane. The signal can be used to record an event of server sled tampering (removal from chassis). The circuit is located on sled baseboard and is powered by the back-up battery. The implementation varies with e.g. the used CPU architecture
SMB_SLED_BUF_SDA	Bidir	SMBUS data between RMC and sleds (common to all sleds). An I2C buffer is required on sled to act as bus repeater and to prevent leakage current flow from RMC, e.g. during sled hot plug.
SMB_SLED_BUF_SCL	Input	SMBUS clock from RMC to sleds (common to all sleds). Open drain. An I2C buffer is required on sled to act as a bus repeater and to prevent leakage current flow from RMC, e.g. during sled hot plug.
PD_BBU_A0	Input	Physical address bit for BBU unit. The signal is present in sled1 connector only and is to be used by BBU only.
FM_BBU_PRSENT_N	Output	BBU presence signal to RMC. Active low. The signal is connected to GND on BBU board. The signal is present in sled1 connector only and is to be used by BBU only.
SMB_BBU_ALERT_R_N	Output	Alert signal from BBU to RMC. Active low. The signal is present in sled1 connector only and is to be used by BBU only.
SMB_PMBUS_BBU_SDA	Bidir	SMBUS data between RMC and BBU. Open drain.
SMB_PMBUS_BBU_SCL	Input	SMBUS clock from RMC to BBU. Open drain.
P3V3_SLED1	Power	3V3 auxiliary voltage from sled to backplane. Used as pull-up voltage for slot address.
GND	Power	Ground

Table 4: Backplane signal connector descriptions, the signal direction (Input, Output, Bidirectional) is presented from sled perspective.

11. Onboard Power System

Different power systems architectures could be conceived for the Open Edge sleds, as long as the chassis and power connector limitations are kept. The maximum power per sled is limited to 500 W for the 1U sleds, and 780 W for the 2U variant. Additionally, the maximum power for the chassis must not exceed 2000 W. The Open Edge sled must also comply with auxiliary power requirements and IO logic for the back plane connectors, as is presented in Table 4. Specific design requirements for the onboard power systems at the sled level are beyond the scope of this base specification.

12. Prescribed Materials

Typical telco deployments include spaces that do not have fire suppression equipment. This has led to requiring that the designs for these spaces be essentially non-flammable. The Open Edge sleds are required to meet the specification of shelf-level fire-resistance as established by in the Telcordia GR-63-Core [9]. This defines the requirements for fire spread and fire propagation characterization. The selection of materials for the Open Edge sleds must take into consideration the fire-resistance requirements are met.

The Open Edge sleds must also be compliant to the directive 2011/65/EU, Article 7b of the European Parliament and of the Council (RoHs). This compliance is fundamental in limiting the use of hazardous substances, protecting the environment and human health. Specific prescribed and disallowed components shall be submitted at the design specifications level.

13. System Firmware

The Open Edge sleds shall adopt open system firmware. In the application of server sleds the system initialization firmware (BIOS) uses one 256Mb (32MiB) flash device located on the chipset SPI bus, and the BIOS shall be recoverable and updatable from the BMC.

Specific system firmware requirements shall be part of the design specifications, which may include the availability of the BIOS in source form from an OCP recognized GITHUB as defined by the OCP Open System Firmware project. In that case it shall be possible for end users to create, install, and redistribute BIOS images with no restrictions.

14. Hardware Management

The hardware management for Open Edge sleds may use a Baseboard Management Controller circuitry (BMC), for server sleds the ASPEED AST2600 64 MB or equivalent is recommended, and for sleds where BMCs might be optional RunBMC is the preferred modular BMC option. The primary requirements for the management of the sled include:

- BMC dedicated 1GbE LAN for communication with RMC.
- Low pin count (LPC) or equivalent connection to the chipset to support in-band management.
- Out of band environmental controls for power and thermal management.
- FRU ID EEPROM for storage of manufacturing data and events (I2C).
- Thermal sensors for inlet, exhaust and other appropriate temperature monitoring (I2C).

- Power monitoring through the 12V Hot Swap Controller circuitry (I2C).
- Service LEDs.
- Server sleds should typically support the VGA option.

For designs that use RunBMC or other BMC modules, care should be taken that manufacture data that should stay with the system is not stored on replaceable BMC modules.

The BMC boots from a flash memory device located on the SPI bus. The device size shall be 256Mb (32MiB) minimum and shall also be used to store FPGA and CPLD recovery images. A secondary device shall be supported to provide BMC recovery. The design shall support a socket for the primary device during preproduction. It is not required to support a socket for the secondary device.

Some deployment scenarios forbid the use of batteries of any type. All types of Open Edge sleds shall be able to remove the coin cell, typically deployed to retain settings and RTC. The BMC must be able to store configuration files in a non-volatile memory and must be able to pull date and time using NTP at boot. It is acceptable to design the sled with a battery holder and ensure that it will work with the battery being present or absent.

The sled is managed through a 1GbE PHY connected from the Open Edge chassis to the BMC. This connection provides 1GbE connectivity to a management switch in the rack management module. The PHY shall be Broadcom BCM53134 or equivalent. If the server design allows for sharing the BMC LAN port with the host OS, then it must be possible to disable this feature at the firmware level.

14.1 Compliance

Some of the features commonly expected in the hardware management controller may include:

- Serial Console over LAN with SSH support.
- Web based user interface.
- HTML5 KVM to host OS.
- Remote Power Control and Power policy.
- Port 80 POST.
- Power and System Identification LED.
- Platform Environment Control Interface (PECI).
- Power and Thermal Monitoring and power limiting.
- CPU, GPU, Switch ASIC, and other peripheral thermal monitoring.
- Sensors/Events.
- System Event Log (local and remote).
- Fan Speed Control in BMC.
- OEM commands.
- Inventory - report on server hardware and firmware components.
- Firmware (BIOS/ONIE) Update with multiple images.
- BMC firmware update with multiple images.

- BMC Update and Access CPLD.
- BMC Time Sync, including NTP.
- PCIe® and Mezzanine card Thermal monitoring.
- BMC Protected Processor Inventory Number (PPIN) Implementation.
- BMC Average Power Reporting.
- BMC Access and Update VR Firmware.
- BMC MSR Dump from OOB.
- BMC Network Status.
- BMC Secure boot.
- Remote login authentication.
- OpenBMC performance monitoring.

15. Security

The Open Edge sleds hardware design must support BIOS secure booting and the Trusted Platform Module (TPM 2.0) for security options.

15.1 Intrusion Detection

As part of the security capabilities of Open Edge Sleds, the system may require the implementation of intrusion detection. In the application of OE server sleds, this intrusion detection design must allow the user to get intrusion status from the system event log (SEL).

In this implementation, when the sled is inserted, the signal PD_SLED1_CHASSIS_INTRUSION will be connected to GND, and then the BMC_INTRUDER# signal will become a high voltage, maintained by the power domain of the OE sled battery.

After the OE server sleds in unplugged, the signal PD_SLED1_CHASSIS_INTRUSION will change from low voltage to high voltage, and the BMC_INTRUDER# will change from high to low voltage, notifying the BMC system of an intrusion event.

In the case where the OE sled battery power is low, or when there is no battery power, the OE server sled BMC must internally regulate 2.2 V to maintain the battery power domain.

16. References

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17. Appendix A - Checklist for IC approval of this Specification

Complete all the checklist items in the table with links to the section where it is described in this spec or an external document.

Item	Status	Link to detailed explanation
Has this contribution been presented to an OCP Project group during a project call or engineering workshop?	Yes	
Approval by Project Leads	Yes	
Is this contribution entered into the OCP Contribution Portal?	Yes	
Was it approved in the OCP Contribution Portal?	Yes	