OPEN

Compute Project

Inspur Server Mother Board Design Scheme

Crane Mountain

Rev 0.1

Author:

Inspur Crane Mountain Team

1. Revision History

Version	Date	Description
0.1	5/14/2019	Initial Release

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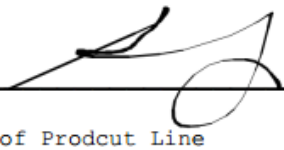
Signature: 

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Form of Appendix

Name of Proposed Specification:

High Density Cloud Optimized Platform 2U4S (Crane Mountain)

Contribution (e.g. Entire proposed Specification, or portion of proposed specification):

Entire proposed L6 specification for the first ever 4 socket platform – excluding Intel Chipset IP

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Appendix A-1

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2. Scope

This standard provides the ***reference*** board-specific information detailing the features and functionality of a general purpose 4-socket server board for adoption by the Open Compute Project community. The purpose of this document is to define four socket server board that is capable of deployment in scale out data centers as well as traditional data centers with 19" rack enclosures. In the creation of the Crane Mountain specification, considerations are made for 4-socket server boards that were in production at time of specification release that would fulfill these needs.

This document is not intended to be used solely as a basis for a procurement of OCP compatible products. The OCP community may have additional requirements. These incremental requirements can be captured in additional procurement documentation.

3. Contents

目录

4. Overview

4.1 Overview

Crane Mountain is based on Intel® Cascade Lake-SP CPU architecture. The motherboard supports up to 48 DIMMs. Crane Mountain is designed in the Q1 of 2019.

4.2 Product Overview

Crane Mountain is a completely independent research and development of server products. Based on Intel® Cascade Lake-SP CPU architecture, using Lewisburg chipset. Support four mainstream Intel Xeon Cascade Lake-SP 82xx/62xx/52xx series processors. Support 48 DIMMs DDR4 memory, the biggest support to 2933 MHZ. PCI Express support expansion slot X24. Supports OCP MEZZ connecter A, B and C.

4.3 Product standard (***BOLD & Underline is MUST HAVE for Crane Mountain***)

CPU	
CPU type	***Supports four Intel® Cascade Lake-SP 82xx/62xx/52xx series processors (TDP 205W)***
Connecter	***Four Socket-P0 slots***

Chipset	
Chipset type	***Any Lewisburg PCH is acceptable***
RAM	
RAM type	***DDR4 ECC RDIMM/LRDIMM/3DS LRDIMM***
RAM slot quantity	***48***
RAM total capacity	Total capacity 6144GB（single 128GB）
I/O Connecter	
USB	Two rear USB 3.0 ports, one on board USB 3.0 port
VGA	One rear VGA
UID	One ID pilot lamp inlay
Network card	
Network card controller	***Support OCP MEZZ connecter A, B and C.***
Manager chipset	
Manager chipset	Integrated one independent 1000 Mbps network interface, specifically for remote management of IPMI.
PCI Express slot	***The motherboard to the system level must support at least minimum (1) PCIe x16 from each CPU***
Power supply	
PSU spec	The whole system adopts three specifications of PSU, the power is 800/1300/1600W, and the maximum configuration is 2 power supplies. According to the system configuration, the appropriate PSU and PSU redundancy modes are selected to support 1+1 redundancy under certain configuration conditions.
Input power	The main specifications is 1600W PSU AC-- 90-264V,NOM-- 100-240V

	DC-- 190-310V, NOM-- 240V
Modular TPM Support	***MUST HAVE***

5. Physical Specifications

5.1 Block Diagram Rerfence for Base Spec

Figure 5-1 illustrates the functional block diagram of the Motherboard.

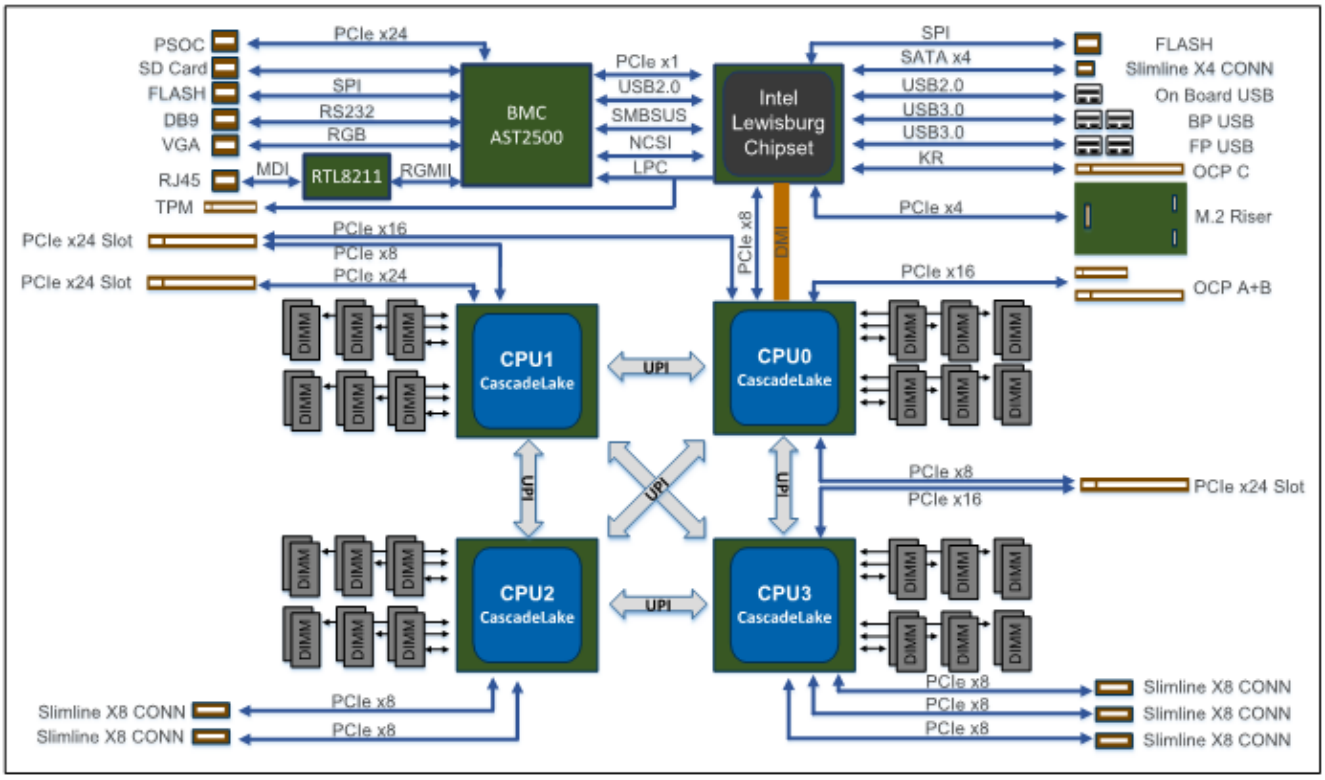


Figure 5-1 Block Diagram

5.2 Placement and Form Factor

Board form factor is within the square limitation of 16.7 inch by 24 inch (16.7”x24”). And Figure 5-2 illustrates a ***reference of board placement.*** The placement is meant to show key components ’relative positions, while exact dimension and position information would be exchanged by DXF format for layout and 3D model for mechanical, and ***as long as the board remain within the 16.7” x 24” with the Power Supply location both on the right hand side; that any alternative OxM design of the board shall able to claim as meeting the Crane Mountain specification.***

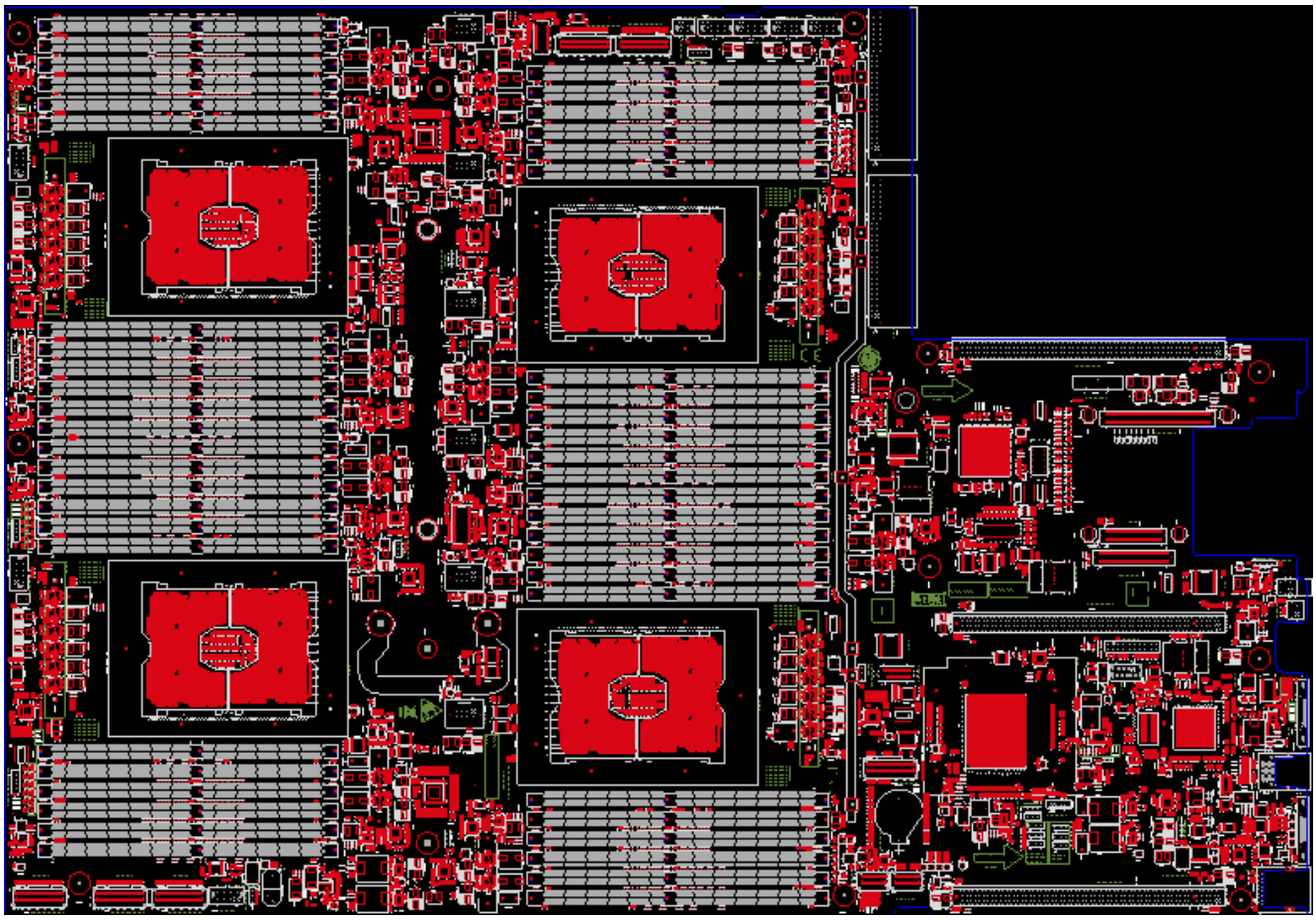


Figure 5-2 Reference Placement

5.3 CPU and Memory

5.3.1 CPU

The motherboard supports all Intel® Cascade Lake -SP processors with TDP up to 205W.

- Support four Cascade Lake-SP processors up to 205W TDP.
- Three full-width Intel UPI links up to 10.4 GT/s/direction for Cascade Lake-SP processor.
- Up to 28 cores per CPU (up to 56 threads with Hyper-Threading Technology).
- Single Processor mode and Two-CPU mode are both supported

5.3.2 DIMM

The motherboard has DIMM subsystem designed as below:

- DDR4 direct attach memory support on CPU0, CPU1, CPU2 and CPU3.
- 6x channels DDR4 registered memory interface on each CPU

- 2x DDR4 slots on each Chanel (total 48x DIMMs)
- Support DDR4 speeds up to 2933MT/s 1DCP, 2666MT/s 2DCP
- Support RDIMMs, LRDIMMs , or 3DS LRDIMMs
- Support SR, DR, QR and 8R DIMMs
- Up to maximum 6144 GB with 128 GB DRAM DIMM
- Follow updated JEDEC DDR4 specification with 288 pin DIMM socket
- Memory support matrix for DDR4 is as Table 5-1

2 Slots Per Channel	
1 DIMM Per Channel	2 DIMM per Channel
2933 MT/s	2666 MT/s

Table 5-1

5.3.3 DCPMM

Board and system design support Intel® Optane™ DC persistent memory with 128G, 256G and 512G. Max, 24 DCPMMs with ADR function.

5.4 PCH

The motherboard uses Intel® Lewisburg chipset, which supports following features:

- 2x rear USB3.0 ports, 1x on board USB3.0 port;
- 1x slimline x4 connector use for SATA 0-3;
- 1x slimline x8 connector use for M.2 Riser Board(PCIe X4 Colay with SATA);
- LPC interface, mux with BMC to enable BMC the capability to perform BIOS upgrade and Recovery
- LPC and SPI interface for TPM header
- SMBUS interface (master & slave)
- Intel® Server Platform Services (SPS) 4.0 Firmware with Intel® Node Manager
- PECI access to CPU
- SMLink0 connect to BMC
- Intel® Manageability Engine (ME) obtain HSC PMBus related information directly.
- Intel® ME SMLink1 connects to Hot swap controller PMBus interface by default.
- BMC connected to HSC PMBus, so it masters HSC PMBus related feature flexibly.

- Temperature sensors reading from BMC
- PCH SKUs
- Board design shall support all PCH SKUs in terms of power delivery and thermal design.

5.5 DIMM Slot

Total 48 DIMMs, DIMM 1 are Black, DIMM0 are White.

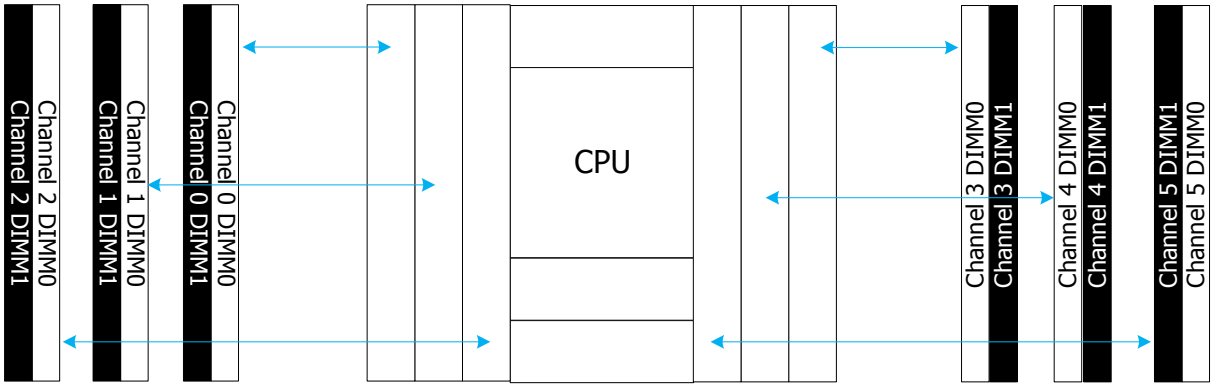


Figure 6-2 DIMM Topology

5.6 PCIe Mezzanine Card

The motherboard support OCP A/C Mezz cards. OCP A card has both Connector A and Connector B, support max PCIe 16x Mezz card.

Connector Pin definition follow the *OCP Mezzanine Card 2.0 rev1.0*

5.7 Network

5.7.1 Data network

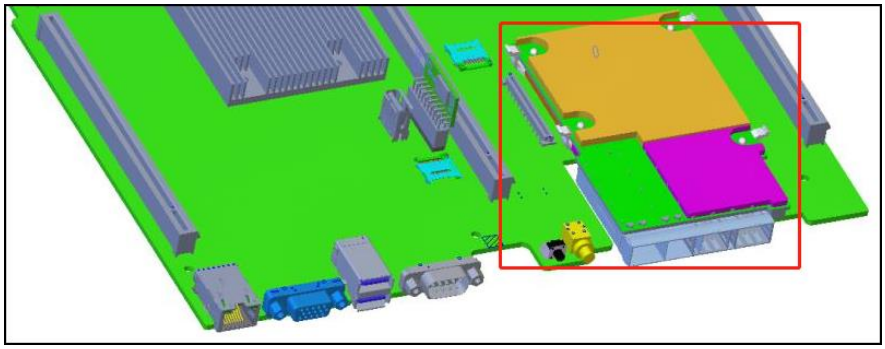
Use Single or Dual Port OCP Mezz cards.

5.7.2 Management network

The motherboard has two options of management network interface for BMC's connection. Management network shares data network's physical interface. Management connection was independent from data traffic, and OS/driver condition.

a) One dedicated RJ45 port for Board management, driven by BMC through RMII/NC-SI.

b) One OCP A shared-NIC, driven by BMC through NCSI



5.8 LED

► DIMM offline diagnosis LED: Yellow, LED1-LED48

--Indicating DIMM error, one-to-one match with 48 DIMMs;

--Turn ON, after SW7 is pressed if corresponding DIMM error occurs

►FAN status LED, Red/Green, LED49-LED52 and LED54-LED55

--Indicating FAN status, one-to-one match with 6 FANs;

--When FAN error occurs, Red. When FAN works normally, Green

► BMC FAULT LED: RED, LED53

--When BMC error occurs, Turn ON.

► CPU CATERR LED: RED, LED64

--When CPU CATERR occurs, Turn ON.

► CPU ERR2 LED: RED, LED66

--When CPU ERR2 occurs, Turn ON.

► PCH PWROK LED: Green, LED71

--When PCH core well power rails are powered and stable, Turn ON.

► SYS PWROK LED: Green, LED72

--When System Power is OK, Turn ON.

► BMC Heart Beat LED: Green, LED63

--When BMC is active, blinking.

► PSOC Version LED: Green, LED401-LED403

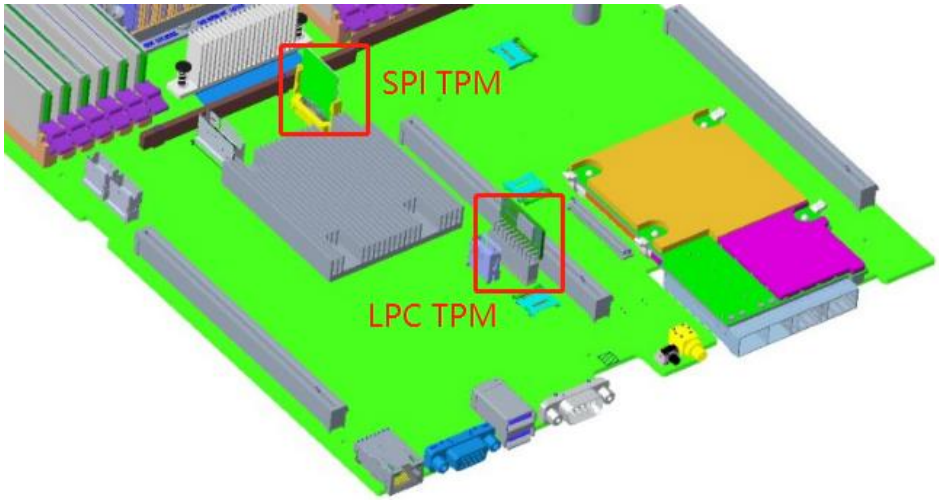
-- Indicating PSOC Version.

► CPLD Version LED: Green, LED59-LED60 and LED73-LED74

-- Indicating CPLD Version.

5.9 TPM

The Motherboard supports one TPM connector with SPI interface, one TPM connector with LPC interface.



5.10 Header

Signal	Description	Location	Default
FM_MFG_MODE	1-2:Enable Manufacture Mode 2-3:Disable Manufacture Mode	J70	Default 2-3
HDA_SDO	1-2:Disable Flash Override 2-3:Enable Flash Override	J72	Default 1-2
FM_ME_RECOVER_N	1-2:Normal 2-3:ME Force Update	J88	Default 1-2
RST_RTCRST_N	1-2:Normal Operation 2-3:Clear CMOS	J89	Default 1-2
FM_PASSWORD_CLEAR_N	1-2:Normal Operation 2-3:Clear Password	J103	Default 1-2
FM_BIOS_TOP_SWAP_SPKR	1-2:Normal Operation and Top Swap Disable 2-3:Recover BIOS and Top Swap Enable	J120	Default 1-2
SMB_HOST_STBY_LVC3_SCL/SDA	For ME Debug	J86	----
SMB_SMLINK2_STBY_LVC3_SCL/SDA	System Management Link 2 SCL/Data	J113	----
INTRUDER_N	Intruder Detect	J57	----
SMBUS6_CPU1_VR_SDA/SCL	SMBUS For CPU1 PVCCIN & PVCCSA VR	J115	----
SMBUS6_CPU2_VR_SDA/SCL	SMBUS For CPU2 PVCCIN & PVCCSA VR	J49	----

SMBUS6_CPU3_VR_SDA/SCL	SMBUS For CPU3 PVCCIN & PVCCSA VR	J65	----
SMBUS6_CPU4_VR_SDA/SCL	SMBUS For CPU4 PVCCIN & PVCCSA VR	J114	----
P5V_HDD_SDA/SCL	SMBUS For P5V_HDD VR	J52	----
P3V3_SDA/SCL	SMBUS For P3V3 VR	J66	----

6. Motherboard Power system

6.1 Open Power budget

Rail	Voltage(V)		CPUn(205W)	DIMM	AEP	Lewisburg-T	NVME SSD	SAS HDD	SYS_Fan	M.2	USB	BMC	PCIE(25W)	CRT	PCIE GPU(300W)	OCPA/B	CPLD	BIOS	CK420	DB1900	TPM	USB2244	Total (A)
IC QTY	IC Qty		4	24	24	1	6	18	6	2	5	1	4	1	4	1	1	1	1	2	1	1	
PVCCIN_CPUn	SVID	1.80	228.00																				912.00
PVCCSA_CPUn	SVID	0.85	16.00																				64.00
PVCCIO_CPUn	SVID	1.00	21.00																				84.00
PVDDQ_XXX	SVID	1.20	17.50	12.00	2.68																		708.00
PVTT_XXX	0.60	0.60		0.30	0.01																		7.20
PVPP_XXX	2.50	2.50	1.20	1.50	0.20																		64.80
P12V_NVDIMM_XXX	12.00	12.00																					
P5V_STBY	5.00	5.00												0.50		2.40							2.90
P3V3_STBY	3.30	3.30	0.08			1.10	0.02					0.40	0.375		0.375	1.60	1.00	0.043			0.05		7.63
P2V5_STBY	2.50	2.50										0.10											0.10
P1V8_STBY	1.80	1.80				1.00						0.10											1.10
P1V2_STBY	1.20	1.20										0.60											0.60
P1V15_STBY	1.15	1.15										0.80											0.80
PVNN_STBY_PCH	SVID	1.00				20.50																	20.50
P1V05_STBY_PCH	1.05	1.05				15.00																	15.00
P12V	12.00	12.00			1.40		2.50	1.50	6.00				2.10		24.25								217.00
P12V_STBY	12.00	12.00														2.40							2.40
P5V	5.00	5.00						1.50			1.00												41.00
P3V3	3.30	3.30								2.50			3.00		3.00	6.40			0.40	0.45		0.20	36.90
Power (max)			205.00	18.33	20.52	29.00	25.00	25.50	72.00	8.25	5.00	3.39	25.00	2.50	300.00	67.20	3.30	0.14	1.32	1.49	0.17	0.66	
			820.00	439.92	492.53	29.00	150.00	459.00	432.00	16.50	25.00	3.39	100.00	2.50	1200.00	67.20	3.30	0.14	1.32	2.97	0.17	0.66	4245.59

Table 7-1 System Power Budget

7. BMC

BMC is an independent system of host server system. This independent system has its own processor and memory; The host system can be managed by BMC system even if host hardware or OS hang or went down.

8.1 Main Feature

- Support IPMI 2.0, IPMI Interface include KCS, LAN, IPMB
- Management Protocol,IPMI2.0, HTTPS, SNMP, Smash CLI
- Web GUI
- Redfish
- Management Network Interface, Dedicated/NCSI
- Console Redirection(KVM) and Virtual Media
- Serial Over Lan(SOL)
- Diagnostic Logs, System Event Log (SEL), Blackbox Log, Audit Log
- Hardware watchdog timer, Fans will full speed when BMC no response in 4 mins
- Intel® Intelligent Power Node Manager 4.0 support

- Event Alert, SNMP Trap(v1/v2c/v3), Email Alert and Syslog
- Dual BMC firmware image support
- Storage, Monitor RAID Controller/HDD/Virtual HDD
- Firmware update, BMC/BIOS/CPLD
- Device State Monitor and Diagnostic

8.2 Integrated BMC Hardware

ASPEED AST2500 Baseboard Management Controller, at the center of the server management subsystem is the ASPEED AST2500 integrated Baseboard Management Controller. This device provides support for many platform functions including system video capabilities, legacy Super I/O functions, hardware monitoring functions, and incorporates an ARM1176JZF-S 32-bit RISC CPU microcontroller to host an IPMI 2.0 compliant server management firmware stack.

The following functionality is integrated into the component:

- Baseboard Management Controller (BMC) with peripherals
- Server class Super I/O (SIO)
- Graphics controller
- Remote KVM redirection, USB media redirection, and HW Encryption

The eSPI/LPC interface to the host is used for SIO and BMC communication. The eSPI/LPC Bus interface provides IPMI Compliant KCS and BT interfaces.

The PCI Express interface is mainly used for the graphics controller interface to communicate with the host. The graphics controller is a VGA-compliant controller with 2D hardware acceleration and full bus master support. The graphics controller can support up to 1920x1200 resolution at high refresh rates. The PCI Express interface is also used for BMC messaging to other system devices using MCTP protocol.

The USB 2.0 Hub interface is used for remote keyboard and mouse, and remote storage support. BMC supports various storage devices such as CDROM, DVDROM, CDROM (ISO image), floppy and USB flash disk. Any of the storage devices can be used as a boot device and the host can boot from this remote media via redirection over the USB interface.

For the main capabilities of the BMC AST2500.BMC provide the 10/100/1000M local RJ45 management connector through RTL8211FD and enable the communication between BMC and OCP A/PCH with NCSI BUS.

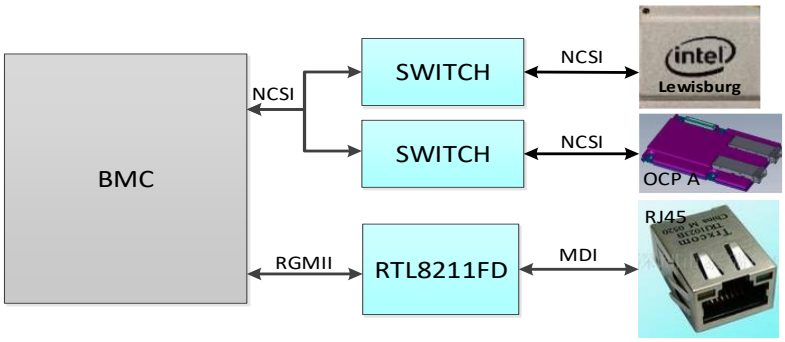


Figure 8-1 BMC managerial network topology

8. Thermal Design Requirements

To meet thermal reliability requirement, the thermal and cooling solution should dissipate heat from the components when system operating at its maximum thermal power. The thermal solution should be found by setting a high power target for initial design in order to avoid redesign of cooling solution; however, the final thermal solution of the system should be most optimized and energy efficient under data center environmental conditions with the lowest capital and operating costs. Thermal solution should not allow any overheating issue for any components in system.

8.1 Thermal kit requirements

Heat Sink

The heat sink design should choose to be most optimized design with lowest cost. The heat sink design should be reliable and the most energy efficient design that satisfies all the conditions described above.

For normal config, system use 2U heatsink 4PCS; For GPU config, system use 2U heatsink 2PCS and 1U heatsink 2PCS.

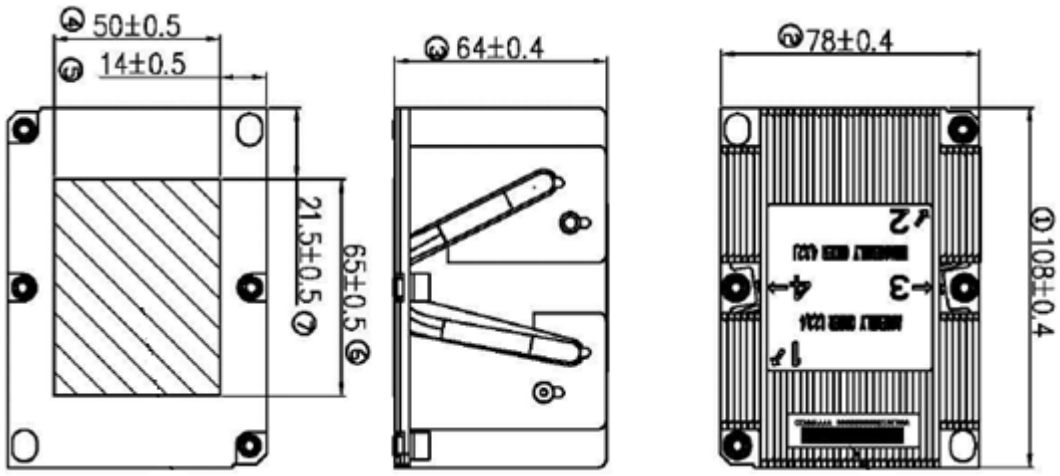


Figure 9-1 2U heatsink

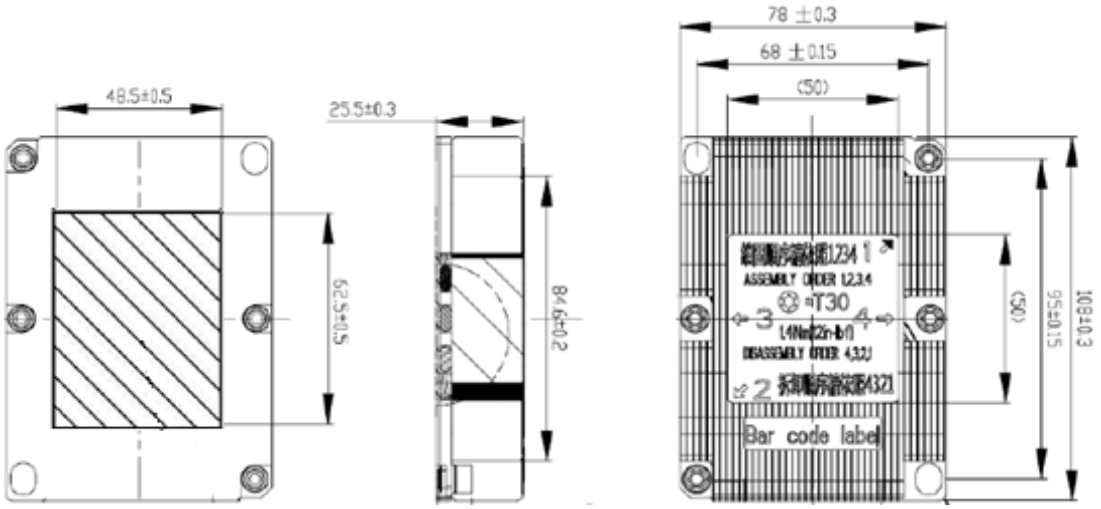


Figure 9-2 1U heatsink

Thermal sensor

The maximum allowable tolerance of thermal sensors in the motherboard is ±3°C. Using higher accuracy sensor is preferred.

9.2 Environmental and Regulations

9.2.1 Motherboard high altitude

Operational at 1500 meters above sea level
Non-Operational at 12192 meters above sea level

9.2.2 Motherboard relative humidity

Operating and Storage relative humidity: 10% to 90% (non-condensing)

9.2.3 Motherboard Temperature

Operating temperature range: -5°Cto +45°C

Storage temperature range: -40°C to +70°C

Transportation temperature range: -40°Cto +70°C (short-term storage)