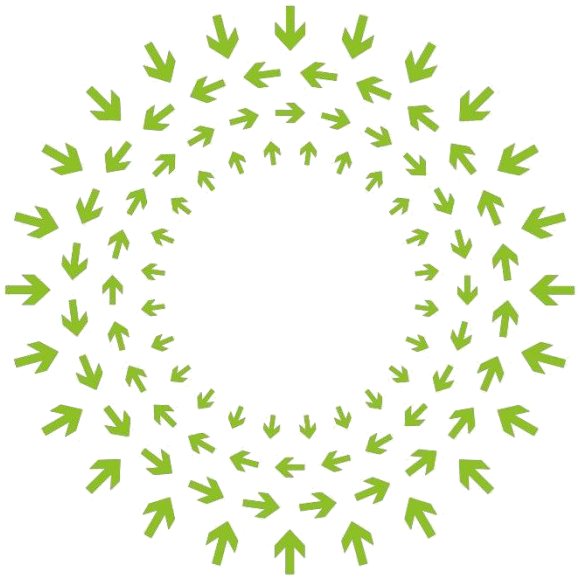


OPEN
Compute Project

Inspur Server Mother Board Design Scheme

Whistler

Rev 0.1

Author:

Inspur Whistler Team

Table of Contents

1. License

2. Revision History

Version	Date	Description
0.1	5/21/2019	Initial Release

Note: Because the product version upgrade or other reasons, the contents of this document will not be updated on a regular basis. Unless otherwise agreed, this document used only as a guide, in this document, all statements, information and advice does not constitute any express or implied guarantees.

3. Scope

This specification describe a kind of 4 sockets server system's mother board design. It is designed based on Intel Purley Platform. It has 4 pcs CPU sockets, 48 DIMMs, 5 pcs M.2 on board and 9 pcs PCIe slots.

4. Overview

4.1 Overview

Whistler is based on Intel® Sky Lake-SP CPU architecture. The motherboard supports up to 48 DIMMs. Whistler was designed in the Q1 of 2018.

4.2 Product Overview

Whistler is a completely independent research and development of server products. Based on Intel® Sky lake-SP CPU architecture, using Lewisburg chipset. Support four mainstream Intel Xeon Sky Lake-SP 81xx/61xx/51xx series processors. Support 48 DIMMs DDR4 memory, the biggest support to 2666 MHZ. Support Lewisburg-1G PCH and AST2500 is managed chipset. There are 9 pcs PCIe Slots on board and maximum support 12 pcs slots. Supports 5 pcs M.2 SSD on board.

4.3 Product standard

CPU	
CPU type	Supports four Intel® Sky Lake-SP 81xx/61xx/51xx series processors (TDP 205W)
Connecter	Four Socket-P0 slots
Chipset	
Chipset type	PCH LBG-1G
RAM	
RAM type	DDR4 RDIMM/LRDIMM/AEP/NVDIMM
RAM slot quantity	48
RAM total capacity	Total capacity 6144GB（single 128GB）

I/O Connecter	
USB	Two external USB 3.0 ports(Front), Internal USB 2.0 port
VGA	One external VGA (Front)
UID	One ID pilot lamp inlay
Manager chipset	
Manager chipset	Integrated one independent 1000 Mbps network interface, specifically for remote management of IPMI.
PCI Express slot	The motherboard supports 9 pcs PCI Express 3.0 slots
HDD	
HDD type	Support one 3.5-inch SAS/SATA HDDs and 32 M.2 SSD
Power supply	
PSU spec	The whole system adopts three specifications of PSU, the power is 1600W, and the maximum configuration is 4 power supplies. According to the system configuration, the appropriate PSU and PSU redundancy modes are selected to support 2+2 redundancy under certain configuration conditions.
Input power	The main specifications is 1600W PSU AC-- 180-264V, Typical 230V DC-- 164-300V, Typical 270V

5. Physical Specifications

5.1 Block Diagram

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

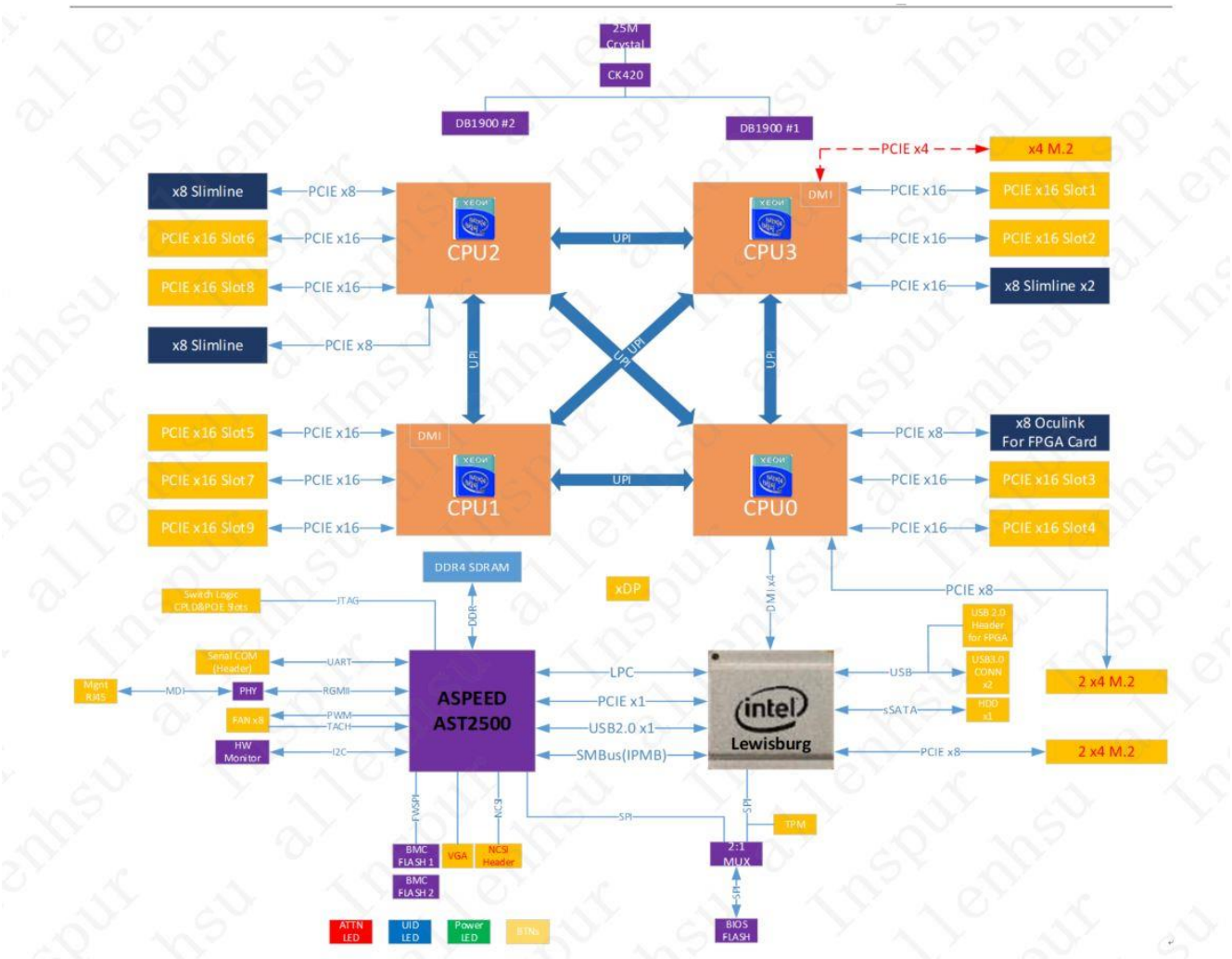


Figure 5-1 Block Diagram

5.2 Placement and Form Factor

Board form factor is 16.7 inch by 22.7 inch (16.7”x22.7”). Figure 5-2 is board placement. The placement is meant to show key components ’relative positions, exact dimension and position information would be exchanged by DXF format for layout and 3D model of mechanical.

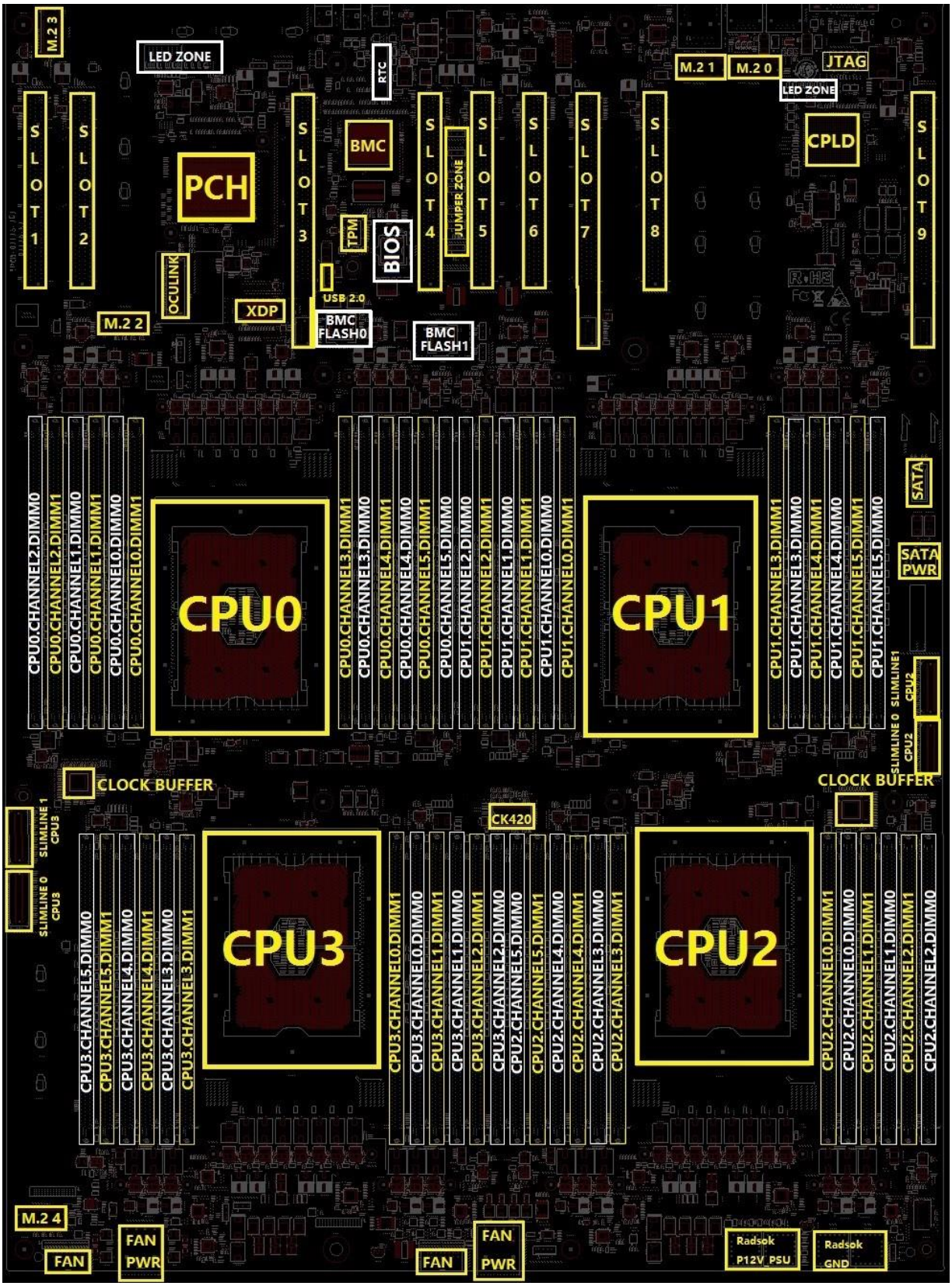


Figure 5-2 Placement

5.3 CPU and Memory

5.3.1 CPU

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

- Support four Sky Lake-SP processors up to 205W TDP.
- Three full-width Intel UPI links up to 10.4 GT/s/direction for Sky 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 2666MT/s 1DCP and 2DCP
- Support DDR4 RDIMM/LRDIMM/AEP/NVDIMM
- 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
2666 MT/s	2666 MT/s

Table 5-1

5.4 PCH

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

- Two external USB 3.0 port(Front), One internal USB 2.0 port;
- 4x slimline x8 connector use x16 PCIE riser card;
- 1x Oculink connector use FPGA card;

- LPC interface, mux with BMC to enable BMC the capability to perform BIOS upgrade and Recovery
- 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 PCIe Usage

PCIe lanes are configured according to Figure 5-3 and Table 5-2:

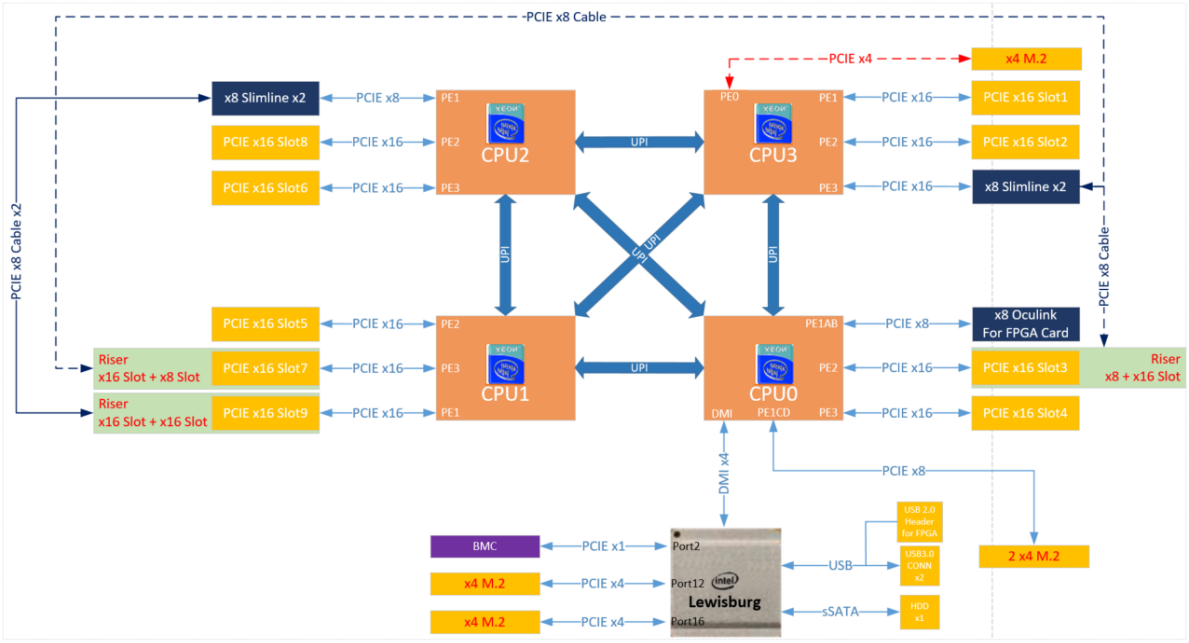


Figure 5-3 PCIe Usage

PCIE Resource Configuration			
CPU0	PE1(Lane0-7)	X8	Oculink for FPGA card
	PE1(Lane8-15)	2 X4	M.2
	PE2(Lane0-15)	X16	PCIe Slot 3
	PE3(Lane0-15)	X16	PCIe Slot 4
CPU1	PE1(Lane0-15)	x16	PCIe Slot 9
	PE2(Lane0-15)	X16	PCIe Slot 5
	PE3(Lane0-15)	X16	PCIe Slot 7
CPU2	PE1(Lane0-15)	2 x8	2 x8 Slimline
	PE2(Lane0-15)	x16	PCIe Slot 8
	PE3(Lane0-15)	X16	PCIe Slot 6
CPU3	PE0(Lane0-7)	2 X4	M.2
	PE1(Lane0-15)	x16	PCIe Slot 1
	PE2(Lane0-15)	X16	PCIe Slot 2
	PE3(Lane0-15)	2 x8	2 x8 Slimline

Table 5-2

5.6 MB PCB Stack Up

Layer Name	Plane Description		Layer Thickness (mil)	COPPER TYPE	Copper Weight (oz)	DK
	solder mask		0.4			
Signal1	SIGNAL		1.6	HTE	1	
PP	1080 RC65%*1		2.7			3.68
Plane 2	GND		1.2	RTF	1	
Core	3313 RC56%*1		4			3.86
Signal 3	SIGNAL		1.2	RTF	1	
PP	2116 RC60*1		4.4			3.78
Plane 4	GND		1.2	RTF	1	
Core	3313 RC56%*1		4			3.86
Signal 5	SIGNAL		1.2	RTF	1	
PP	2116 RC60*1		4.4			3.78
Plane 6	GND		1.2	RTF	1	
Core	1086 RC58%*1		3			3.78
Signal 7	SIGNAL		1.2	RTF	1	
PP	2113 RC60%*3		11			3.78
Plane 8	POWER		2.4	RTF	2	
Core	3313 RC56%*1		4			3.86
Plane 9	POWER		2.4	RTF	2	
PP	2113 RC60%*3		11			3.78
Signal 10	SIGNAL		1.2	RTF	1	
Core	1086 RC58%*1		3			3.78
Plane11	GND		1.2	RTF	1	
PP	2116 RC60*1		4.4			3.78
Signal 12	SIGNAL		1.2	RTF	1	
Core	3313 RC56%*1		4			3.86
Plane13	GND		1.2	RTF	1	
PP	2116 RC60*1		4.4			3.78
Signal 14	SIGNAL		1.2	RTF	1	
Core	3313 RC56%*1		4			3.86
Plane 15	GND		1.2	RTF	1	
PP	1080 RC65%*1		2.7			3.68
Signal 16	SIGNAL		1.6	HTE	1	
	solder mask		0.4			
Material	**IT170GRA with RTF**	**Total**	**94.2**			

Figure 5-4 stack up

5.7 DIMM Slot

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

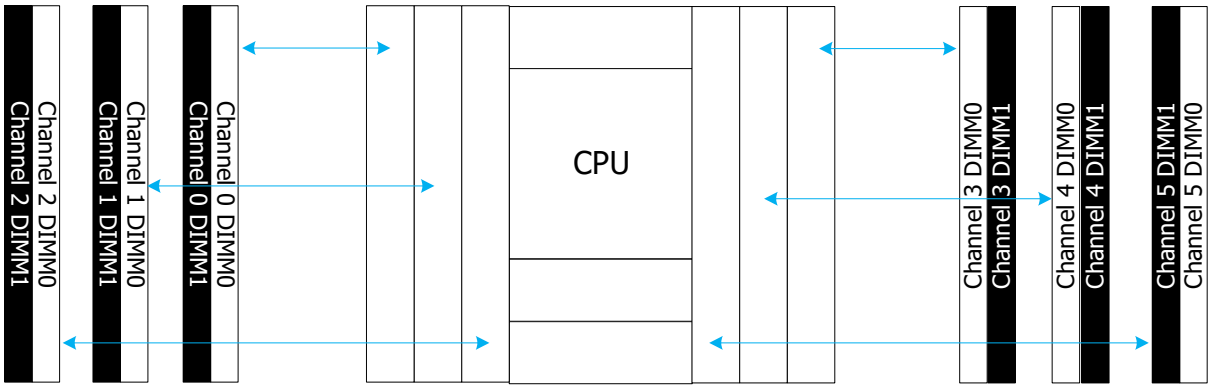


Figure 5-5 DIMM Topology

5.8 Network

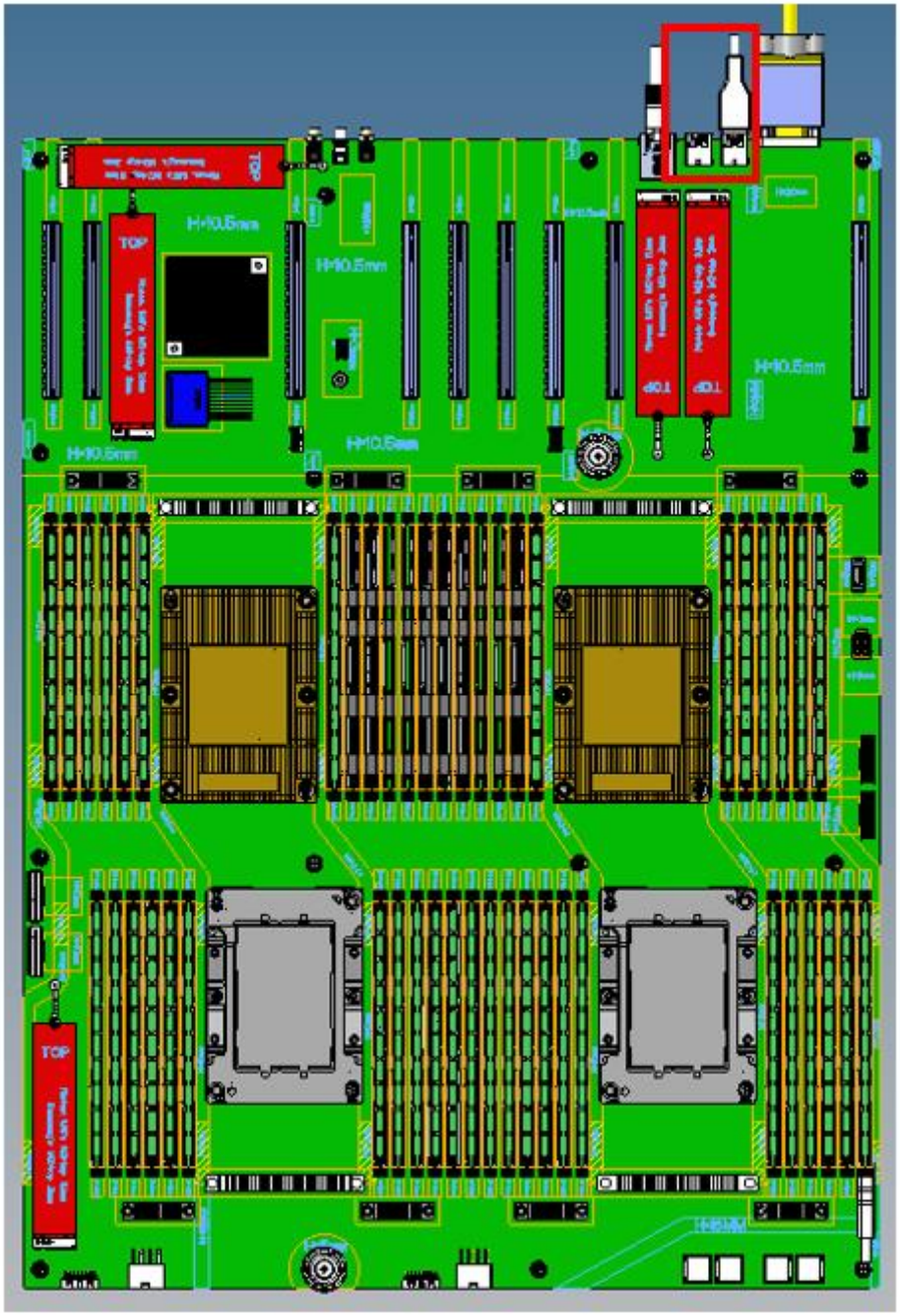
Management network

The motherboard has one management network interface for BMC's connection. Dedicated RJ45 port for Board management, driven by BMC through RMII/NC-SI.

5.9 USB

The Motherboard has two external USB2.0/3.0 connectors located in Front edge of Motherboard and one internal USB 2.0 header. BIOS should support follow devices on USB ports available on Motherboard:

- USB Keyboard and mouse
- USB flash drive (bootable)
- USB hard drive (bootable)
- USB optical drive (bootable)



5.10 LED

► Power status LED, Green/Orange

--When power on, turn on green LED

--When Power off, turn on orange LED

► UID status LED, Blue

--When device is selected, turn on LED

--When device is not selected, turn off LED

► Attention status LED: RED

--When system is abnormal, turn on LED

--When system is normal or power off, turn off LED

5.11 TPM

The Motherboard supports one TPM with SPI interface.

5.12 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
	1-2: Normal Operation Also Top Swap Disable 2-3: Recover BIOS Also Top Swap Enable	J120	Default 1-2
	1-2: Normal 2-3: BMC disable	J90	Default 1-2

6. Power system

6.1 Power Simple Topology

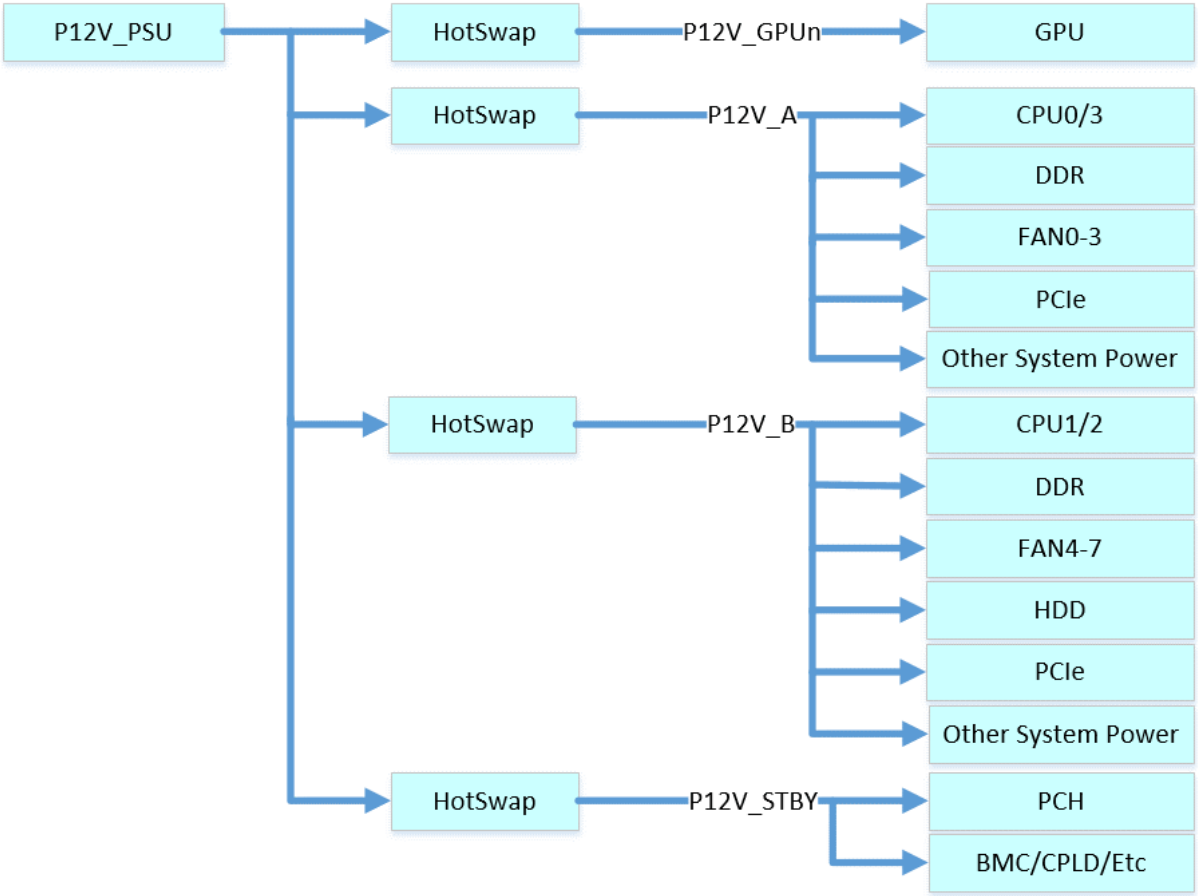


Figure 6-1 power topology

6.2 Input voltage Level

The nominal input voltage delivered by the power supply is 12.2V DC nominal at light loading with a range of 11.8V to 12.6V.

	Typical	Min	Max
AC Input	230V	180V	264V
DC Input	270V	164V	300V
Output Main	12.2V	11.8V	12.6V
Output STBY	12.0V	11.4V	12.6V

Table 6-2 PSU Output Characteristics

6.3 DC-DC Power Design

6.3.1 CPU VR

CPU VR follow latest VR13 SPEC. Using the minimum number of total phases to support the maximum CPU power. CPU VR have auto phase dropping feature, and

run at optimized phase count among 1, 2, 3,…, and maximum phase count. CPU VR support all Power States to allow the VRM to operate at its peak efficiency at light loading.

6.3.2 DIMM VR

DIMM VR support auto phase dropping for high efficiency across loading. DIMM VR compliant to latest VR13 specification.

6.3.3 Detail design

Power Rail	VOUT	VIN	VR Type	VR QTY /BRD	VR Controller IC and FET	SMBus Address
PVCCIN_CPU0 PVCCIN_CPU3	SVID	P12V_A	Switcher	2	MPS MP2965+7Phase MP86956；	CPU0:0X40 CPU1:0X40 CPU2:0X40 CPU3:0X40 With I2C SW
PVCCIN_CPU1 PVCCIN_CPU2	SVID	P12V_B	Switcher	2		
PVCCSA_CPU0 PVCCSA_CPU3	SVID	P12V_A	Switcher	2	Infineon PXE1110C+1Phase TDA21470	CPU0:0XC8 CPU1:0XC8 CPU2:0XC8 CPU3:0XC8 With I2C SW
PVCCSA_CPU1 PVCCSA_CPU2	SVID	P12V_B	Switcher	2	Infineon PXE1110C+1Phase TDA21470	
PVCCIO_CPU0 PVCCIO_CPU3	SVID	P12V_A	Switcher	2	Infineon IR38163	CPU1:0X80 CPU2:0X80 CPU3:0X80 CPU4:0X80 With I2C SW
PVCCIO_CPU1 PVCCIO_CPU2	SVID	P12V_B	Switcher	2	Infineon IR38163	
PVDDQ_ABC PVDDQ_DEF PVDDQ_UVW PVDDQ_XYZ	1.2V	P12V_A	Switcher	4	Infineon PXM1310C+3Phase TDA21470	PVDDQ_ABC:0XC0 PVDDQ_DEF:0XE4 PVDDQ_GHJ:0XC0 PVDDQ_KLM:0XE4 PVDDQ_NPQ:0XC0 PVDDQ_RST:0XE4 PVDDQ_UVW:0XC0 PVDDQ_XYZ:0XE4
PVDDQ_GHJ PVDDQ_KLM PVDDQ_NPQ PVDDQ_RST	1.2V	P12V_B	Switcher	4	Infineon PXM1310C+3Phase TDA21470	
PVTT_ABC PVTT_DEF PVTT_UVW	0.6V	P12V_A	Switcher	4	IR3897MTRPBF	

PVTT_XYZ						
PVTT_GHJ PVTT_KLM PVTT_NPQ PVTT_RST	0.6V	P12V_B	Switcher	4	IR3897MTRPBF	
PVPP_ABC PVPP_DEF PVPP_UVW PVPP_XYZ	2.5V	P12V_A	Switcher	4	TPS53515RVER	
PVPP_GHJ PVPP_KLM PVPP_NPQ PVPP_RST	2.5V	P12V_B	Switcher	4	TPS53515RVER	
PVNN_STBY_PCH	0.85V 0.9V 0.95V 1.0V	P12V_STBY	Switcher	1	IR38263MTRPBF	PVNN:0X86
P1V05_STBY_PCH	1.05V	P12V_STBY	Switcher	1	TPS53353DQPR	
P1V8_STBY	1.8V	P12V_STBY	Switcher	1	MPQ8632GLE-6-Z	
P3V3_STBY	3.3V	P12V_STBY	Switcher	1	TPS53515RVER	
P2V5_STBY	2.5V	P3V3_STBY	LDO	1	TPS7A7200RGTT	
P1V2_STBY	1.2V	P2V5_STBY	LDO	1	TPS7A7200RGTT	
P1V15_STBY	1.15V	P12V_STBY	Switcher	1	MPQ8636GLE-4-Z	
P5V	5.0V	P12V_B	Switcher	1	TPS53515RVER	
P3V3	3.3V	P12V_A	Switcher	1	MP2951+2Phase MP86945	
P3V3_B	3.3V	P12V_B	Switcher	1	TPS53355DQPR	
P12V_STBY	12V	P12V_PSU	Hot Swap	1	MP5023GV-000-Z	P12V_STBY:0X82
P12V_A	12V	P12V_PSU	Hot Swap	1	ADM1278	P12V_A:0X8C
P12V_B	12V	P12V_PSU	Hot Swap	1	ADM1278	P12V_B:0X8A

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.

7.1 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

7.2 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 BCM54612 and enable the communication between BMC and OCP A/PCH with NCSI BUS.

8. Labels and Markings

8.1 Labels

The motherboard shall include the labels such as adhesive and silk screen labels on the component side of the motherboard.

8.2 Markings

The motherboard shall include the markings such as adhesive and silk screen markings in accordance with required international certification.

Mother board shall include the following labels on the component side of the motherboard. The labels shall not be placed in a way that may cause them to disrupt the functionality or the air flow path of system.

Open top panel stickers	Adhesive label	Yes
Component description stickers (rear panel view、motherboard view……)	Adhesive label	Yes
Host nameplate label	Adhesive label	Yes
Carton configuration label	Adhesive label	Yes
The serial number label	Adhesive label	Yes
Certification label (FCC)	Adhesive label	Yes
Remove the protective film label	Adhesive label	Yes
More power supply label	Adhesive label	Yes