Ins pur Server Mother Board Design Scheme

Crane Mountain
Rev 0.1

Author:
Inspur Crane Mountain Team
1. Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>0.1</td>
<td>5/14/2019</td>
<td>Initial Release</td>
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Title: Sr. Director of Product Line

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Title: _________________________________________________________________

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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.

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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)

<table>
<thead>
<tr>
<th>CPU</th>
</tr>
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<tbody>
<tr>
<td>CPU type</td>
</tr>
<tr>
<td>Supports four Intel® Cascade Lake-SP 82xx/62xx/52xx series processors (TDP 205W)</td>
</tr>
<tr>
<td>Connector</td>
</tr>
<tr>
<td>Four Socket-P0 slots</td>
</tr>
<tr>
<td><strong>Chipset</strong></td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>Chipset type</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>RAM</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM type</td>
</tr>
<tr>
<td>RAM slot quantity</td>
</tr>
<tr>
<td>RAM total capacity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>I/O Connector</strong></th>
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</thead>
<tbody>
<tr>
<td>USB</td>
</tr>
<tr>
<td>VGA</td>
</tr>
<tr>
<td>UID</td>
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<table>
<thead>
<tr>
<th><strong>Network card</strong></th>
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<tr>
<td>Network card controller</td>
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<table>
<thead>
<tr>
<th><strong>Manager chipset</strong></th>
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<tbody>
<tr>
<td>Manager chipset</td>
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<tr>
<td>PCI Express slot</td>
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<th><strong>Power supply</strong></th>
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<tbody>
<tr>
<td>PSU spec</td>
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<tr>
<td>Input power</td>
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</table>
5. Physical Specifications

5.1 Block Diagram Reference for Base Spec

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

![Block Diagram](image)

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.
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

<table>
<thead>
<tr>
<th>2 Slots Per Channel</th>
<th>1 DIMM Per Channel</th>
<th>2 DIMM per Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2933 MT/s</td>
<td>2 DIMM per Channel</td>
<td></td>
</tr>
<tr>
<td>2666 MT/s</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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
5.9  TPM

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

5.10  Header

<table>
<thead>
<tr>
<th>Signal</th>
<th>Description</th>
<th>Location</th>
<th>Default</th>
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<tr>
<td>FM_MFG_MODE</td>
<td>1-2:Enable Manufacture Mode</td>
<td>J70</td>
<td>Default 2-3</td>
</tr>
<tr>
<td></td>
<td>2-3:Disable Manufacture Mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDA_SDO</td>
<td>1-2:Disable Flash Override</td>
<td>J72</td>
<td>Default 1-2</td>
</tr>
<tr>
<td></td>
<td>2-3:Enable Flash Override</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM_ME_RECOVER_N</td>
<td>1-2:Normal</td>
<td>J88</td>
<td>Default 1-2</td>
</tr>
<tr>
<td></td>
<td>2-3:ME Force Update</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM_BIOS_TOP_SWAP_SPKR</td>
<td>1-2:Normal Operation 2-3:Recover BIOS and Top Swap Enable</td>
<td>J120</td>
<td>Default 1-2</td>
</tr>
<tr>
<td>SMB_HOST_STBY_LVC3_SCL/SDA</td>
<td>For ME Debug</td>
<td>J86</td>
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<tr>
<td>SMB_SMLINK2_STBY_LVC3_SCL/SDA</td>
<td>System Management Link 2 SCL/Data</td>
<td>J113</td>
<td>----</td>
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<tr>
<td>INTRUDER_N</td>
<td>Intruder Detect</td>
<td>J57</td>
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<tr>
<td>SMBUS6_CPU1_VR_SDA/SCL</td>
<td>SMBUS For CPU1 PVCCIN &amp; PVCCSA VR</td>
<td>J115</td>
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<tr>
<td>SMBUS6_CPU2_VR_SDA/SCL</td>
<td>SMBUS For CPU2 PVCCIN &amp; PVCCSA VR</td>
<td>J49</td>
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</table>
6. Motherboard Power system

6.1 Open 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

Table 7-1 System Power Budget
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.
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.
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°C to +45°C
Storage temperature range: -40°C to +70°C
Transportation temperature range: -40°C to +70°C (short-term storage)