Lenovo Carnage

System Specification

Storage Location:

http://ecm.lenovo.com/os/ProductGroup/Server%20Business/Forms/AllItems.aspx?RootFolder=%2Fos%2FProductGroup%2FServer%20Business%2FGlobal%20Server%20Development%20Lab%2FProject%2FProduct%20Projects%2FNew%20Product%2FPurley%204R%2B1T%2F2UCarnage%2FSystem%20Lead%2FSystem%20Spec&FolderCTID=0x01200098D321E3239CFB44ADA691868EB474A7&View=%7BD23CC73D-102F-464C-A896-E0E49E37F4FB%7D

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PA			
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Note: The 1.0 or higher version must be approved.

Revision History

Date	Revision	Author	History
7/12/2015	0.5	Jeff Hu	Initial version release
7/20/2015	0.6	Jeff Hu	Follow MRD Ver. 0.8d and 1U Entry rack system specification 0.8
7/30/2015	0.97	Jeff Hu	Follow MRD Ver. 0.97 and update the system configuration. Remove nvme from 2U value.
8/4/2015	1.0	Jeff Hu	Follow MRD Ver. 1.0 and CBB feedback
9/15/2015	1.5	Jeff Hu	Update ThinkSystem CARNAGE serial wording into document Update Platform feature list Update System Block Diagram to 1.2b Adding IMM-I2C TPM H/W circuit by DM request Adding Performance worksheet into section 9 by DM request
9/22/2015	1.7	Jeff Hu	Update feature summary set Correct No BP configuration from 8x 3.5” to 8x 2.5” Chassis with main system building block Final LOM be Intel implementation. And Value Rack with EEPROM based on Intel requirement. Remove NSCI, WOL support with ML2 for Value rack Adding PSU boot policy and correct mix PSU behavior. Adding Tertiary Lightpath LEDs define on value rack only for exist on exterior of those system are Hot Swap HDDs, Hot Swap PSU. Update VPDID table with PSU and planar
9/24/2015	1.8	Jeff Hu	Update system restriction content Correct HDD & RAID card Configurations
9/24/2015	1.9	Jeff Hu	Correct LFF BP name be “4x2” Adding SAS HBA>Basic RAID>Advanced RAID + Supercap on RAID card Configurations Add SATA, SSATA information to indicate SW RAID on block diagram and IDE description
9/25/2015	2.0 Candidate	Jeff Hu	Add support rule for two HBA,RAID (basic,Adv)-8i on 16HDDs Rename to 2.0 Candidate for plan exit.
9/29/2015	2.0	Jeff Hu	Adding USB mobile app (Under investigation) Adding Host TPM chip down as default. Remove all product name from system spec.
10/12/2015	2.1	Jeff Hu	Add new content below into Carnage/Constantine system spec. 2.1 “system power budget” section Adding LCD mode" or "BMC connected mode with front USB port0, delete Al Folded Fin, Cu Base heat sink from Processor heat Sink, delete memory RAS Lock step mode, Adding Marvell 88E1514 PHY wording for LOM description, CFG BP cable (Y-cable may combine to different BP), Adding 32MB UEFI SPI flash ROM (Slave Attached Flash Storage) for avoid uEFI flashing limitations on bring-up / BBFV only from feature list from feature list Adding IMM UEFI Flash with system block diagram Update Memory populate rule Adding Carnage Storage config Matrix Update PCH and CPU SMBUS/I2C topology. FPGA, IMM3 (To be update by EE)
10/19/2015	2.2	Jeff Hu	Correct VGA port output when both install on system. Delete rear

			port display will high priority than front port description Correct VGA port output when both install on system. Delete rear port display will high priority than front port description. Adding dedicate and share NIC from IMM MAC port with feature summary update. Delete RAID 16i basic adapter update with feature summary and RAID update block diagram. System cable update
04/06/2015	2.3	Jeff Hu Jinghua Wu	1. Correct team roster 2. Change the HS description in page 13 3. Change from "<=" to ">"in page 21 4. Exchange the pic of 2.5" Front HDD Bay Configuration System Vie w in Page 31 5. Update sparing mode in page 41
08/11/2016	2.4	Jeff Hu Jinghua Wu	1. Add 12*3.5 configure 2. Update memory population rule 3. Internal Hypervisor change to Internal USB in table 10
09/19/2016	2.5	Jinghua Wu	1. Update VPDID/POSID table 2. Update system power budget table 3. Update 2U 3.5" storage5configure matrix 4. Add Shelf 4 120W CPU supporting in feature set table 5. Update MB placement
12/26/2016	2.6	Jinghua Wu	1. Update CPU TDP supporting from 120W to 125W 2. Update CPU core supporting to 20 3. Update the front USB to 1 USB2.0+1 USB3.0 4. Update share NIC to support only on port0 and port2 5. Update Table 2- Main System Building Blocks, combine 8*3.5 and 12*3.5 chassis together 6. Update front and rear view 7. Update PECI design in block diagram 8. Update UID LED behavior

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CT_QZ2 Zhang	Shock and Vibration	CT_QZ2 Zhang /Beijing/LENOVO
Leef fang YJ4 Fang	Cable	Leef fang YJ4 Fang/Beijing/LENOVO

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Reference Specifications:

Intel

Skylake Server External Design Specification (EDS) - Volume 1/2/3
Skylake Server Thermal/Mechanical Specification and Design Guide (TMSDG)
Lewisburg PCH Thermal/Mechanical Specification and Design Guide (TMSDG)
RS - Platform Environment Control Interface (PECI) Specification, Rev 3.1
RS - Intel® Ultra Path Interconnect (Intel® UPI) External Link Specification
RS - Intel® Ultra Path Interconnect (Intel® UPI) Connector Specification
Voltage Regulator Module (VRM) and Enterprise Voltage Regulator-Down (EVRD) 13 Design Guidelines
RS - Intel® Trusted Execution Technology BIOS Specification
Skylake Server Processor BIOS Writer's Guide
Lewisburg Platform Controller Hub External Design Specification (EDS)
Skylake Server Boundary Scan Description Language
CK420BQ Clock Synthesizer/Driver Specifications

Industry Standards

Advanced Configuration and Power Interface Specification 4.0
PCI Local Bus Specification 3.0
PCI Express Base Specification, Revision 3.0
System Management Bus(SMBus) Specification
DDR4 SDRAM Specification and Register Specification
SATA Specification, Revision 3.2
Intel intelligent Platform Management Interface (IPMI) Specification
Network Controller Sideband Interface (NC-SI) Specification

BMC Specification

Pilot4_ELX_Specification
Pilot4_Layout_Guidelines

Lenovo Purley Documentation (All Disciplines)

Mechanical Design Guidelines
SOW for Rail and CMA Design Guidelines
Lenovo ECAT Labeling Guide
Lenovo BDC EE HW Design Requirement
BDC EE High Touch Model SOW
Lenovo Server Hardware Design Guidelines - Usability
Connector and Cable Plating thickness Specification
Connector&Cable Plating Matching Review Check List
ESCL SER external version
CPLD Design Reference Circuit
FPGA Design Reference Circuit
Purley TPM2.0-TCM SPI Daughter Card Reference Design
Prestwick Reference Design Guide
Purley 4R1T BMC FW SOW

Purley 4R1T_ECAT Power SOW
Lenovo Purley PSU SOW
Lenovo Purley UEFI Firmware SOW
Purley 4R1T_SV-ODM-SOW
Purley_Thermal-Acoustic_SOW
RELIABILITY DATA Requirements
Server Reliability Common spec
Smokeless Guide Line
Key_Components_Derating_Guide Line
Caps_Lifetime_Review_Guide Line
PCIe Thermal Environment Specification
Thermal Management Regression Test Procedures Specification
HDD Thermal Specification
Lenovo EBG Acoustic Specification
Lenovo_PCIe Card_SV_Thermal_Requirements
Lenovo_Portfolio_Thermal_Management_Specification
Lenovo_PortfolioThermal_Performance_Specification
Lenovo_Purley_M_2_Boot_Solution_Specification
LightPath_Spec
Lenovo NFC design specification
Lenovo_Purley_porfolio_Phy_module_spec
Motherboard silkscreen requirement
CFF Power Supply v3 spec
Lenovo Power Management System-Level Design Power Supply Oversubscription
Lenovo Server Label Design Guidelines
Lenovo ODM Package SOW
Lenovo ODM Packaging Requirements
Lenovo Packaging Specification
Package SOW for Purley RFQ
Performance requirement
RAS Requirements
RAS Requirements Master
RAS Requirements Validation Tool Master
Classical EMI EMS RFQ for Server Product
Classical Environment RFQ for Server Product
Classical Safety RFQ for Server Product
Classical Thermal Acoustic RFQ for server product
Lenovo Qualified Reliability Lab Equipment Audit Guideline
Lenovo Qualified Reliability Lab System Requirement

Shock/Vibration/Package:
Lenovo 1-3600-002L
Lenovo 1-9711-004L
Lenovo 1-9711-005L
Lenovo 1-9711-008L
Lenovo 015L Rack Standard
LENOVO ENT_OP SHOCK_V02
LENOVO ENT_OP VIB_V02

LENOVO ENT_PLV_V02

Environmental:

C-S 2-0001-005L-1310 Electrostatic Discharge (ESD); Immunity Limits and Test Methods
N-B 2-0001-003L-1503 Electromagnetic Interference (EMI) Regulations for Computing Devices – Unintentional Radiators, Marketed in Canada
N-B 2-0001-026L-1503 FCC Part 15 Compliance for Unintentional Radiators, Marketed in the United States
N-B 2-0001-126L-1506 Electromagnetic Interference (EMI) Regulations for Intentional Radiators Subject to Certification in the United States and Canada

Compliance:

C-S 0-2535-004L-0707 Marking of Lenovo Parts
C-S 1-1121-003L-1502 Country of Origin Labeling for Products, Sub-assemblies and Parts
C-S 1-1121-010L-1301 Product Definitions and Serial Numbering; Format, Visibility, Attachment, and Control
C-S 1-1121-015L-0907 Automatic Identification (AI); Packaging, Distribution and Manufacturing
C-S 1-1121-017L-1502 Compliance, Power and Certification Labels on Products; Location, Visibility, Classes, and Control
C-S 2-0002-030L-0910 Telecommunication and Radio Product Compliance (Worldwide Homologation Requirements)
N-B 2-4700-017L-1103 Power Line Harmonics - Limits and Test Methods; National Requirements
C-S 2-4700-033-0412 Power Line Disturbance (PLD), Susceptibility Limits and EU Immunity Limits
C-S 2-0001-001L-1303 Electrical Fast Transients/Burst (EFT/B); Immunity Levels and Test Methods
C-S 2-0001-022L-0911 Surge - Immunity Limits and Test Methods Based on IEC 61000-4-5
N-B 3-0501-033L-1009 Product Safety Certification, National Requirements
C-S 3-0501-070L-1409 Product Safety, Lenovo Requirements; Elec., Mech., and Flammability
N-B 3-0501-201L-1009 Product Safety, National Requirements, All Countries
C-S 6-0460-001L-1004 Air Shipments of Magnetic Materials, International and United States Regulations for Air Shipments of Magnetic Material

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1 Introduction

This Specification provides system specific information detailing the features, functionality, and high-level architecture of the Lenovo Value Rack 2U Server xxx which code name is Carnage. Carnage is a new 1U dual-socket server based on the Intel Skylake/ Cannonlake processors.

1.1 Document Scope

This document is Hardware-centric, and focuses on the architectural and system/block level functionality of the Platform. It may allude to the Firmware/Software required to implement functionality, but will not describe this in detail. Also, this document is not meant to give detailed information on the minor parts' theory of operation.

1.2 Definitions

Acronym/Term	Definition
LC	Lenovo China
LI	Lenovo International
CPU	Central Processing Unit
HDD	Hard Disk Drive
DIMM	Dual in-line memory module
FRU	Field Replaceable Unit
FSC	Fan Speed Control
CRU	Customer Replaceable Unit
FW	Firmware
BP	Backplane
HS	Hot Swap
JTAG	Joint Test Action Group
LAN	Local area network
LP	Low Profile PCIe card and LP I/O bracket (size per PCI Special Interest Group standard)
MB	Motherboard
OS	Operating System (typically LENOVO Product Group software – Custom, Windows, or Linux)
PCB	Printed Circuit Board
PCIe	Peripheral Component Interconnect Express (a PCI Special Interest Group Standard)
PSU	Power Supply Unit (typically refers to the system bulk power supply module)

Acronym/Term	Definition
RC	Riser Card
SAS	Serial Attached SCSI
SATA	Serial Advanced Technology Attachment
SSD	Solid State Disk
Anydrive Slot	Refers to a drive slot that is compatible with SAS/SAS and PCIe SSD Drives (wired for x4 lanes of Gen3)
LPRiser	A stand up PCIe HLHH or “LP” slot which can also expand IO with a Riser card

2 System Overview

2.1 System Feature Set Summary

See below table for Carnage system feature set summary.

Table 1- Feature Set

Platform Feature List	
Carnage	
System Chassis Configuration	
2U 8x3.5” LFF Drive Chassis	8 x 3.5" SATA front access 8 x 3.5" SAS/SATA front access 12 x 3.5" SAS/SATA front access
2U 16x2.5” SFF Drive Chassis	2 x M.2 only (no BP/HDD) 8 x 2.5" SAS/SATA front access 16 x 2.5" SAS/SATA front access
System Appearance	
OP Panel -(Silicon Lite)	Power-Control Button with Power-on LED (Green) Ethernet activity LED (Green) System-locator button with LED (Blue) System error LED (Yellow) Integrated front Thermal sensor
Front Conns	2x USB2.0 (Front USB port 0 support BMC log function with switch for FW), There are two type support "LCD mode" or "BMC connected mode" for use case. USB mobile app under investigation 1x VGA port- Stand on left ear (Optional)
Rear LEDs	System locator LED 1x RJ45(Mgt NIC, activity & link) System error LED 2x RJ45 (LOM, activity & link)
Rear button	NMI button
Rear Conns	2x PHY NIC ports (Optional) 1x RJ45 for 1G Mgt NIC 2x USB3.0 2x RJ45 for 1G NIC 1x VGA(DB15)
Motherboard Buttons/LEDs/ Switches	Refer to Lenovo Purley Constantine_Carnage motherboard specification for details
ID	ThinkSystem
Processor, Chipset and Memory	

CPU	Support for only 1 processor configuration Support for Socket P0 (LGA-3647) architecture Full Intel Purley Shelf 1 & 2, 3, 4 (Bronze, Silver, Gold, Platinum)update to 125W maximum Processor support list please follow Lenovo AVL. XCC high frequency will not on support scope due to thermal limitation. Support 2 UPI links @10.4GT/s Support for future Intel Skylake/Cannonlake EP series CPUs VRM 13 support
Processor Heat-sink	Purley Narrow 2U Extrued (Leverage from MS-2U) Up to 125W Al extruded heat sink
Processor Cores	Up to 20
Processor Cache	Depend on Intel Purley CPU
Processor Quantity	Up to 2
Memory Type (Reg/LR)	Support RDIMM and LRDIMM which must meet or exceed Intel Purley platform PDG DDR4 speeds. Depend on CPU sku. RDIMM,LRDIMM Refer to AVL for memory support list
Number of DIMMs Supported	12 DIMMs
Memory slot Quantity /Channel Quantity	6 channels/CPU, 1x Slot/Channel
Memory RAS	Mirroring, Sparing
Memory of capacity	RDIMM: 8GB, 16GB, 32GB LRDIMM: 32GB,64GB Memory DIMM support list follow AVL
Core Chipset	Intel PCH Lewisburg-2 with PCIe x8 uplink
FPGA	Altera EP4CE15F23C8N
Storage and I/O, PCB	
RAID	PCIe Gen-3 x8 slots for HW RAID. Refer to Lenovo AVL PCH SW RAID for eight HDDs
Front Drive bays	**Simple swap** PCH-Controlled SATA: Up to 8x3.5” LFF SS drive bay (SATA) **Hot Swap** HW RAID card 8i (Basic /Advanced), 16i Advanced / SAS HBA 8i,16i -Controlled SAS/SATA Up to 8x3.5” HS LFF drive bay (SATA/SAS) - w/ one 2U 4x2 -3.5” SAS/SATA Backplane Up to 12x3.5” HS LFF drive bay (SATA/SAS) - w/ one 2U 4x3 -3.5” SAS/SATA Backplane

	Up to 8x2.5” HS SFF drive bay (SATA/SAS) - w/ one 2U 1x8 -2.5” SAS/SATA Backplane Up 16x2.5” HS SFF drive bay (SATA/SAS) - w/ two 2U 1x8 -2.5” SAS/SATA Backplane
HDD indicator	HDD Status and Activity LEDs (Follow ID image design)
HDD Backplane Type	2U 4x2 -3.5” HS Backplane (8 SAS/SATA) 2U 1x8 -2.5” HS Backplane (8 SAS/SATA) 2U 4x3 -3.5” HS Backplane (12 SAS/SATA) All HDDs support will base above 2 BP type for system various configuration.
Peripheral Bays	Slim ODD (De-pop)
M.2 Support	SATA&PCIe(Post SS) refers to Lenovo_Purley_M_2_Boot_Solution_Specification
NVMe PCIe SSD Support	No support
LAN	One dedicated management LAN PHY (BCM-54612E) -Link and Speed LEDs on the RJ45 Connector. Embedded Lewisburg – onboard 2 ports 1GbE (Marvell 88E1514). Co-planar PHY module - selectable LOM up to 2 ports support PHY module: 2x 1GbE, 2x 10GbE Base-T, 2x 10Gb SFP+
Video	Matrox G200 graphics controller embedded in BMC(Pilot4) DRAM Chip DDR4 SDRAM 512MB 667/800 MHz Graphic Memory, Video Memory Cache depends on resolution.
PCIE 3.0 slot	**CPU1** 2U-Riser-1A: slot 1 is top side - PCIe Gen-3 x8 FHHL Slot1 - PCIe Gen-3 x8 FHHL Slot2 - PCIe Gen-3 x8 FHHL Slot3 2U-Riser-1B: - PCIe Gen-3 x8 FHHL Slot1 - PCIe Gen-3 x8 FHHL Slot2 - PCIe ML2 x8 Slot3 2U-Riser-1C:(Optional) - PCIe Gen-3 x16 FHHL Slot1 - Empty - PCIe Gen-3 x8 LP Slot3 Vertical Gen-3 x8 LP Slot4 CPU1,**CPU2** 2U-Riser-2A: slot 5 is top side - PCIe Gen-3 x16 FHHL Slot5(CPU2) - PCIe Gen-3 x8 FHHL Slot6(CPU1)
Expansion PCIe slots	Maximum 6 external slots
Graphic Card	NVS (2D Graphics)- 310 (1GB) (Special Bid) NVS (3D Graphics) -Pascal passive GPU 25W (Special Bid)

Serial Port	1* Serial Port. (Optional) if need will occupy on Vertical PCIe slot4 bracket
PCB	L-shape dimension <= 350 * 440mm PCB stack up <= 8 layer STD, Mid loss material for Purley Entry rack requirement
Internal Conns	1 x Dual M.2 SATA Conn. PCIe M.2 Support (Post SS) 1 x Int USB2.0 without mechanical retention 1 x TPM/TCM Conn 2 x iPASS Conn(SATA) 1x SATA ODD Conn (De-pop) 4 x Fan Conns 1 x Front VGA Conn 1 x OP Panel Conn 1 x NFC Conn (De-pop) 1 x Front USB 2.0 + 1 x Front USB 3.0 Conn 1 x HDD BP PWR1 Conn (1st x8 HDD BP) 1 x HDD BP PWR2 Conn (2nd x8 HDD BP) 1 x COM header 1 x IMM3 debug Conn (Optional) 1 x CFG HDD BP Conn
Chassis, Power and Cables specifications	
Bezel Drive Carrier Dummy HDD Filler Dummy ODD Filler Dummy Power Supply Filler PHY module filler	2U Value_Carnage_Mechanical Design Guidelines 2U Value_Carnage_Mechanical Feature List and Design Requirement Rack ID template for RFQ
Riser Fillers left /right	Install when 1CPU Option or no Riser option
Fan Blank Filler CPU and DIMM blank	2U Value_Carnage_Mechanical Design Guidelines 2U Value_Carnage_Mechanical Feature List and Design Requirement Rack ID template for RFQ
PSU	550W Platinum 750W Platinum 750W Titanium (GA)
Power Budget	Please refer power configuration or power planer for detailed Power budget information
Requirement for UPS	Sine wave UPS only; Not support Square wave UPS
Input range	AC input: 550W/750W Platinum:100-127VAC, 200-240VAC

	750W Titanium: 200-240VAC
	DC input: 240VDC all supported wattages
AC Input Frequency	50-60 Hz
Efficiency	80Plus Platinum (All) Compliant 80Plus Titanium (750W Only) Compliant
Type	1U Hot Swap Redundant PSU 1+1 Redundant (also support N+0 configurations)
Cables	(1). FP Cable for buttons, OP-LEDs (2). Front USB 2.0 + USB 3.0 Cable (3). Front Ear VGA Cable (Optional) (4). NFC Cable (GA) (5). Serial port Cable (Optional) (6). Mini SAS to 8x3.5 SATA 6G Cable(Power+Signal) (Optional) (7). 1st HDD BP power + CFG Cable (Optional) (8). 2nd HDD BP power + CFG Cable (Optional) (9). Mini SAS HD 12G cable A 8*3.5 (Optional) (10). Mini SAS HD 12G cable B 8*3.5 (Optional) (11). 1st HDD BP Mini SAS HD 12G cable A 8*2.5 (Optional) (12). 1st HDD BP Mini SAS HD 12G cable B 8*2.5 (Optional) (13). 2nd HDD BP Mini SAS HD 12G cable A 8*2.5 (Optional) (14). 2nd HDD BP Mini SAS HD 12G cable B 8*2.5 (Optional) (15). Super Cap cable (Optional) Cable lengths vary based on requirements leverage wherever possible
System Fan model/ type /Quantity	2 CPU: 4 x6038 internal system Fans, 3+1 Redundant with single rotor fail
	1 CPU: 3 x6038 internal system Fans, 2+1 Redundant with single rotor fail
PSU FAN	PSU internal Fans- refer to CFF Power Supply v3 specification for details
System form factor	2U RACK
System outline dimensions	2U Value_Carnage_Mechanical Design Guidelines 2U Value_Carnage_Mechanical Feature List and Design Requirement Rack ID template for RFQ
Range of System weight	2U Value_Carnage_Mechanical Design Guidelines 2U Value_Carnage_Mechanical Feature List and Design Requirement Rack ID template for RFQ
Range of system packaging weight	TBD
Rail and CMA	2U Value_Carnage_Mechanical Design Guidelines 2U Value_Carnage_Mechanical Feature List and Design Requirement

	Rack ID template for RFQ
Labels	
Lenovo label /material	Service Label, Mechanical labels- details refer to document
Server management	
BMC Chip	Emulex Pilot 4 iBMC
IMM ROM	4MB SPI boot flash
UEFI ROM	No Support. 32MB UEFI SPI flash ROM (Slave Attached Flash Storage) for avoid uEFI flashing limitations on bring-up / BBFV only
IMM TPM	Reserve H/W in MB (Detailed check MB spec)
Bus interface	eSPI/LPC supported
IPMI compliance	IPMI V2.0
System maintenance	**– System Inventory and health monitoring** HW Inventory (VPD) / System Info, System and device monitors **– Notification for event and error** IPMI PETs, SMTP, SNMP TRAPs, Syslog **– Logging for event and error** IPMI SEL, Text logs, Latest OS Failure Screen capture **– System power control** **– Error handing** Lightpath Indicators **– Devices firmware update support** All updates signed checked, IMM3 FW, UEFI (non-CRTM), FPGA/PSOC, Locked, flashable while IMM3 in trusted state (during IMM3 boot) **– Thermal management and Fan control** **– Discovery and Deployment support** Service Location Protocol (SLP), Simple Service Discovery Protocol (SSDP), Deployment Manager **– Remote control** Serial Redirection Methods, Remote KVM, Virtual mass storage **– Diagnostic** **– Recovery** Automatic BIOS Recovery (ABR), Automatic Server Restart (ASR) **– Watchdogs** Automatic BIOS Recovery (ABR), SP Application provides user configurable watchdogs
NFC Interface	Support
USB Mobile APP	TBD
User interfaces	IPMI, Web GUI, SNMPv3, REST, Remote Presence
Security and authentication	Directory Services (AD,LDAP), Locate authentication, Firewall (IP blocker), Signed Firmware update, IMM3 trusted boot, NIST SP 800-57

	NIST SP 800-131a, FIPS 140-2 compliant, NIST SP800-147B compliance
System Management	Default Tier 2 support. Up to Tier 3 support Refer to IMM3 SPEC
Nand Controller	eMMC 8GB
WOL	WOL on LOM (Lewisburg with PHY LOM)
DCMI	Support for DCMI 1.5 features
Node manager support	Power Measurements (Node Manager 4.0)
Dedicate/ Share mgmt port	One dedicate management LAN PHY from IMM3 MAC1 (System Managerment network port) IMM3 MAC0 Share management PCH with PHY LOM through NCSI interface can be (Ethernet Port 0 or Port 2)
BIOS	
Type	UEFI
Legacy Support	Yes
UEFI ROM	32MB UEFI SPI flash ROM (Master Attached Flash Storage)
CRTM	Yes
Firmware Recovery	Yes, IMM ESPI to PCH SPI ROM
Firmware Rollback	Yes
Power Operating Modes	Minimal Power, Efficiency –Favor Power Efficiency –Favor Performance Maximum Performance Custom
Reboot on fatal error	Yes
Boot Support	HDD (internal), CD (internal), USB FDD/CD/Drive Key/M.2, PXE Boot
TCM Support	No, For PRC only
TPM support	Yes, Host TPM chip down as default, except PRC
ACPI	S0,S5
OS Support List	
OS Supported	**Please refer SWOD** Microsoft: Windows Server 2012 R2 Windows Server 2016 Datacenter VMware: ESXi 6.0 U3 (2015 U3) -Virtual Storage Area Network (vSAN) ESXi 6.1 (2016 U1) & Custom Image -Virtual Storage Area Network (vSAN)

	RedHat: RHEL 6.8 RHEL 7.3 SUSE: SLES 11 SP4 SLES 12 SP2 Citrix: XenServer 6.x (Certification) Canonical: Canonical Ubuntu 16.04 Other: NeoKylin (Tested), CentOS 7.3 (Tested)
OS Preload List	Please refer SWOD Windows Server 2012 R2: -HDD, Drop in the Box, ROK Windows Server 2016: -HDD, Drop in the Box, ROK ESXi 6.1 (2016 U1) Custom Image -M.2 CTO, M.2 Option ESXi 6.0 (2015 U3) Custom Image -M.2 CTO, M.2 Option
OS Certification List (RH cert/WHQL)	Please refer SWOD
Virtualization Certification	Please refer SWOD
System Manual	Electron Version--------Website
Safety, Certification and Reliability	
Support country list	Refer to Lenovo Regulatory certification list for Purley severs
EMC	Refer to Lenovo Environmental spec class A
Safety Certification	Refer to Lenovo Environmental spec CCC, UL(compliant with country list)
RoHS	Meet the requirements of Lenovo Engineering Specification 41A7733/41A7731
Climate Savers	Yes(USA)
China Environment Labeling	No. PRC only
Energy Star Server	2.0 (USA) per draft specification
Supplier Material Declaration	Supplier must follow the attached declaration guidance to fill in the "IPC 1752-1" file and sign back to Lenovo.
240VA(Safety)	Yes, (system level 240VA)

Smokeless	Yes, detail requirement and spec Please Refer to Lenovo Smokeless reference docs.
Environment Specification	
Temperature operating	Current System Spec System support Ashare A2, A3 and A4 with limitation (Support of A3, A4 is the expectation for the configurations defined) (Ashare A3, A4 support will be restricted with below subsystem (Single PSU, CPU>125W, GPU, AEP, NVMe). Value Rack No Cooling Redundancy Claim for A3/A4 Support A3, A4 with CPU performnce reduction, with Memory performance reduction, with Front HDD performance reduction, with PCIe performance reduction. Performance reduction<25% on >36C ≤40C, Performance reduction<50% on >41C ≤45C. No specific humidity definition for A2-A4 Design by project, but if system follow ASHRAE standard, should follow below requirements Maximum rate of change(℃/hr) should ≤ 20 Humidity transition rate should ≤10%/hr. A2: 10℃ to 35℃. Humidity: 20%~80% RH, Non-condensing. A3: 5℃ to 40℃. Humidity: 8%~85% RH, Non-condensing. A4: 5℃ to 45℃. Humidity: 8%~90% RH, Non-condensing. Supported Altitude* (unpressurized): 0-10000ft (0-3048m) A2: Operating temperature de-rated 1℃ per 300m (1000ft) to 3000m (10000ft) above 950m A3: Operating temperature de-rated 1℃ per 175m (575ft) to 3000m (10000ft) above 950m A4: Operating temperature de-rated 1℃ per 125m (410ft) to 3000m (10000ft) above 950m Please refer ASHRAE standard
Temperature Non-operating w/o PKG	Current Spec Temperature: -10℃ to 60℃ Humidity: 8%~90% RH, non-condensing(check China server standard)
Storage w/ PKG	Current Spec Temperature: -40℃ to 70℃ Humidity: 8%~90% RH, non-condensing
Altitude (LC 2000m, LI 10000ft)	Supported Altitude* (unpressurized): 0-10000ft (0-3048m) A2: Operating temperature de-rated 1°C per 300m (1000ft) to 3000m (10000ft) above sea level, No A3/A4 support
Humidity operating	8%~90%, non-condensing
Humidity non operating	8%~90%, non-condensing
Storage w/ PKG	8%~90%, non-condensing
Acoustic idle	Acoustic Levels:1U Idle Active

/working mode

Table 2. Limits for 1U Rack Products

Configuration	idle SWL LWAm[1][bels]	oper SWL LWAm[bels]	General Description
Min	4.7	5.2	Single socket or dual socket, light load processors, light memory, single hard drive
Typical	5.2	5.9	Single or Dual Socket, mid-range processors, nominal memory, half HDD capacity
Max	5.8	6.6	Dual socket, cooling-constrained processors, full memory, full HDD

Acoustic Levels:2U Idle Active

Table 3. Limits for 2U Rack Products

Configuration	idle SWL LWAm[bels]	oper SWL LWAm[bels]	General Description
Min	4.6	5.2	Single socket or dual socket, light load processors, light memory, single hard drive
Typical	5.2	5.9	Dual Socket, mid-range processors, nominal memory, half HDD capacity
Max	6.2	6.8	Dual socket, cooling-constrained processors, full memory, full HDD

Performance Loss Verification

• HDD performance criteria:

Enterprise PLV	Minimum Performance IOps%	
	Homogenous SKU	Intermix-HDD SKU
Part 1 - HDD-HDD	85%	85%
Part 2 - Fan-HDD	80%	80%

• PLV Configuration:

Test Sku	Test Item	HDD	Test Method	Fan PWM (System & PSU)	IOMeter Script
Homogenous	Part1B HDD-HDD	All BC or all MC	Stress all HDDs simultaneously	Normal speed 20~40%	4KRW, Q8 Ramp up 30sec Test time 2min
	Part 2 Fan-HDD	All BC or all MC	Stress all HDDs simultaneously	20%, 40%, 60%, 64%, 68%, 72%, 76%, 80%, 84%, 88%, 92%, 96%, 100%	256KSW, Q8 Ramp up 30sec Test time 2min
Intermix	Part1A HDD-HDD	One BC HDD with other MC HDDs	Stress all HDDs simultaneously, but record BC only	Normal speed 20~40%	4KRW, Q8 Ramp up 30sec Test time 2min
	Part 2 Fan-HDD	All BC	Stress all HDDs simultaneously	20%, 40%, 60%, 64%, 68%, 72%, 76%, 80%, 84%, 88%, 92%, 96%, 100%	256KSW, Q8 Ramp up 30sec Test time 2min

Please follow document “LENOVO ENT_PLV_V02”

Vibration Non-Operating unpackaged

Random vibration: Grms = 1.04

Test time: 15 minutes

Surfaces: ±X,±Y,±Z

Profile break points:

	<table><tr><th>Frequency (Hz)</th><th>G²/Hz (PSD Level)</th></tr><tr><td>2.0</td><td>0.0010</td></tr><tr><td>4.0</td><td>0.0300</td></tr><tr><td>8.0</td><td>0.0300</td></tr><tr><td>40.0</td><td>0.0030</td></tr><tr><td>55.0</td><td>0.0100</td></tr><tr><td>70.0</td><td>0.0100</td></tr><tr><td>200.0</td><td>0.0010</td></tr><tr><td colspan="2">Note: *Reference: A rms = 1.038 G, V rms = 5.209</td></tr></table> Please follow document “Lenovo 1-9711-004L”
Vibration packaged	Random vibration: Grms = 1.04 Test time: 15 minutes Surfaces: ±X,±Y,±Z Profile break points <table><tr><th>Frequency (Hz)</th><th>G²/Hz (PSD Level)</th></tr><tr><td>2.0</td><td>0.0010</td></tr><tr><td>4.0</td><td>0.0300</td></tr><tr><td>8.0</td><td>0.0300</td></tr><tr><td>40.0</td><td>0.0030</td></tr><tr><td>55.0</td><td>0.0100</td></tr><tr><td>70.0</td><td>0.0100</td></tr><tr><td>200.0</td><td>0.0010</td></tr><tr><td colspan="2">Note: *Reference: A rms = 1.038 G, V rms = 5.209</td></tr></table> Please follow document “Lenovo 1-9711-005L"
Vibration Operating	• PSD profile: <table><tr><th colspan="2">0.21 Grms</th></tr><tr><td>Frequency (Hz)</td><td>G²/Hz</td></tr><tr><td>5</td><td>0.0001</td></tr><tr><td>350</td><td>0.0001</td></tr><tr><td>500</td><td>0.00005</td></tr></table> • Stress tool script: • The test will be done with two different IOMeter workloads, 4k random write and 256k sequential write. IOMeter setup and script – see Appendix for additional information o OPVIB_4k Random Write and 256k Sequential Write <table><tr><th>Test Script</th><th>Target HDDs</th><th>Test Time</th></tr><tr><td>4k Random Write</td><td>4k RW, Q8</td><td>Ramp up 30 sec Run time 5 minutes</td></tr><tr><td>256k Sequential Write</td><td>256k SW, Q8</td><td>Ramp up 30 sec Run time 5 minutes</td></tr></table> • HDD performance criteria:

<table>
<tr><td></td><td>

HDD performance IOps% pass criteria for rack-simulated fixture

<table>
<tr><th>Enterprise OP-Vib</th><th>Minimum HDD Performance IOps%</th></tr>
<tr><td>4k RW</td><td>50%</td></tr>
<tr><td>256k SW</td><td>25%</td></tr>
</table>

HDD performance IOps% pass criteria for aluminum bar stock

<table>
<tr><th>Enterprise OP-Vib</th><th>Minimum HDD Performance IOps%</th></tr>
<tr><td>4k RW</td><td>25%</td></tr>
<tr><td>256k SW</td><td>NA</td></tr>
</table>
Please follow document “LENOVO ENT_OP VIB_V02”
</td></tr>
<tr><td>Shock operating</td><td>
Wave form: Half Sine wave
Spec: 15G/3ms, one shock/axis. Total 6 shocks.
Axes: ±X,±Y,±Z
<table>
<tr><th>Shock Waveform</th><th>G level</th><th>Duration</th><th>Direction</th><th>Interval time between shocks</th><th>Shock#</th></tr>
<tr><td>Half Sine</td><td>15g</td><td>3ms</td><td>6 directions (±X, ±Y, ±Z)</td><td>5 sec minimum</td><td>1 shock per direction, total 6 shocks</td></tr>
</table>
Interval between shocks: 5s
Please follow document “LENOVO ENT_OP SHOCK_V02”
</td></tr>
<tr><td>Shock Non-operating Un-packaged</td><td>
Wave form: Square wave
Spec: One shock/face. Total 6 shocks
<table>
<tr><th>Product Mass (Unpacked)</th><th>Minimum Shock Level</th><th>Minimum ΔV</th></tr>
<tr><td>0 – 3 kg (0 – 7 lbs)</td><td>50 G</td><td>4,572 mm/sec (180 in/sec)</td></tr>
<tr><td>4 – 11 kg (8 – 25 lbs)</td><td>50 G</td><td>4,242 mm/sec (167 in/sec)</td></tr>
<tr><td>12 – 22 kg (26 – 50 lbs)</td><td>50 G</td><td>3,861 mm/sec (152 in/sec)</td></tr>
<tr><td>23 – 31 kg (51 – 70 lbs)</td><td>35 G</td><td>3,861 mm/sec (152 in/sec)</td></tr>
<tr><td>32 – 68 kg (71 – 150 lbs)</td><td>35 G</td><td>3,454 mm/sec (136 in/sec)</td></tr>
<tr><td>69 – 106 kg (151 – 235 lbs)</td><td>25 G</td><td>2,995 mm/sec (118 in/sec)</td></tr>
</table>
Please follow document “Lenovo 1-9711-008L”
</td></tr>
<tr><td>Standalone packaged Drop</td><td>Drop schedule:1 corner 3 edge 6 face:
Drop height:</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><th colspan="2">Mass (Packaged Product)</th><th rowspan="3">Number of Shocks (Drops)</th><th colspan="4">Typical Design Drop Height**</th></tr>
<tr><th>lbs</th><th>kg*</th><th colspan="2">All Modes</th><th colspan="2">Padded Van</th></tr>
<tr><th>Above - Including</th><th>Above - Including</th><th>in</th><th>mm*</th><th>in</th><th>mm*</th></tr>
<tr><td>0-7</td><td>0-3</td><td>10 (Section 5.2.2 on page 5)</td><td>42</td><td>1,067</td><td>36</td><td>915</td></tr>
<tr><td>8-25</td><td>4-11</td><td>10 (Section 5.2.2 on page 5)</td><td>36</td><td>915</td><td>36</td><td>915</td></tr>
<tr><td>26-70</td><td>12-31</td><td>10 (Section 5.2.2 on page 5)</td><td>30</td><td>762</td><td>30</td><td>762</td></tr>
<tr><td>71-150</td><td>32-68</td><td>10 (Section 5.2.2 on page 5)</td><td>24</td><td>610</td><td>18</td><td>610</td></tr>
<tr><td rowspan="2">151-235</td><td rowspan="2">69-106</td><td>6 (all faces)</td><td>18</td><td>458</td><td>-</td><td>-</td></tr>
<tr><td>5 (no top drop)</td><td>-</td><td>-</td><td>12</td><td>458</td></tr>
<tr><td>236-530</td><td>107-240</td><td>(2 bottom)
12
(10 bottom)</td><td>8

2</td><td>204

51</td><td>8

2</td><td>204

51</td></tr>
<tr><td>531-1,000</td><td>241-453</td><td>(2 bottom)
12
(10 bottom)</td><td>6

2</td><td>153

51</td><td>6

2</td><td>153

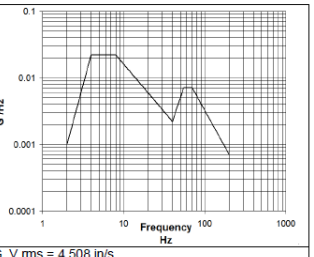
51</td></tr>
<tr><td>Over 1,000</td><td>Over 453</td><td>(2 bottom)
12
(10 bottom)</td><td>4

2</td><td>102

51</td><td>4

2</td><td>102

51</td></tr>
</table>
Please follow document “Lenovo 1-9711-005L"
</td></tr>
<tr><td>Standalone Package Vibration</td><td>
Table 2 All Transportation Modes - Very High Assurance. Minimum test time required is 15 minutes per face. The area of the PSD is approximately 1.04 G rms*.
<table>
<tr><th>Frequency (Hz)</th><th>G^2/Hz (PSD Level)</th></tr>
<tr><td>2.0</td><td>0.0010</td></tr>
<tr><td>4.0</td><td>0.0300</td></tr>
<tr><td>8.0</td><td>0.0300</td></tr>
<tr><td>40.0</td><td>0.0030</td></tr>
<tr><td>55.0</td><td>0.0100</td></tr>
<tr><td>70.0</td><td>0.0100</td></tr>
<tr><td>200.0</td><td>0.0010</td></tr>
<tr><td colspan="2">Note: *Reference: A rms = 1.038 G, V rms = 5.209</td></tr>
</table>
Please follow document “Lenovo 1-9711-005L"
</td></tr>
<tr><td>Rack level Vibration (Non-Operating)</td><td>
A minimun test time of 15 minutes is required. If longer test times are needed, it is recommended that a maximum of one houre be used.

Table 4 Truck, Air, Rail and Ocean Vibration Spectrum (0.8 G rms)*
<table>
<tr><th>Frequency (Hz)</th><th>G^2/Hz (PSD Level)</th></tr>
<tr><td>2</td><td>0.0010</td></tr>
<tr><td>4</td><td>0.0220</td></tr>
<tr><td>8</td><td>0.0220</td></tr>
<tr><td>40</td><td>0.0022</td></tr>
<tr><td>55</td><td>0.0070</td></tr>
<tr><td>70</td><td>0.0070</td></tr>
<tr><td>200</td><td>0.0007</td></tr>
</table>


Note: *Reference: A rms = 0.8044 G, V rms = 4.508 in/s, D rms = 0.1578 in zero to peak

Please follow document “Lenovo 015L Rack Standard”
</td></tr>
</table>

Rack level Drop (Non-Operating)

Configured Rack Product (for palletized and/or unpalletized testing)			
Number of Drops	Free-fall Drop Height	Guided Platen Shock	
		ΔV	Duration
10	1.5 inches (40 mm)	40 in/sec (1020 mm/sec)	2-3 ms
2	2.75 inches (70 mm)	55 in/sec (1400 mm/sec)	2-3 ms
Rack Component (mounted in a palletized rack enclosure)			
Number of Drops	Free-fall Drop Height	Guided Platen Shock	
		ΔV	Duration
10	1.5 inches (40 mm)	40 in/sec (1020 mm/sec)	2-3 ms
2	4 inches (100 mm)	70 in/sec (1775 mm/sec)	2-3 ms
Rack enclosure (for palletized and unpalletized testing)			
Under 1000 lbs (450 kg)*			
Number of Drops	Free-fall Drop Height	Guided Platen Shock	
		ΔV	Duration
10	1.5 inches (40 mm)	40 in/sec (1020 mm/sec)	2-3 ms
2	4 inches (100 mm)	70 in/sec (1775 mm/sec)	2-3 ms
Over 1000 lbs (450 kg)*			
Number of Drops	Free-fall Drop Height	Guided Platen Shock	
		ΔV	Duration
10	1.5 inches (40 mm)	40 in/sec (1020 mm/sec)	2-3 ms
2	2.75 inches (70 mm)	55 in/sec (1400 mm/sec)	2-3 ms

** Enclosure weight*

Please follow document “Lenovo 015L Rack Standard”

PLV

Test Sku	Test Item	HDD	Test Method	Fan PWM (System & PSU)	IOMeter Script
Homogenous	Part1B HDD-HDD	All BC or all MC	Stress all HDDs simultaneously	Normal speed 20~40%	4KRW, Q8 Ramp up 30sec Test time 2min
	Part 2 Fan-HDD	All BC or all MC	Stress all HDDs simultaneously	20%, 40%, 60%, 64%, 68%, 72%, 76%, 80%, 84%, 88%, 92%, 96%, 100%	256KSW, Q8 Ramp up 30sec Test time 2min
Intermix	Part1A HDD-HDD	One BC HDD with other MC HDDs	Stress all HDDs simultaneously, but record BC only	Normal speed 20~40%	4KRW, Q8 Ramp up 30sec Test time 2min
	Part 2 Fan-HDD	All BC	Stress all HDDs simultaneously	20%, 40%, 60%, 64%, 68%, 72%, 76%, 80%, 84%, 88%, 92%, 96%, 100%	256KSW, Q8 Ramp up 30sec Test time 2min

Please follow document “LENOVO ENT_PLV_V02”

System Assembly Strain

|Rudimental value| < 450 uStrain for principal strain value

Please follow document “Desktop Assembly Dynamic Strain Measurement”

Dynamic MB Strain

Strain Range (micro strain, με)	Associated Risk	Recommendation/Comments
1800 ⩾ | ε_{min} |	low	Solder joint failure is under customer's risk requirement

Please follow document “Desktop Assembly Dynamic Strain Measurement”

2.2 System Hardware Configuration Options

This is a Table showing the Carnage main System Building Blocks (SBBs). This is here to depict an overall hardware configurability and capability for the complex set of feature options that the Carnage needs to be able to support in hardware. Not all configurable combinations or feature options are shown here, such as DIMM memory options, or TPM/TCM, as examples.

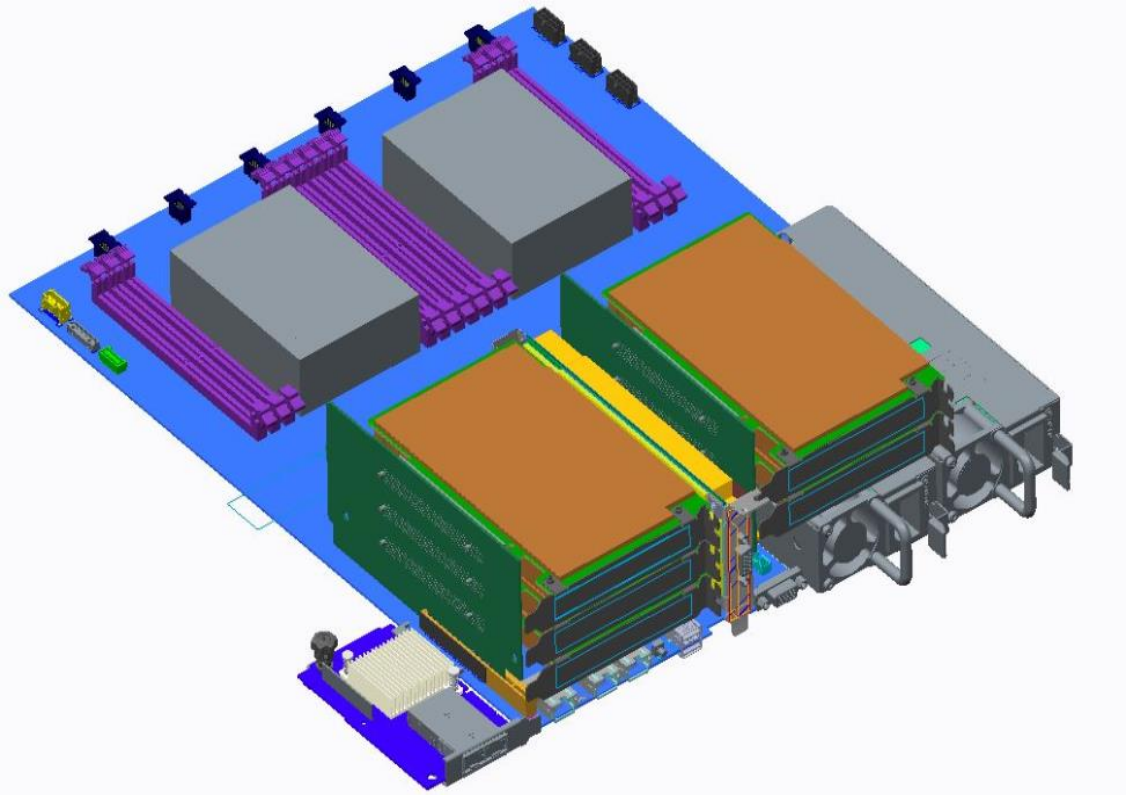
Table 2- Main System Building Blocks

Value Rack 2U (Carnage)																									
Chassis	HDD configuration	Backplane	HDD Type						M.2 Boot Module		RAID				SS HBA (no RAID)		Riser Type				Intel PHY Module		
			3.5" SATA	3.5" SAS	2.5" SATA /SATA SSD with 3.5" HDD cage	2.5" SAS / SAS SSD with 3.5" HDD cage	2.5" SAS, SATA/ SSD	M.2 SSD	Single Slot	Dual Slot w/ HW RAID	SW RAID	8i Basic	8i Adv	16i Adv	8i	16i	CPU1 2U-Riser-1A	CPU1(ML2) 2U-Riser-1B	CPU1(only) 2U-Riser-1C	2 CPU 2U-Riser-2A	2x 1 GbE	2x 10 G BaseT	2x 10 GbE SFP+
8x3.5/12x 3.5 LFF	8x3.5" SATA (SS)		x		x			x	x	x	x						x	x	x	x	x	x	x
	8x3.5" SAS/SATA (HS)	4x2 -3.5" (New 30)	x	x	x	x		x	x	x		x	x		x		x	x	x	x	x	x	x
	12x3.5" SAS/SATA (HS)	4x3 -3.5" (New 37)	x	x	x	x		x	x	x				x		x	x	x	x	x	x	x	x
16x2.5 SFF	2 x M.2 only							x		x							x	x	x	x	x	x	x
	8x2.5" SAS/SATA (HS)	1x8 -2.5" (New 21)					x	x	x	x		x	x		x		x	x	x	x	x	x	x
	16x2.5" SAS/SATA (HS)	2* 1x8 - 2.5"					x	x	x	x		x	x	x	x		x	x	x	x	x	x	x

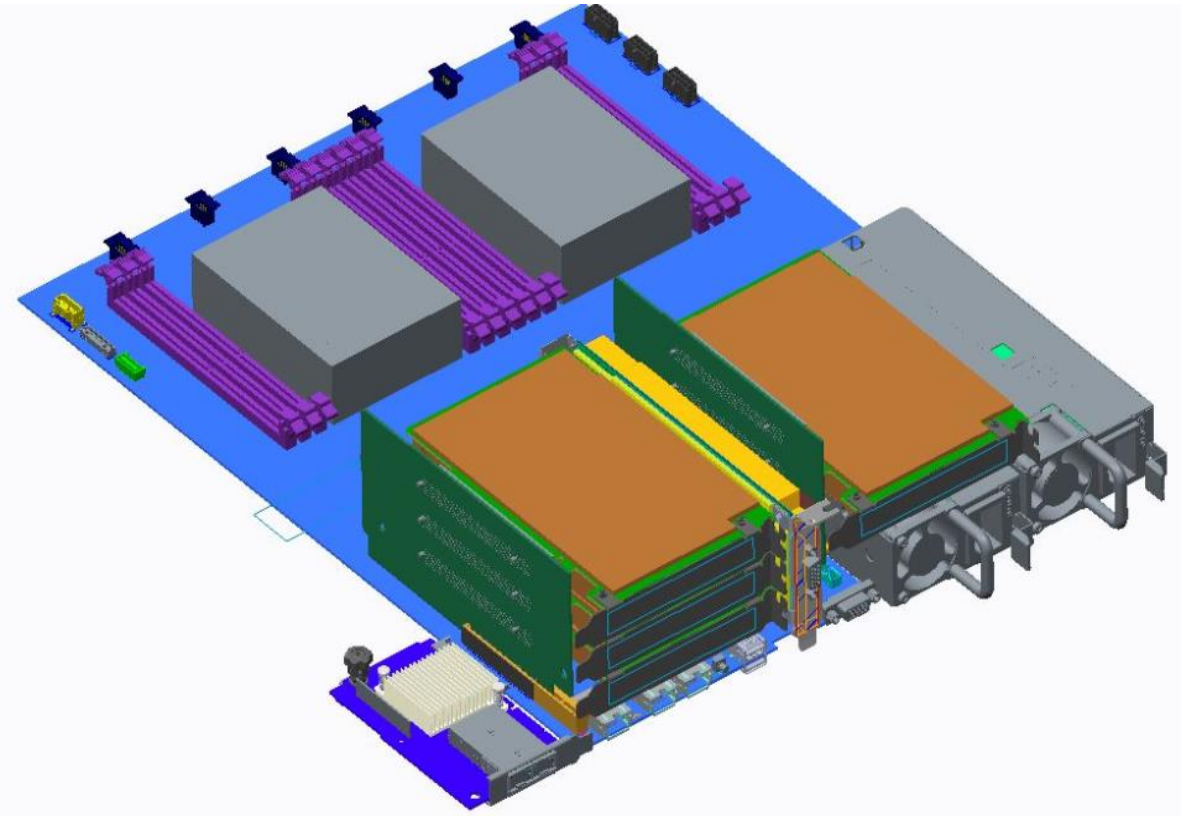
2.3 System Layout Views and MB key component

Figure 1- Carnage System Internal Layout View

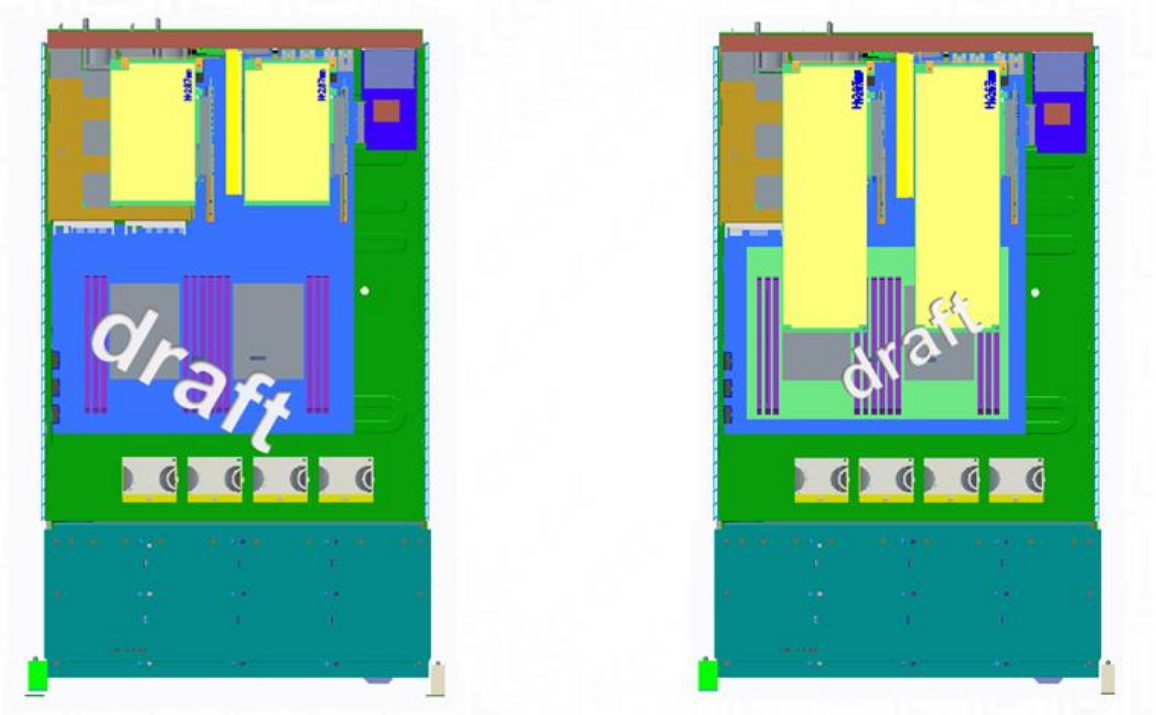
Planar placement:
(6 x PCIe Slots)



Planar placement:
(5 x PCIe Slots)

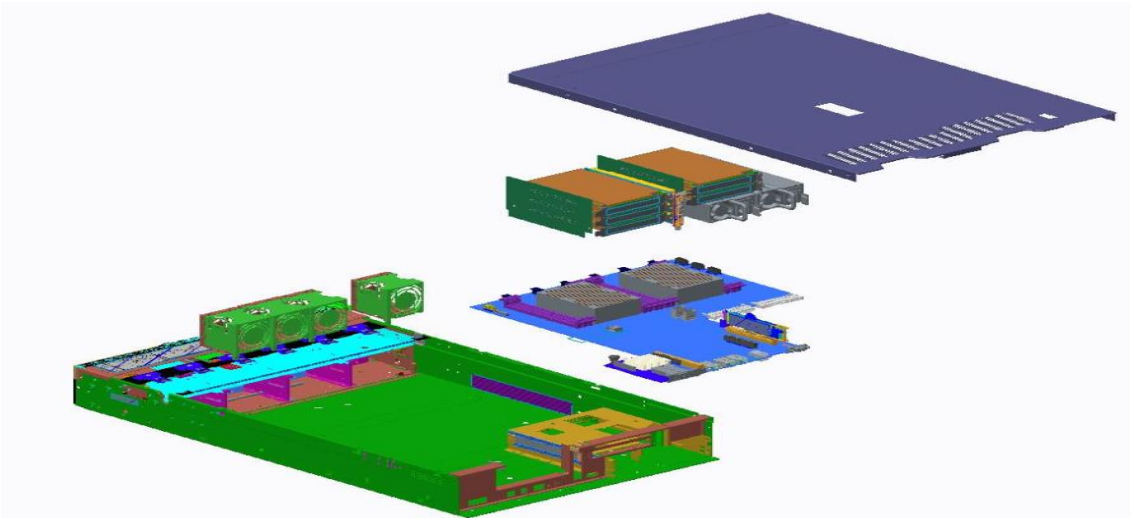


- **3.5” Front HDD Bay Configuration Top View**

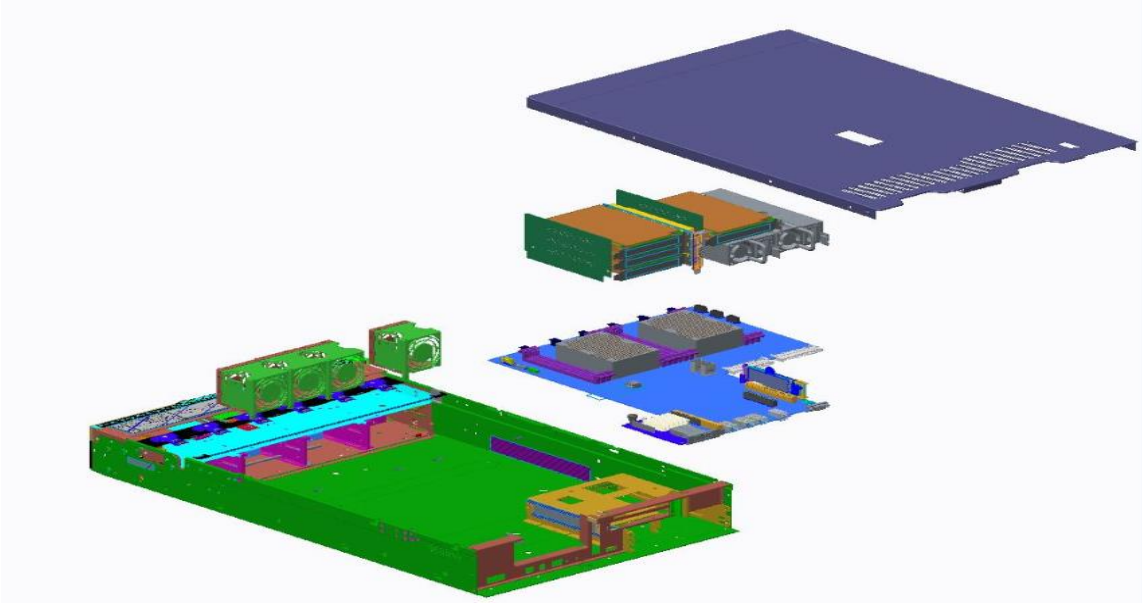


- **3.5” Front HDD Bay Configuration System View**

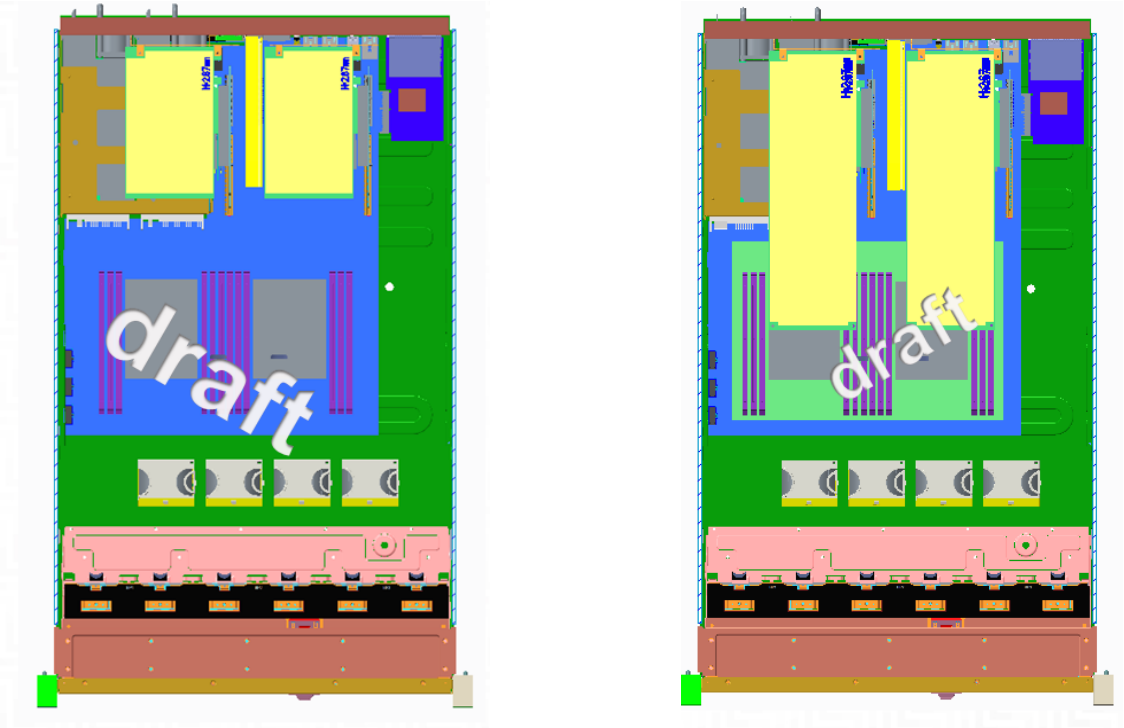
(6 x PCIe Slots)



(5 x PCIe Slots)

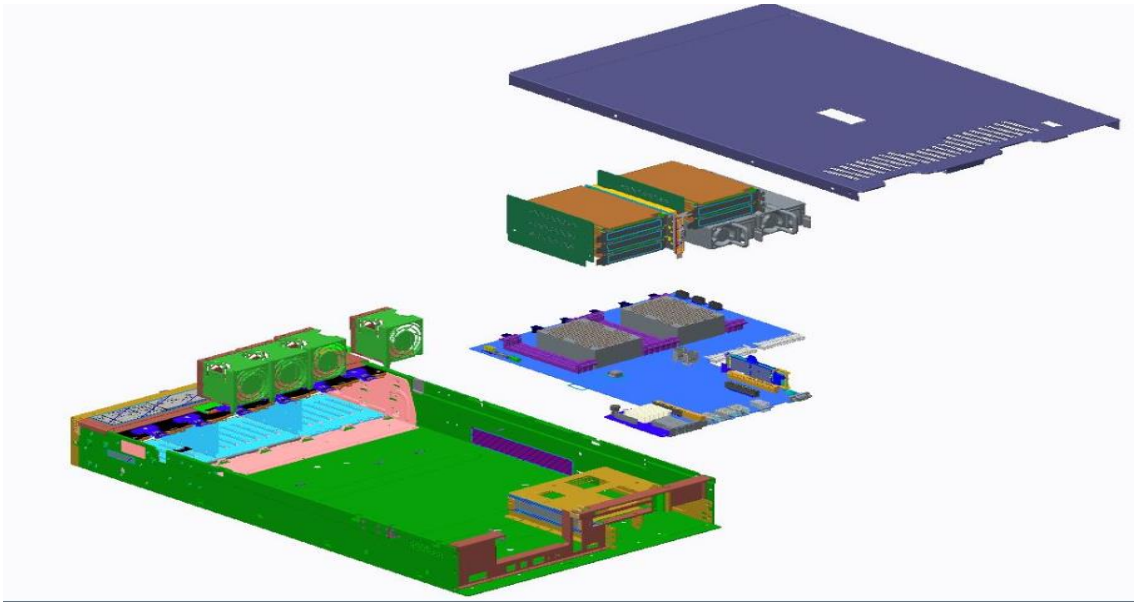


- **2.5” Front HDD Bay Configuration Top View**

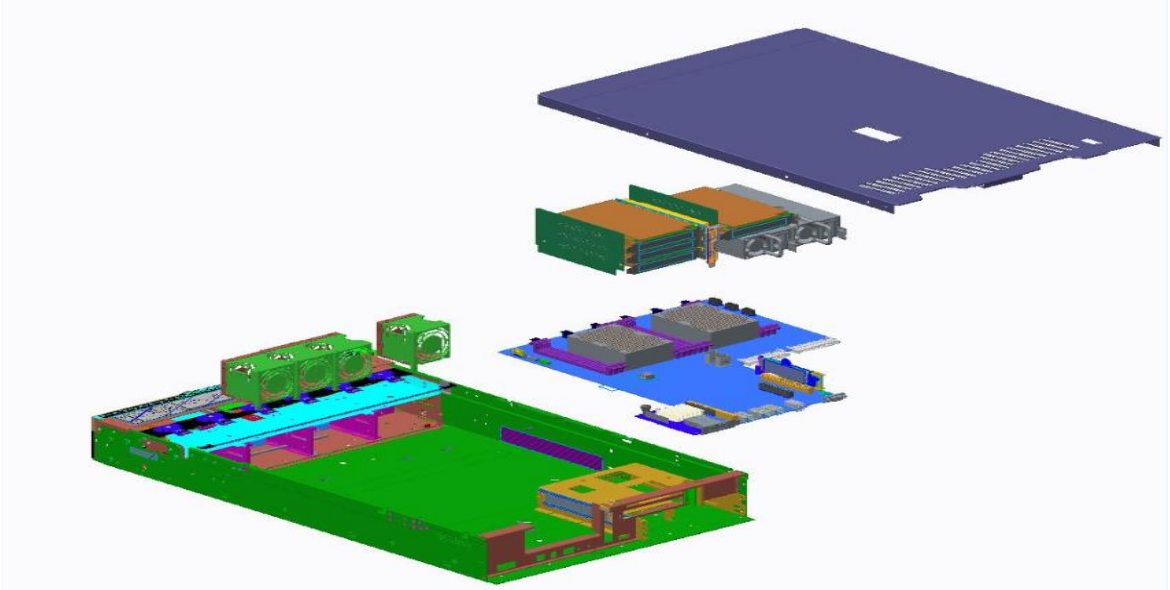


- **2.5” Front HDD Bay Configuration System View**

(6 x PCIe Slots)



(5 x PCIe Slots)



2.4 System Front Views

2.4.1 8x3.5” SATA, SAS/SATA

Figure 2- Carnage 8x3.5” Simple Swap (SATA) Front view

2.4.2 8x3.5” SATA, SAS/SATA

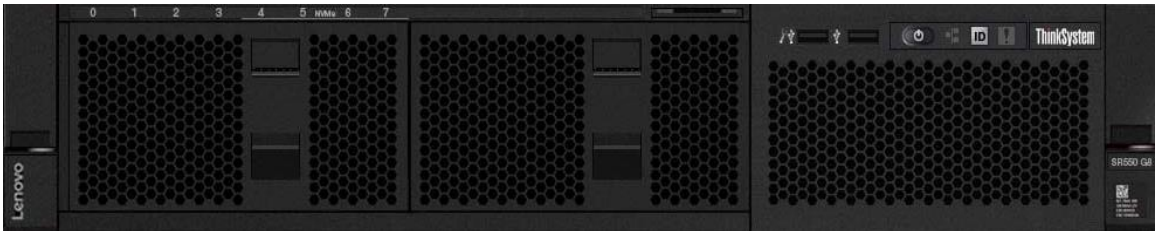
Figure 3- Carnage 8x3.5” Hot Swap (SAS/SATA) Front view

2.4.3 12x3.5” SATA, SAS/SATA

Figure 4- Carnage 12x3.5” Hot Swap (SAS/SATA) Front view

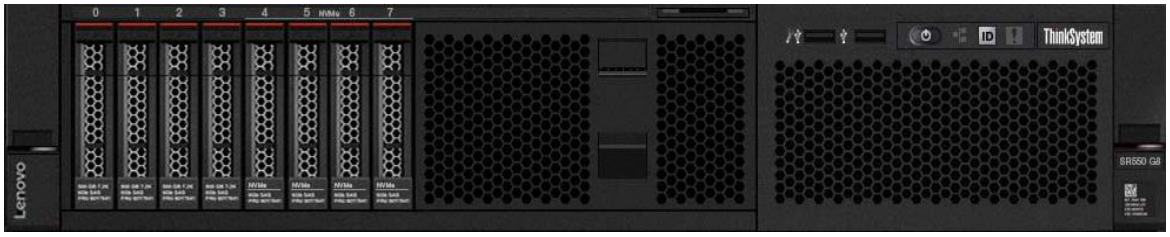
2.4.4 8x2.5” chassis W/O front BP (M.2 only)

Figure 4- Carnage 8x2.5” chassis W/O front BP (M.2 only) Front view



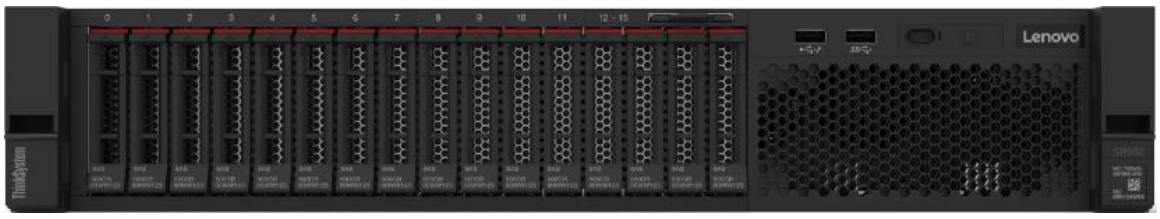
2.4.5 8x2.5” SAS/SATA

Figure 5- Carnage 8x2.5” Hot Swap (SAS/SATA) Front view



2.4.6 16x2.5” SAS/SATA

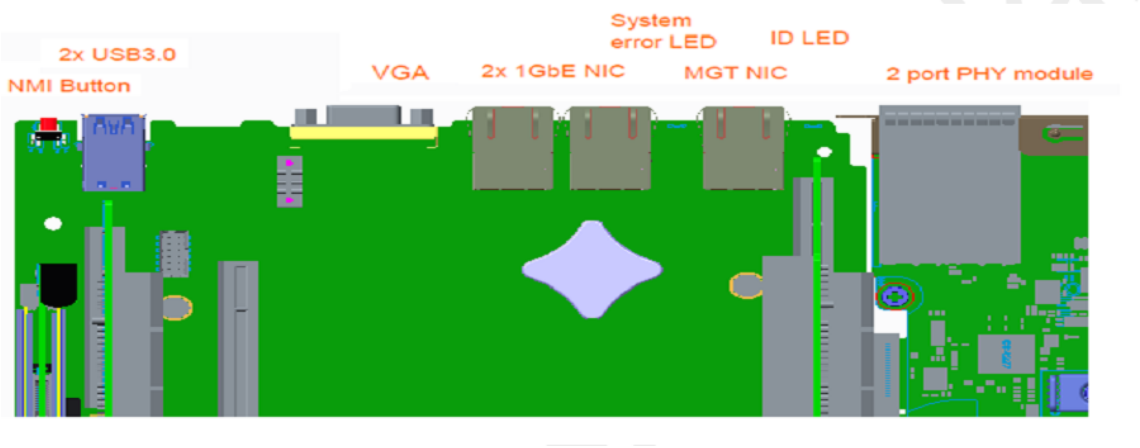
Figure 6- Carnage 16x2.5” Hot Swap (SAS/SATA) Front view



2.5 System Rear Views

This rear view is a Placeholder for Mechanical drawings of rear airdam IO, PHY module, PSU, ect.. for base configs (to come later)

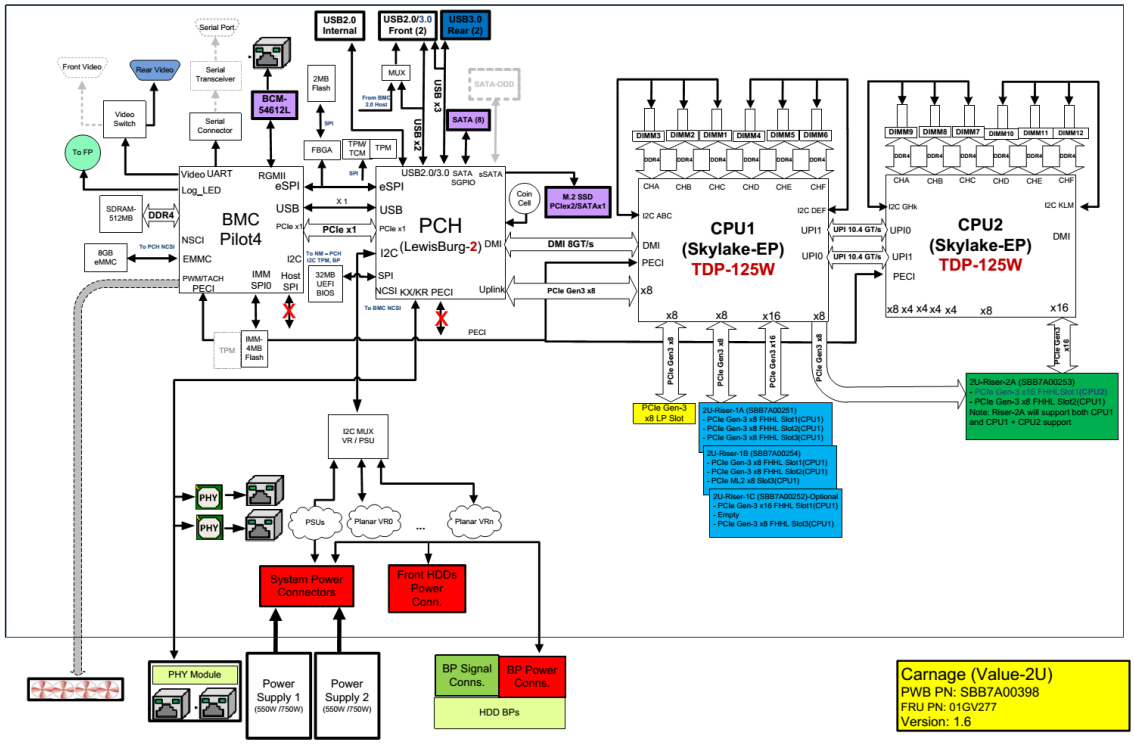
Figure 7- Carnage System Rear view



Note: When insert only 1 CPU, system don’t support slot5.

2.6 System Block Diagram

Figure 8- Carnage System Block Diagram



2.7 System LEDs

This table defines the Carnage System LEDs required. Green Power button/LED, Green Network Activity LED, Blue Locate button/LED, Yellow System Error LED
Note: The Light Path Spec for LED requirements.

OP features from left to right:

- Power button (Green)
- Network LED (Green)
- Locate: “ID” button (Blue) - protrudes
- System Health LED (Amber)

Tertiary Lightpath LEDs on value rack

The only L3 LEDs that will exist on the exterior of these systems are:

- Hot Swap HDDs
- Hot Swap Power Supplies

Table 3- System LED Function Table

Name	Location	Description	Color	Possible States
Power LED	Front	indicate power-on (solid green), power permission delay (blinking 4 Hz, 125msec on/125msec off), stand-by power (blinking, 1 Hz, 500msec on/500msec off)	Green	On, Off, Blinking (1Hz, 4Hz)
Network Acrivity LED	Front	Indicate Network connector and active	Green	Off, Blinking
System Locator LED (X2)	Front/Rear	Front and Rear Locator LED control by same one BMC GPIO. When button in the front is pressed, the LED in the button will light and the LED in the rear will also light.	Blue	On, Blinking, Off
System Error LED	Front	There is a problem with the system, and therefore will prompt the user to check the status	Yellow	On, Off

2.8 Subsystems

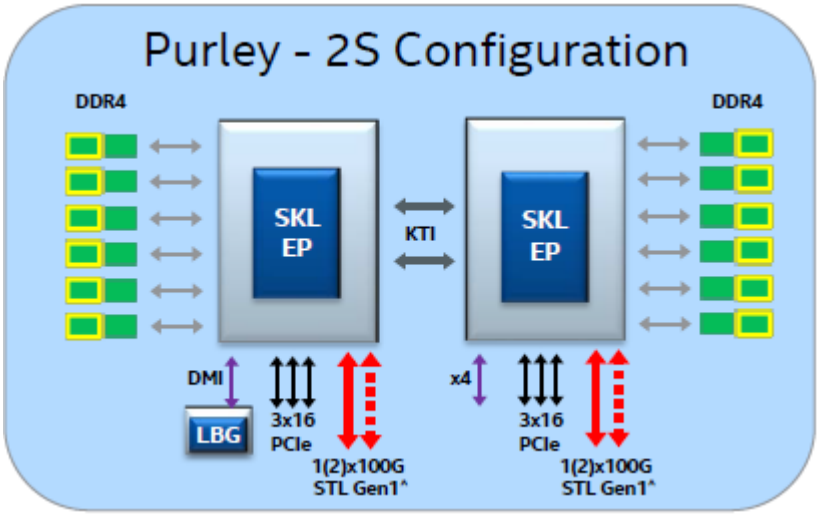
2.8.1 Processor & Chipset Subsystem

Carnage supports one or two Intel Xeon E5 series processors with one Motherboard. E5 Series processors are based on the Intel Skylake-*EP 14*nm core and use socket P0 LGA-3647 package with up to 10.4 GT/s UPI interface. This Motherboard must also support Intel's 'Tick' Purley Platform Processor called Skylake. It must fit, function, and perform within this architecture's while enabling all the Intel Skylake-EP processor capabilities possible using this same Motherboard. Interoperability with all the System Components specified here must be maintained.

Table 4- Supported Processors (Per SDL)

Type	Support for one or two Intel Skylake-EP Processor(s) in LGA 3647 Socket P0 package with Thermal Design Power up to 125W Skylake-EP Processor support.
XEON	CPU list to be provided by Lenovo AVL

Figure 9- Skylake-EP DDR4 Processor on the 2 Socket Purley Platform



2.8.1.1 Electrical / Architectural key System features (SKX & CNX)

- Support all Dual –EP Intel CPU's. Support the Dual UPI channels between them
- Support all Intel POR and stretch goals for error/management/RAS capabilities
- Support 2 generations of CPUs (SKL & CNL or Tock & Tick) with a single motherboard design and no compromises
- Support VRD13.0 for system need VRD solution
- Reference Lenovo detailed design guideline to support implementation
- 6 channels of DDR4 ECC memory/CPU, 1 DIMM per channel, with no compromises meeting and exceeding Intel reference memory speed support for both Skylake and Cannonlake
- 96 lanes of PCI Express Gen3 interconnected or distributed within the system per this specification
- CPU1 to use DMI3 port as the chip-to-chip interface to the Lewisburg PCH (Chipset)
- Intel Lewisburg Platform Controller hub (PCH)
- One PECI (Platform Environment Control Interface) to the PCH
- All SATA3 ports to be supported off the PCH at maximum capabilities to target (regardless of target device capabilities)

- All USB 3.0 ports supported off the PCH at maximum capabilities to targets and backwards compatible with USB 2.0.

2.8.1.2 Thermal

The Skylake-EP Central Processing Unit (CPU) family for the Carnage Family of Servers has a range of thermal design power (TDP) envelopes up to and including 125W Max. The Carnage system design supports the max TDP of 125 watts per CPU in the Dual CPU configuration and shall meet the Lenovo Portfolio Thermal Performance Specification for performance for all failure states.

The System environmental specifications are contained in Purley Portfolio Common Hardware Thermal Requirements Specification and the CPU thermal profiles CPU SKU's Tcase at all supported power levels shall be met.

2.8.2 Memory Subsystem

Carnage supports Twelve DIMMs, including RDIMM, LRDIMM. 6 channels are supported per Socket with 1 DIMM per channel while reaching or exceeding all Intel Purley platform PDG DDR4 speeds. This includes CNX supported memory speed(s) including all Intel stretch goals to be met. Must meet all Intel 1DPC supported maximum bandwidths per supported configurability for both supported DDR4 DIMM types. The memory operating speed will depend on various CPU SKUs support maximum capacity

2.8.2.1 Supported Memory

Table 5- DIMM Support

Type	RDIMM, LRDIMM
RDIMM	List follow AVL
LRDIMM	List follow AVL

2.8.2.2 Memory Electrical / Architectural

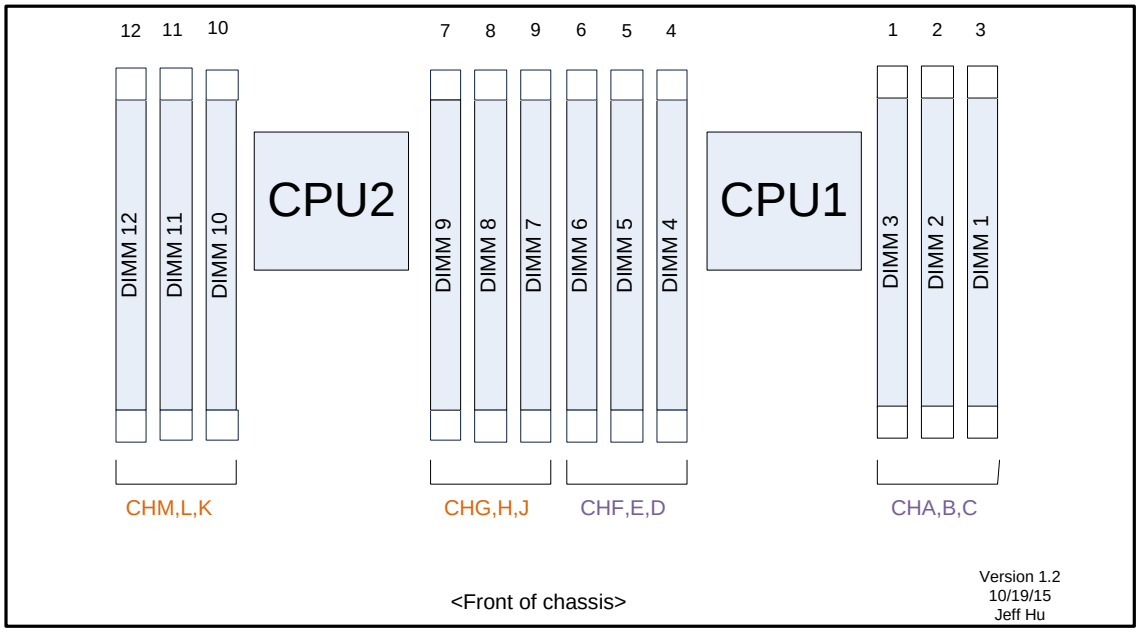
Support mixing of memory speed (operates at highest common speed & inform customer of imitation) Support Single DIMM isolation for FRU replacement. A failure in the memory subsystem must be able to identify a single DIMM for replacement Support Full DIMM inventory by BMC or other management agent (power-on or power-off state). Every FRU component in the system must be capable of being inventoried

2.8.2.3 Memory RAS Support (including and not limited to):

Rank Level Sparing and Device Tagging
Demand and Patrol Scrubbing
DRAM Single Device Data Correction (SDDC) for any single x4 or x8 DRAM device.
Independent channel mode supports x4 SDDC. x8 SDDC requires lockstep mode
Data scrambling with address to ease detection of write errors to an incorrect address.
Error reporting via Machine Check Architecture
Read Retry during CRC error handling checks by iMC
Channel mirroring within a socket

Memory Population Rules

(See T3 BOM for more detail rules)



Number of CPU						
One CPU	x		x		x	
Two CPU		x		x		x
Memory Mirroring						
Yes			x	x		
No	x	x			x	x
Memory Sparing						
Yes					x	x
No	x	x	x	x		
Minimum Required for DIMM	1 Dimm	2 Dimms	2 Dimms	4 Dimms	1 Dimms	2 Dimms
Maximum Allowed for DIMM	6 Dimms	12 Dimms	6 Dimms	12 Dimms	6 Dimms	12 Dimms
Memory Independent Mode for EP	x	x				
Enable Memory Mirroring-EP			x	x		
Enable Memory Sparing-EP					x	x

Independent Mode:

This mode is also known as performance mode. In this mode, each DDR channel is addressed individually via burst lengths of 8 bytes. All six channels can be populated in any order and there are no DIMM matching requirements in Independent Channel Mode. However, all channels must run at the
Same interface frequency. Individual channels may run at different DIMM timings (RAS latency, CAS latency, and so forth).

- SDDC with x4 DRAMs is supported in independent mode.
- Feature control: Independent channel mode can be enabled/disabled using a MRC

Table 6- Memory Population Rule

Independent Mode:

		CPU2						CPU1					
		IMC1			IMC0			IMC1			IMC0		
		12	11	10	7	8	9	6	5	4	1	2	3
		DIMM 12	DIMM 11	DIMM 10	DIMM 9	DIMM 8	DIMM 7	DIMM 6	DIMM 5	DIMM 4	DIMM 3	DIMM 2	DIMM 1
1 CPU	1										X		
	2									X	X		
	3									X	X	X	
	4								X	X	X	X	
	5								X	X	X	X	X
	6							X	X	X	X	X	X
2 CPU	2				X						X		
	3				X					X	X		
	4			X	X					X	X		
	5			X	X					X	X	X	
	6			X	X	X				X	X	X	
	7			X	X	X			X	X	X	X	
	8		X	X	X	X			X	X	X	X	
	9		X	X	X	X			X	X	X	X	X
	10		X	X	X	X	X		X	X	X	X	X
	11		X	X	X	X	X	X	X	X	X	X	X
	12	X	X	X	X	X	X	X	X	X	X	X	X

Note:

CPU 1: DIMM(3)->DIMM(4)->DIMM(2)->DIMM(5)->DIMM(1)->DIMM(6)

CPU 1&CPU 2: DIMM((3,9)->DIMM(4)->DIMM(10)->DIMM(2)->DIMM(8)->DIMM(5)->DIMM(11)->

Rank Sparing Mode:

In Rank Sparing Mode, one or more ranks are spares for the other ranks on the same channel. The spare rank(s) are held in reserve and are not available as system memory. The spare rank(s) must have identical or larger memory capacity than any of the other ranks (sparing source ranks) on the same channel. After sparing, the sparing source rank will no longer be available as system memory.

Sparing Mode:

		CPU2						CPU1					
		IMC1			IMC0			IMC1			IMC0		
		12	11	10	7	8	9	6	5	4	1	2	3
		DIMM 12	DIMM 11	DIMM 10	DIMM 9	DIMM 8	DIMM 7	DIMM 6	DIMM 5	DIMM 4	DIMM 3	DIMM 2	DIMM 1
1 CPU	1										X		
	2									X	X		
	3									X	X	X	
	4								X	X	X	X	
	5								X	X	X	X	X
	6							X	X	X	X	X	X
2 CPU	2				X						X		
	3				X					X	X		
	4			X	X					X	X		
	5			X	X					X	X	X	
	6			X	X	X				X	X	X	
	7			X	X	X			X	X	X	X	
	8		X	X	X	X			X	X	X	X	
	9		X	X	X	X			X	X	X	X	X
	10		X	X	X	X	X		X	X	X	X	X
	11		X	X	X	X	X	X	X	X	X	X	X
	12	X	X	X	X	X	X	X	X	X	X	X	X

Note:

CPU 1: DIMM(3)->DIMM(4)->DIMM(2)->DIMM(5)->DIMM(1)->DIMM(6)

CPU 1&CPU 2: DIMM((3,9)->DIMM(4)->DIMM(10)->DIMM(2)->DIMM(8)->DIMM(5)->DIMM(11)->

Mirror Mode:

In Mirrored Channel Mode, the memory contents are mirrored between Channels 0, 1, 2 or Channels 3, 4, and 5. For example, the memory contents can be mirrored between Channel 0 DIMM0 and Channel 1 DIMM0, between Channel 0 DIMM0 and Channel 2 DIMM0

Mirror Mode:

		CPU2						CPU1					
		IMC1			IMC0			IMC1			IMC0		
		12	11	10	7	8	9	6	5	4	1	2	3
		DIMM 12	DIMM 11	DIMM 10	DIMM 9	DIMM 8	DIMM 7	DIMM 6	DIMM 5	DIMM 4	DIMM 3	DIMM 2	DIMM 1
1 CPU	2										X	X	
	3										X	X	X
	4								X	X	X	X	
	5								X	X	X	X	X
	6							X	X	X	X	X	X
2 CPU	4				X	X					X	X	
	5				X	X					X	X	X
	6				X	X			X	X	X	X	
	7				X	X			X	X	X	X	X
	8		X	X	X	X			X	X	X	X	
	9		X	X	X	X			X	X	X	X	X
	10		X	X	X	X		X	X	X	X	X	X
	11		X	X	X	X	X	X	X	X	X	X	X
	12	X	X	X	X	X	X	X	X	X	X	X	X

Note:

CPU 1: DIMM(3,2)-DIMM(4,5)-DIMM(1,6). ODD: DIMM(3,2,1)->DIMM(4,5)

CPU 1&CPU 2: DIMM(3,2,9,8)-DIMM(4,5)-DIMM(10,11)-DIMM(1,6)-DIMM(7,12).
ODD: DIMM(3,2,1,9,8)->DIMM(4,5)->DIMM(10,11)->DIMM(6,7)

Memory Operating Mode Selections

In uEFI setup menu, there are different operating mode option mapping to different memory voltage and speed setting. For detail information, please refer to document “BIOS-Power_perf_ModesJJ.pdf”

The average customer doesn’t know the best way to set each individual power/performance feature for their specific environment. Because of this, a menu option is provided that can help a customer optimize the system for things such as minimum power usage/acoustic levels, maximum efficiency, Energy Star optimization, or maximum performance.

“**Minimal Power**” mode strives to minimize the absolute power consumption of the system while it is operating. The tradeoff is that performance may be reduced in this mode depending on the application that is running.

“**Efficiency –Favor Power**” mode maximizes the performance/watt efficiency with a bias towards power savings. It provides the best features for reducing power and increasing performance in applications where maximum bus speeds are not critical. It is expected that this will be the favored mode for SPECpower testing. “Efficiency – Favor Power” mode maintains backwards compatibility with systems that included the preset operating modes before Energy Star for servers was released.

“**Efficiency –Favor Performance**” mode optimizes the performance/watt efficiency with a bias towards performance. It is the favored mode for Energy Star. Note that this mode is slightly different than “Efficiency – Favor Power” mode. In “Efficiency – Favor Performance” mode, no bus speeds are derated as they are in “Efficiency –Favor Power” mode. “Efficiency –Favor Performance” mode is the default mode.

“**Maximum Performance**” mode will maximize the absolute performance of the system without regard for power. In this mode, power consumption is a don’t care. Things like fan speed and heat output of the system may increase in addition to power consumption. Efficiency of the system may go down in this mode but the absolute performance can go up depending on the benchmark that is run.

A fifth setting, “**Custom**”, allows the user to individually modify any of the low-level settings that are preset and unchangeable in any of the other 4 preset modes.

Having the operating mode menu selection will also make it easier to incorporate any bit changes required in the future to optimize for power savings or performance.

Detailed settings for each mode are provided in the table that follows.

Must follow Intel memory population rules for tick and tock of Skylake and Cannonlake

2.8.3 HDD RAID and ODD Storage Subsystem

The Carnage supports many types of RAID configurations built from different type of HDD BP that connect from RAID Storage Subsystem

For detailed explanation of each card reference:
Lenovo_Purley_HDD_backplane_Board_Specfication

2.8.3.1 Hot Swap HDD Backplane

For more design details, please refer to Lenovo_Purley_HDD_backplane_Board_Specfication. Support Backplane list to different HDDs type support
1. 4x2 -3.5” SAS/SATA Backplane HS (New 30)
2. 1x8 -2.5” SAS/SATA Backplane HS (New 21)
3. 4x3 -3.5” SAS/SATA Backplane HS (New 37)

2.8.3.2 Front End - HDD & RAID card Configurations

Reference Section 2.4 System Front Views
Carnage supports Enterprise class SATA/SAS/SSD HDDs.
System Chassis Configuration
System offers 4 Supercap for 2 internal and 2 external

Figure 10- 8x3.5” SAS/SATA SKU

Hot Swap:

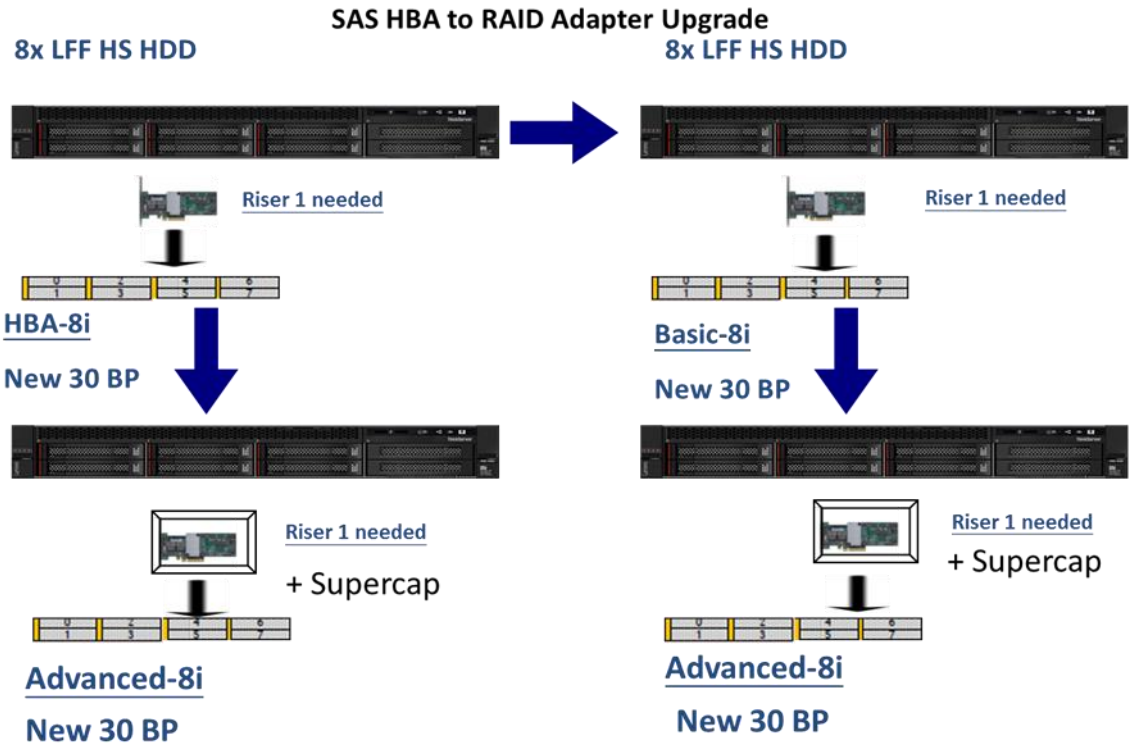


Figure 11- 8x3.5" PCH-controlled SATA SKU

Simple Swap:

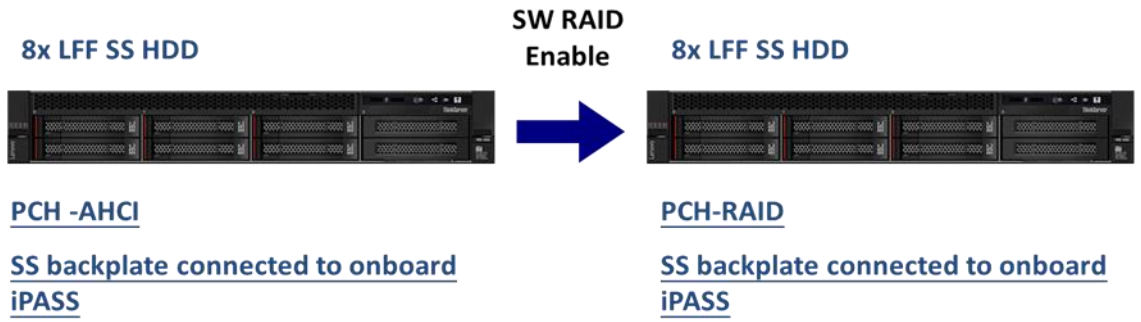


Figure 12- 8x2.5" SAS/SATA/SSD SKU

Hot Swap:

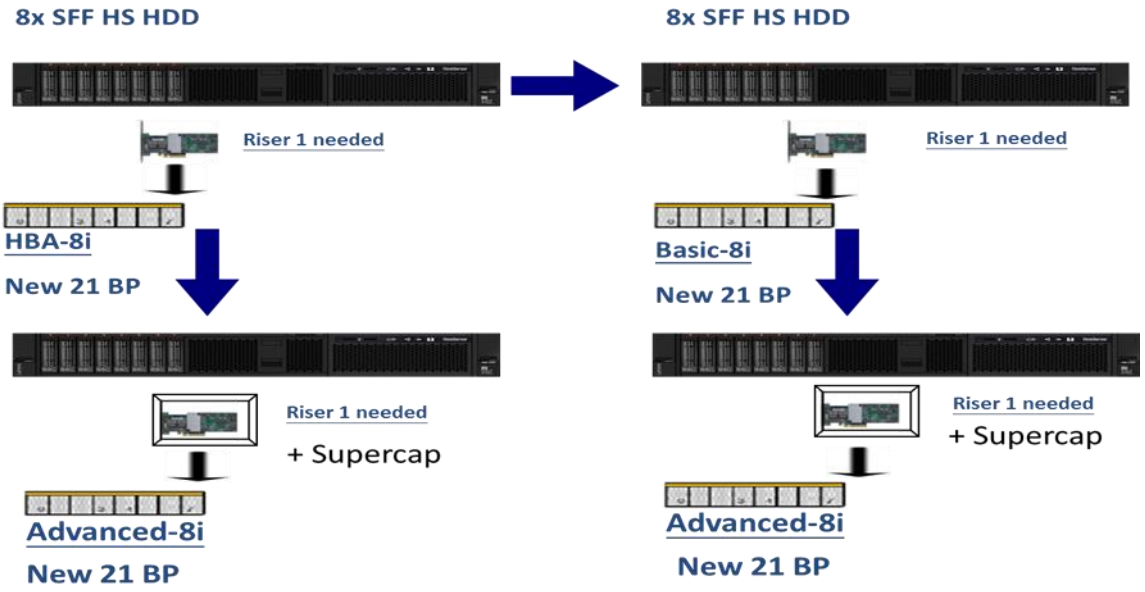
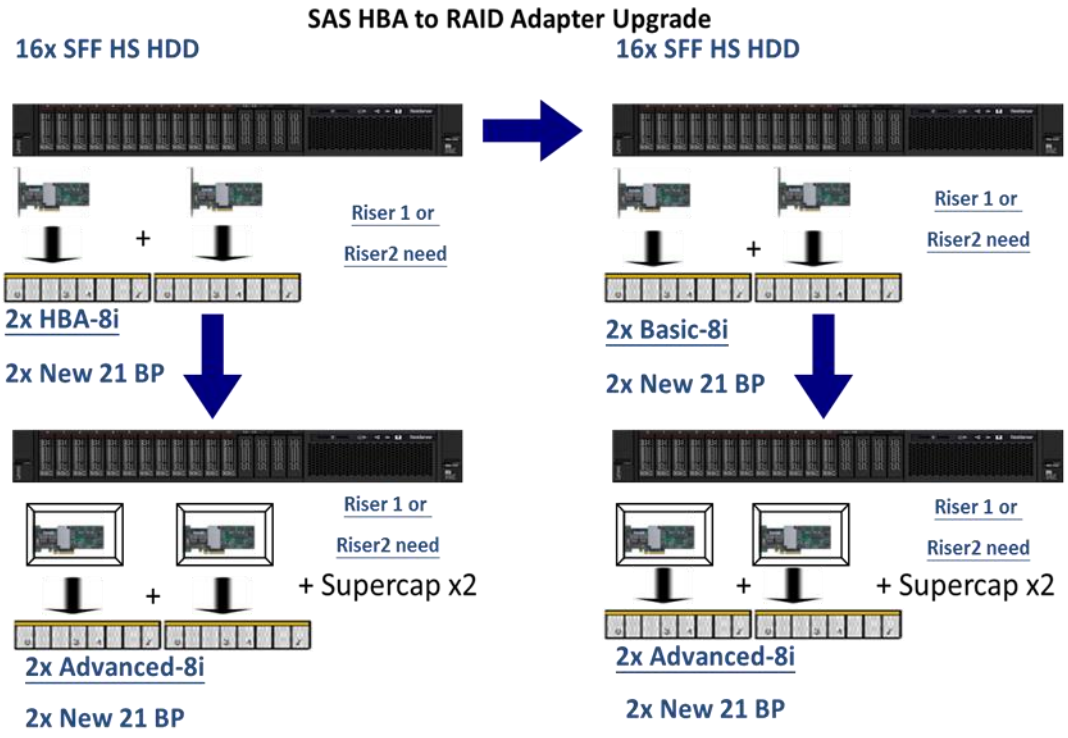


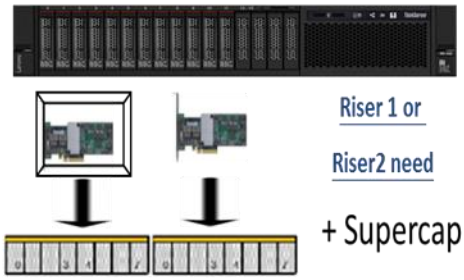
Figure 13- 16x2.5" SAS/SATA/SSD SKU

Hot Swap:



Mix SAS HBA8i, RAID -8i(Basic, Adv) Support

16x SFF HS HDD



Riser 1 or

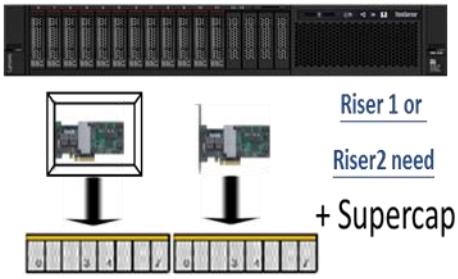
Riser2 need

+ Supercap

Adv-8i + HBA 8i

2x New 21 BP

16x SFF HS HDD



Riser 1 or

Riser2 need

+ Supercap

Adv -8i + Basic 8i

2x New 21 BP

SAS HBA / RAID -8i (Basic) Restriction

16x SFF HS HDD

Riser 1 or

Riser2 need

Basic -8i + HBA-8i

2x New 1 BP

Carnage Storage config Matrix:

2U 3.5”:

Config#	Chassis	Front HDD	PCIe Switch, 8-port (x16)	8i Basic	8i Adv	16i Adv	24i adv	8i	16i	Support at SS (Y/N)
1	8 x 3.5″	4x2 -3.5″ SAS/SATA (new30)		1						Y
2	8 x 3.5″	4x2 -3.5″ SAS/SATA (new30)			1					Y
3	8 x 3.5″	4x2 -3.5″ SAS/SATA (new30)						1		Y
4	12 x 3.5″	4x3 -3.5″ SAS/SATA (new37)							1	Y
5	12 x 3.5″	4x3 -3.5″ SAS/SATA (new37)				1				Y

2U 2.5”:

				HW RAID				SAS HBA (no RAID)			
Config#	Chassis	Front HDD	PCIe Switch, 8-port (x16)	8i Basic	8i Adv	16i Adv	24i adv	8i	16i	Support at SS (Y/N)	Comments
1	16 x 2.5"	1xB -2.5" SAS/SATA (new21) 1xB -2.5" SAS/SATA (new21)				1				Y	
2	16 x 2.5"	1xB -2.5" SAS/SATA (new21) 1xB -2.5" SAS/SATA (new21)		2						Y	
3	16 x 2.5"	1xB -2.5" SAS/SATA (new21) 1xB -2.5" SAS/SATA (new21)			2					Y	upgrade for config 10
4	16 x 2.5"	1xB -2.5" SAS/SATA (new21) 1xB -2.5" SAS/SATA (new21)		1	1					Y	upgrade path for config 9 CTO use config 33
5	16 x 2.5"	1xB -2.5" SAS/SATA (new21) 1xB -2.5" SAS/SATA (new21)							1	N	
6	16 x 2.5"	1xB -2.5" SAS/SATA (new21) 1xB -2.5" SAS/SATA (new21)						2		Y	upgrade for config 11 For CTO use config 5 for best cost
7	16 x 2.5"	1xB -2.5" SAS/SATA (new21) 1xB -2.5" SAS/SATA (new21)		1				1		N	
8	16 x 2.5"	1xB -2.5" SAS/SATA (new21) 1xB -2.5" SAS/SATA (new21)			1			1		Y	
9	16 x 2.5"	1xB -2.5" SAS/SATA (new21)		1						Y	
10	16 x 2.5"	1xB -2.5" SAS/SATA (new21)			1					Y	
11	16 x 2.5"	1xB -2.5" SAS/SATA (new21)						1		Y	

2.8.3.3 Onboard ODD SATA Controller

The SATA function supports AHCI or RAID mode.
The SATA controllers do not support legacy IDE mode or combination mode.

The SATA controller features 14 ports split across the SATA (8) and SSATA (6) controllers that can be independently enabled or disabled (they cannot be tri-stated or driven low). Each interface is supported by an independent DMA controller.
One integrated 6G SATA port controlled by the Lewisburg (PCH) chipset connected the Slim Optical Disk Drive (ODD) connection (De-pop) to the Front HDD Backplane.
.

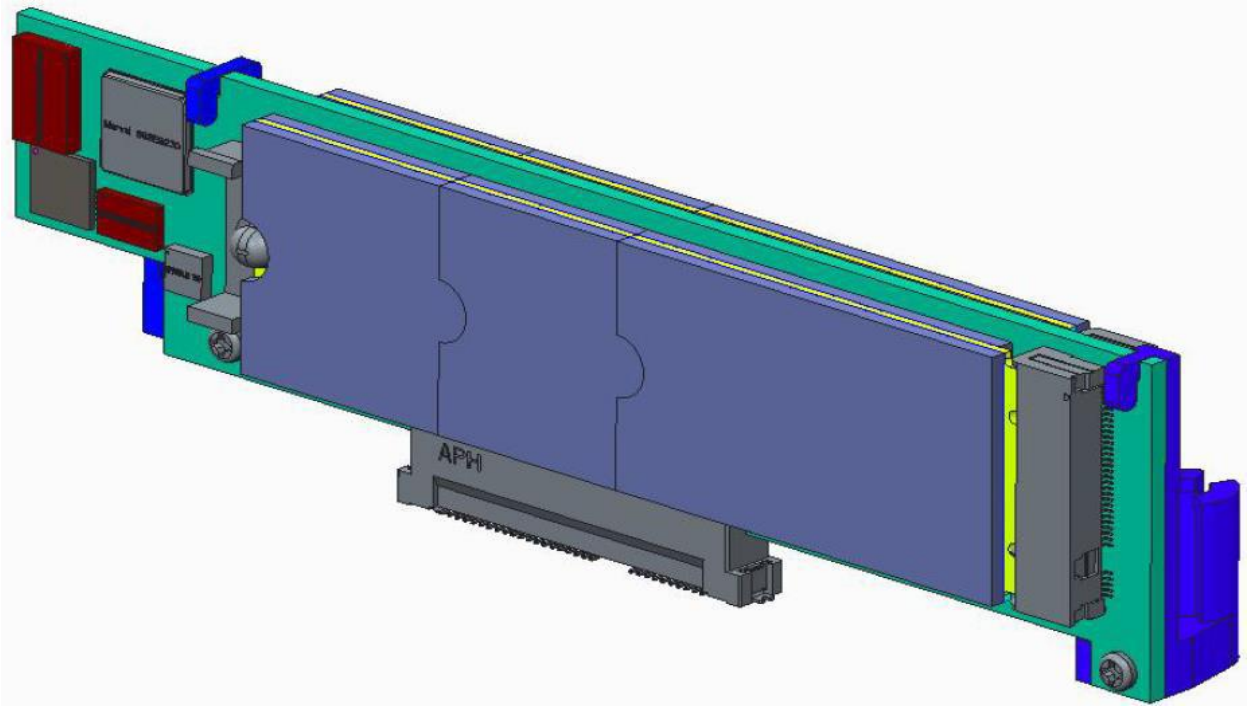
2.8.3.4 Onboard Lewisburg SATA Control

Eight integrated 6G SATA ports controlled by the Lewisburg (PCH) chipset supports should **from SATA (8)** are routed to two x4 iPASS connector.

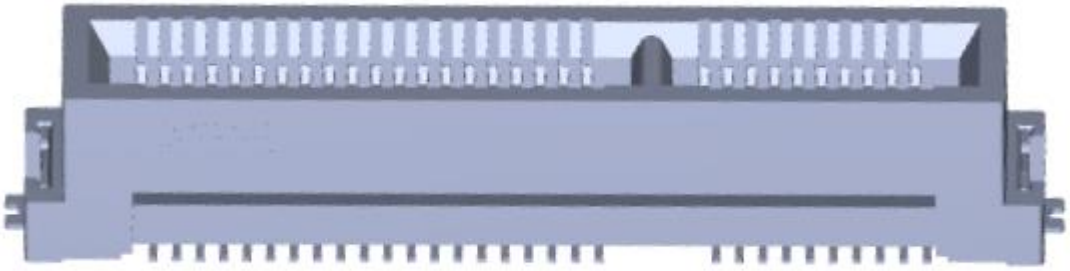
2.8.3.5 M.2 Adapter Boot

There are two kind of M.2 adapter will be support with M.2 RAID Boot Adapter and M.2 Boot Adapter on the planar connector (Amphenol Cool Edge 60-pin Connector SE100601310102X). The Pin definition and Block diagram will be following.

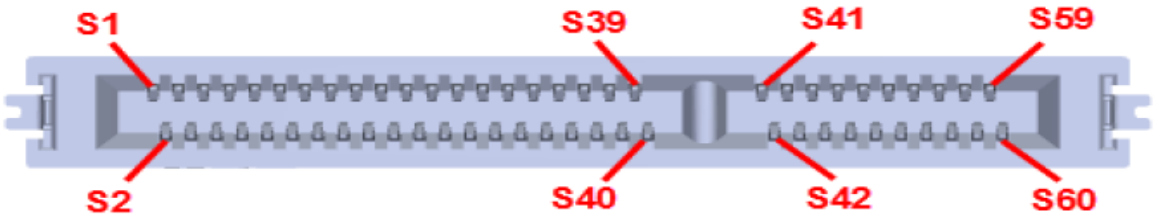
Detail please refers Lenovo_ Purley_M_2_Boot_Solution_Specification spec.



M.2 Boot Adapter host Connector



M.2 Boot Adapter host Connector Pin Numbering



The pin-out is defined as follows (naming convention with respect to host): Boot Adapter host Connector Pin Numbering

Pin #	Signal Name		Signal Name	Pin #
S59	3.3V		M2_PRESENCE_RETURN	S60
S57	3.3V		GND	S58
S55	3.3V		GND	S56
S53	3.3V		GND	S54
S51	3.3V		GND	S52
S49	RSVD_S49		I2C_IMM_SCL	S50
S47	GND		I2C_IMM_SDA	S48
S45	GND		I2C_IMM_INT_N	S46
S43	M2_ADAPTER_FAULT#		GND	S44
S41	PCIE_M2_RST1_N		PCIE_M2_RST2_N	S42
S39	M2_MUX_SEL_N		GND	S40
S37	GND		REFCLK0_P	S38
S35	PCIE_RX0_P		REFCLK0_N	S36
S33	PCIE_RX0_N		GND	S34
S31	GND		PCIE_TX0_P	S32
S29	PCIE_RX1_P		PCIE_TX0_N	S30
S27	PCIE_RX1_N		GND	S28
S25	GND		PCIE_TX1_P	S26
S23	REFCLK1_P		PCIE_TX1_N	S24
S21	REFCLK1_N		GND	S22
S19	GND		CLKREQ0_N	S20
S17	RSVD_S17		CLKREQ1_N	S18
S15	3.3VAUX		GND	S16
S13	3.3VAUX		GND	S14
S11	RSVD_S11		RSVD_S12	S12
S9	GND		3.3V	S10
S7	GND		3.3V	S8
S5	GND		3.3V	S6
S3	M2_PRESENCE_N		3.3V	S4
S1	GND		3.3V	S2

Dual M.2 SATA Boot Solution Option

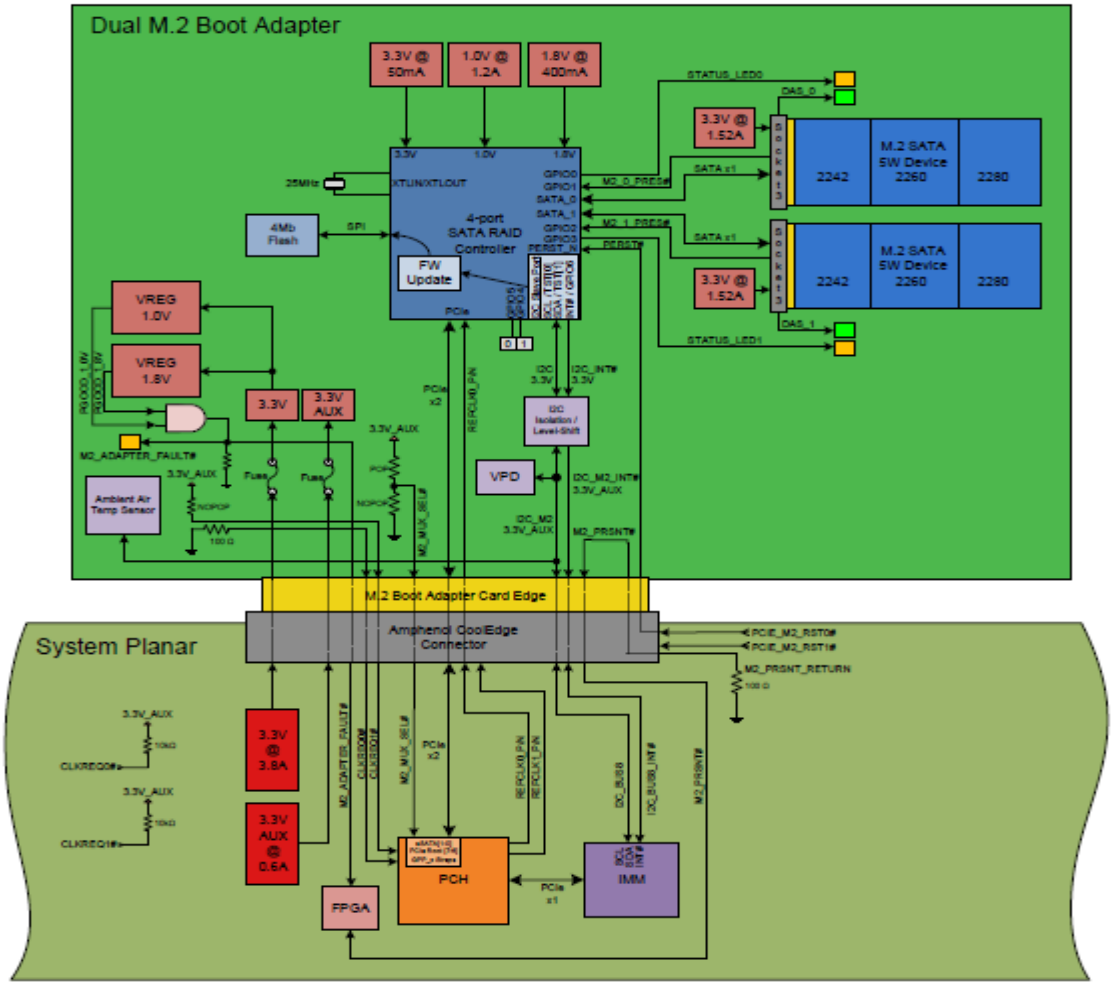
The Dual M.2 SATA Boot Option adapter is required to have a RAID Controller which accepts two lanes from the system's Platform Controller Hub (PCH) and provides access to up to two M.2 SATA (x1) SSDs.

The Dual M.2 SATA Boot adapter is required to provide the following functionality:

- PCIe Gen 2.0 x2 connectivity to root complex
- SATA 6Gbps connectivity to up to two M.2 SATA SSDs
- Support JBOD and RAID 0 and 1 modes
- Support uEFI configuration setting which enables/disables RAID mode
- uEFI support for controller and drive inventory
- Support updating RAID Controller FW through I2C

- Support updating M.2 SATA SSD FW via Lenovo Flashdrive tool
- Support monitoring and reporting of events and temperature through I2C
- Support independent customization of attention / status LED for each M.2 slot
- IO-CORE Tier 3 level support
- Energy Star support

Dual M.2 RAID Boot Adapter:



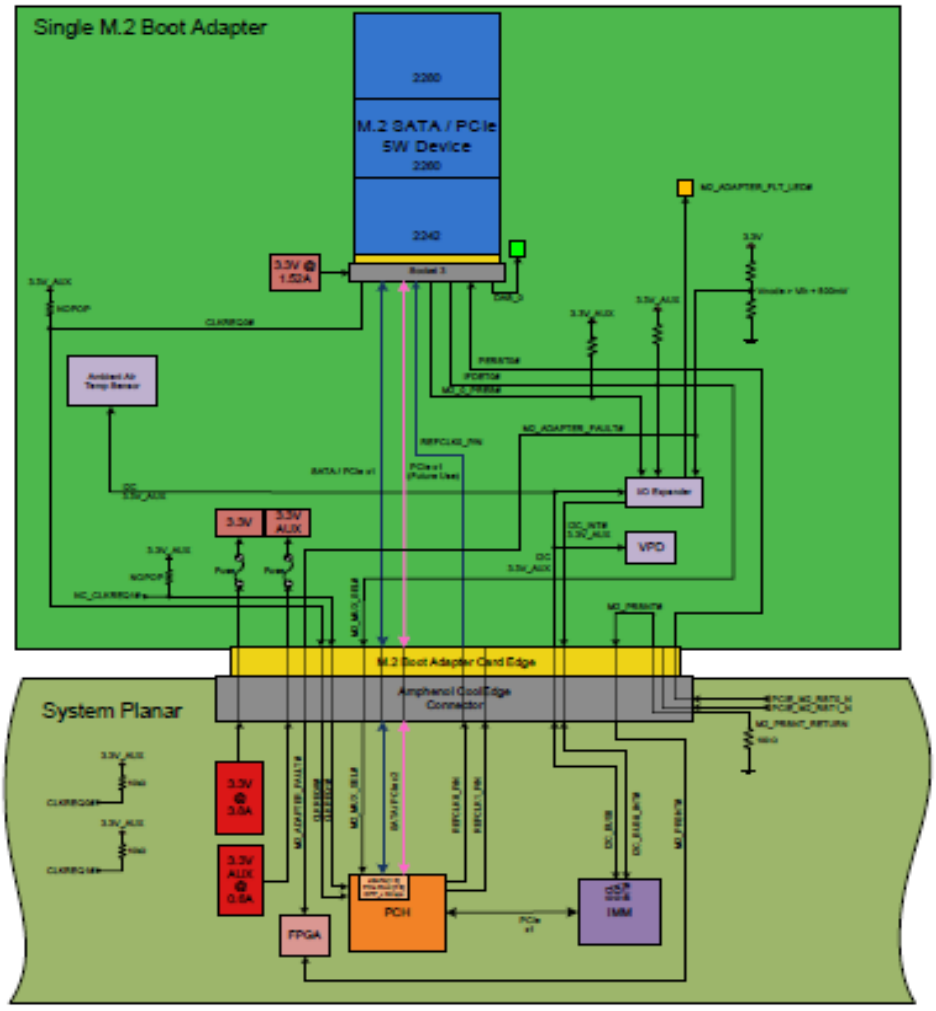
Single M.2 SATA/PCIe Boot Solution Option

The Single M.2 SATA/PCIe Boot Option adapter is required to accept two lanes from the system's Platform Controller Hub (PCH) and provide access to either one M.2 SATA (x1) or one M.2 PCIe (x1) SSD.
The Single M.2 SATA/PCIe Boot adapter is required to provide the following functionality:

- Depending on Interface Detection (PEDET) of M.2 device:
  - SATA 6Gbps x1 connectivity from host to M.2 SATA SSD
  - PCIe Gen 3.0 x2 connectivity from root complex to M.2 PCIe SSD
    - Interface wired as a x2 interface (for future use)
- Support monitoring and reporting of events and temperature through I2C
- VPD reporting of Single M.2 SATA/PCIe Boot Adapter inventory
- Support updating M.2 SATA/PCIe SSD FW via Lenovo Flashdrive tool

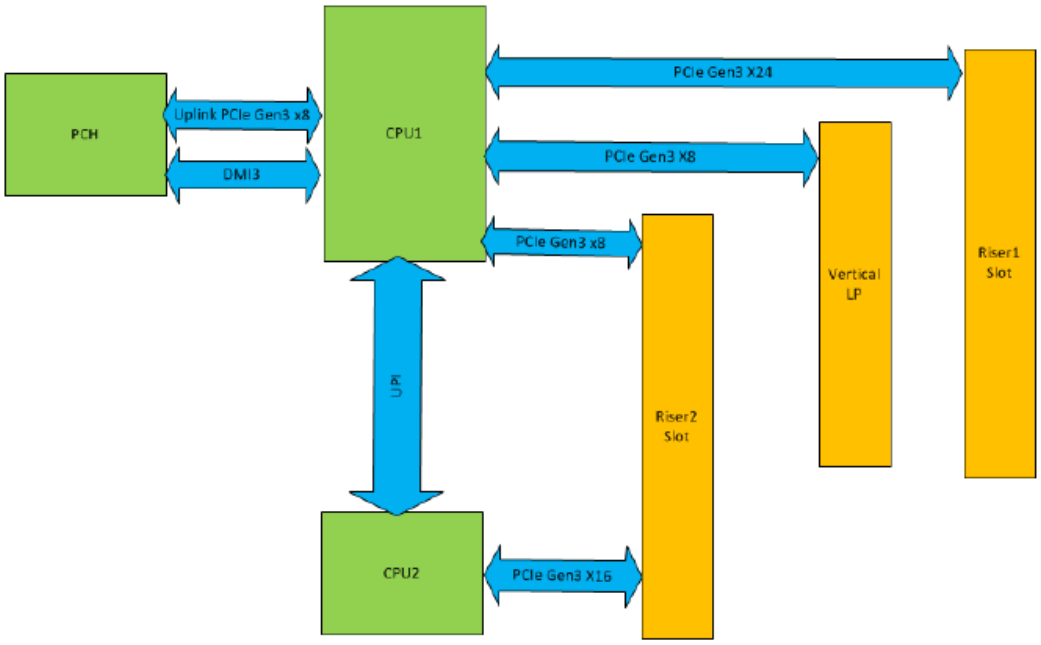
- IO-CORE Tier 3 level support

Single M.2 Boot Adapter:



2.8.4 I/O Subsystem

Reference these documents:
Carnage Layout Views & Rear Views (within this document)
Carnage PCIe Distribution Diagram below (in Carnage motherboard specification)



2.8.4.1 IO Adapter Slot support

Carnage supports up to two riser cards installation(s) to expand up to five PCIe cards and one vertical PCIe slot for the systems IO capabilities. Both power and PCIe are designed to support this extra capability. The riser card types supported are specified elsewhere in this document.

All the PCIe slots within the Carnage must be compliant to the PCI-SIG PCIe Base 3.0 specifications and backwards compatible with PCIe 2.0 and 1.0. All slots are mechanically x16 connectors

2.8.4.2 Thermal Flow and Ambient Conditions

Ambient Inlet Temperature:

The system is designed for continuous operate at ASHRAE Class A2, A3, 35 °C, 40 °C.
The system will be tested and characterized to ASHRAE A2, A3. Update to A4 (45C) based on Marketing update on requirements.

	MRD Requirement	Carnage Thermal Statement			
Environment	Support A4	A2		A3/A4	
		Normal	Fail	Normal	Fail
Fan Status	Cooling solution must be N+1 redundant -No limitation on duration of a single failure condition, , system may throttle	Support, -No system performance reduction	Support, -No performance reduction on <=27C, -Performance reduction<40% on >27C ≤35C,	Support, -No performance reduction on <=35C, -Performance reduction<25% on >36C ≤40C, -Performance reduction<50% on >41C ≤45C,	Not support
CPU	Full Intel Purley Shelves 1 & 2, work item to understand cost adder to support shelf 3	Support up to 120W	Support up to 120W, with Performance reduction	Support up to 120W, with Performance reduction	Not support
Memory	2S config - 12 Dimms up to 2400 (Size 16 dimms but cannot add cost, otherwise 12 dimms)	Support	Support, with Performance reduction	Support, with Performance reduction	Not support
Front HDD	8x 3.5" SAS/SATA, 16x 2.5" SAS/SATA	Support	Support	Support, with Performance reduction	Not support
Rear HDD	Not support	Not support	Not support	Not support	Not support
PCIe	-Maximum of 6 PCIe half length, -PCIe riser supports HL/FH card	Support	Support	Support, with Performance reduction	Not support
GPU	NVS- 310, Pascal passive GPU 25W	Support	Support, with Performance reduction	Not support	Not support
M.2 Boot	Two M.2 Flash drives for booting (integrated if it adds no cost)	Support	Support	Support	Support
IO Accelerator (Fusion IO, Coldstream AIC, etc.)	Flash PCIe Add in Cards (AIC)	TBD (need further study)	TBD (need further study)	Not support	Not support
Apache Pass DIMM	Not support	Not support	Not support	Not support	Not support
NVMe	Not support	Not support	Not support	Not support	Not support

Flow Condition:

The system will be providing 1.0 m/s minimum of incoming air at 55C and 0.3 m/s at 40C to the I/O card area

2.8.4.3 Riser Card

Reference to Lenovo_Purley_Family_Riser_Card_Specification for more information.
Note: Each riser should be reserve Power monitor circuit on riser for NPI development. De-pop components after SIT.

There are four Riser slots using the same riser Card to support the Carnage system, listed as below:

Left Riser :2U-Riser-1A, 2U-Riser-1B, 2U-Riser-1C (Rear side view)
Right Riser :2U-Riser-2A(Rear side view)
Please refer table 7 for detail

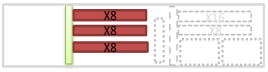
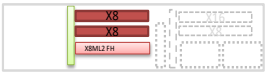
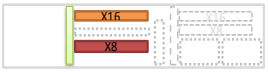
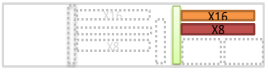
2.8.4.4 IO Slot Configurability

The following table shows the hardware capabilities for all IO slot capability in the Carnage system.

Table 7- Carnage Rear I/O Configurability

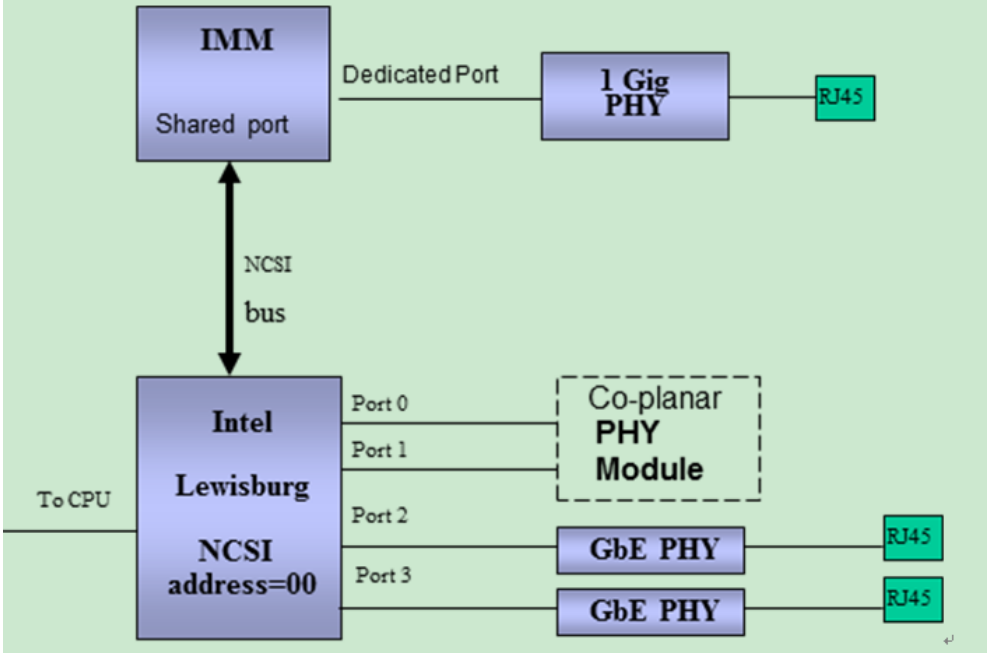
2U Value Rack-(4)	
Riser 1(CPU1)	2U-Riser-1A - PCIe Gen-3 x8 FHHL Slot1(CPU1) - PCIe Gen-3 x8 FHHL Slot2(CPU1) - PCIe Gen-3 x8 LP Slot3(CPU1)
	2U-Riser-1B - PCIe Gen-3 x8 FHHL Slot1(CPU1) - PCIe Gen-3 x8 FHHL Slot2(CPU1) - PCIe ML2 x8 Slot3(CPU1)
	2U-Riser-1C(Optional) - PCIe Gen-3 x16 FHHL Slot1(CPU1) - Empty - PCIe Gen-3 x8 LP Slot3(CPU1)
Riser2(CPU1,2)	2U-Riser-2A - PCIe Gen-3 x16 FHHL Slot1**(CPU2)** - PCIe Gen-3 x8 FHHL Slot2(CPU1)

Table 8- Riser card matrix -2U

Riser_Name (PCBA)	Rear I/O FF (riser cage	1U Performance (Cable)	1U Entry (Constantine)	2U Performance (Cyborg)	2U Entry (Carnage)		
2U-Riser-1A - PCIe Gen-3 x8 FHFL Slot1(CPU1) - PCIe Gen-3 x8 FHFL Slot2(CPU1) - PCIe Gen-3 x8 FHHL Slot3(CPU1)	2U No1			X	X	2U_Riser1	
2U-Riser-1B - PCIe Gen-3 x8 FHFL Slot1(CPU1) - PCIe Gen-3 x8 FHFL Slot2(CPU1) - PCIe ML2 x8 FHHL Slot3(CPU1)	2U No1			X	X	2U_Riser5	
2U-Riser-1C(Optional) - PCIe Gen-3 x16 FHFL Slot1(CPU1) - Empty - PCIe Gen-3 x8 FHHL Slot3(CPU1)	2U No1			X	X	2U_Riser2	
2U-Riser-2A - PCIe Gen-3 x16 FHFL Slot1**(CPU2)** - PCIe Gen-3 x8 FHFL Slot2(CPU1)	2U No2				X	2U_Riser4	

2.8.4.5 Network Interface Controller (NIC)

Carnage supports 3x 1GbE networks. One is the onboard BCM54612E PHY for dedicated management LAN interface through IMM3 MAC1 RGMII dedicates port. Other two are use Intel Lewisburg 10G/1G interface with on board two Marvel 1GbE PHY for share NICs through IMM3 MAC0 NSCI port on H/W level with embedded Lewisburg selectable PHY module update to 2 ports.
PHY Module support 2x 1GbE Base-T, 2x 10GbE Base-T, 2x 10Gbs SFP+ (Refer to Constantine common motherboard specification, PHY module specification).



2.8.5 Front and Rear Service Ports

Reference the Lenovo Carnage and Carnage Motherboard Specification

These are the following connections on the CARNAGE Rear air dam (directly on Motherboard) for service support:
Two rear USB 3.0 connectors (compatible with USB 2.0, both ports capable of supporting USB 3.0 Debug without any USB Hub or switch).

- One Serial Port DB9 Connector on PCIe bracket slot 4 (Optional)
- One VGA DB15 Connector
- One system locator LED
- One system error LED
- One NMI button
- Two RJ45 1 GbE Ports
- Two USB 3.0
- One RJ45 management LAN connector

These are the following components designed on the Carnage Front Service Panel (connected to Motherboard): One front USB 2.0 port (Port 0) need reserve switch for PCH and BMC access by FW selection.

- Two Button(Power on, System locator) w/ LED
- One Ethernet activity LED
- One system health LED

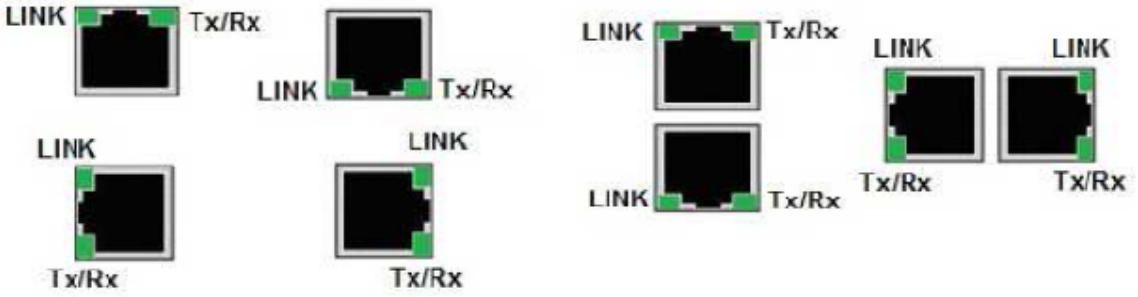
- Two USB 2.0 Conn
- One VGA port Conn (Optional)

2.8.5.1 RJ-45 Ethernet connector

This Carnage provides status two green LED's indicating Link / Activity. Activity LED on the upper right side and Link Status LED on the upper left right side (viewed facing the connector). Connection speed and is dedicates for system management (direct attach to BMC).

The detailed LED definition:

Label	Enthernet Status LED	Color	LED state	Description
	1/Link	None	off	Network working link is disconnected
		Green	on	Network working link is established
	2/Activity	None	off	The severice is disconnected from a LAN
		Green	Blinking	Network is connected and activity



2.8.5.2 Serial Port (Optional)

Carnage planar provides one internal serial port header. With an option of serial port cable and occupy PCIe bracket slot4, this system provides a 9-pin male D-shell connector at the rear of the machine. The serial port is for system use and can be shared with the BMC for serial redirection functions. The serial port is software compatible with the 16550A.

The pin assignments are defined for RS-232-C. The voltage levels are EIA only. The pin configuration and signal assignments are shown below:

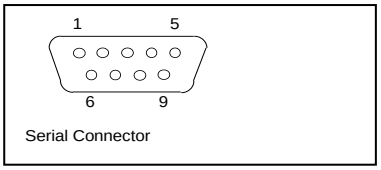


Table 9- Serial Port pin assignments

PIN	Signal Name
1	Data Carrier Detect
2	Receive Data
3	Transmit Data
4	Data Terminal Ready
5	Signal Ground
6	Data Set Ready
7	Request To Send
8	Clear To Send
9	Ring Indicator

2.8.5.3 Video Port

The Matrox G200 graphics module is a high performance 2D graphics core, which is used with shared memory architecture. The G200eR2 is controlled via a PCI interface. It includes a digital video output port that interfaces to the Emulex Pilot 4 build-in DAC and video compression modules. The G200 uses a 64-bits bus to the memory subsystem.

- SVGA compatible video controller (Matrox G200)

Video memory 16MB is not expandable in this system. Two analog video ports (one front, one rear) both video connected at the same time.

The front video port is connected to the planar through a cable.

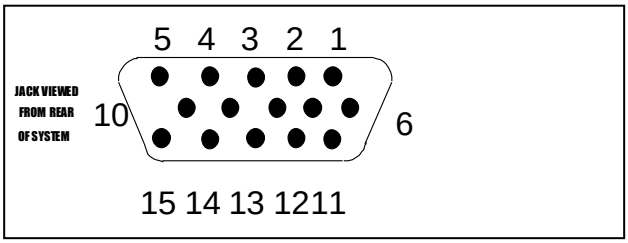
Supported video modes for the controller:

Supported video modes and resolution

Width	*Height*	*Refresh rate*	*Color Depth*
640	*480*	*60, 72, 75, 85*	*8, 16, 24*
800	*600*	*60, 72, 75, 85*	*8, 16, 24*
1,024	*768*	*60, 70, 75, 85*	*8, 16, 24*
1,440	*900*	*60*	*8, 16, 24*
1,280	*1024*	*60, 75*	*8, 16, 24*
1,680	*1,050*	*60*	*8, 16, 24*
1,600	*1,200*	*60, 75*	*8, 16, 24*

The maximum resolution of the video controller is **1600x1200* @ 75**

NOTE: Netware and SCO drivers are contained in the respective operating system packages or bulletin boards.



The connector is a 15-pin D-shell. A video cable of 1.8 meters is the maximum supported length.

Video port pin assignments

Pin	Signal	Pin	Signal
1	Analog Red	2	Analog Green or Mono
3	Analog Blue	4	Pull to +5V through 1K ohm
5	Digital Return	6	Red Return
7	Green Return	8	Blue Return
9	Video VCC Thermal	10	Digital Return
11	Pull to +5V through 1K ohm	12	DDC SDA
13	H-Sync	14	V-Sync
15	DDC SCL		

2.8.5.4 USB 3.0/2.0

The Intel® Lewisburg PCH contains an eXtensible Host Controller Interface host controller which supports up to 14 USB 2.0 ports and up to 10 USB 3.0 ports with board routing, ACPI table and BIOS considerations. This controller allows data transfers of up to 5 Gb/s. The controller supports SuperSpeed, High-Speed, Full-Speed and Low-Speed traffic on the bus. The xHCI controller supports USB Debug port on all USB3.0 capable ports. The xHCI supports USB debug capability on all USB 3.0 capable ports. The xHCI also supports USB Attached SCIS Protocol. Legacy EHCI controllers have been removed from the Lewisburg PCH.

Table 10- Carnage USB Distribution

	PCB USB 2.0	PCH USB 3.0	BMC USB 2.0 Host	BMC USB 2.0
Front USB	x2		x1	
Rear USB	x2	x2		
Internal USB	x1			
BMC link with PCH	x1			x1
Total	x6	x2	x1	x1

2.8.5.5 TPM/TCM

Integrated Trusted Platform Module (TPM) version 1.2/2.0 security chip performs cryptographic functions and stores private and public security keys.
It provides the Hardware support for the Trusted Computing Group (TCG) specification. User can download the software to support the TCG specification when the software is available. The TPM firmware can be upgraded in the field.
There is a TPM/TCM compatible connector and TPM chipset down (default) on Carnage motherboard to connect TPM module for LI market and TCM module for LC market selection. BIOS can support TPM/TCM module automatically per TPM/TCM module plugged into connector, no need to modify BIOS SETUP item.
Please refer Purley TPM2.0-TCM SPI Daughter Card Reference Design spec for detail information of TPM/TCM module.
The Planar must reserve iMM3 I2C TPM H/W Components Detailed check MB spec (De-pop).

2.8.6 Power Subsystem

Reference:
Lenovo Purley Portfolio PSU specifications (550W, 750W)
Lenovo Purley Power Supply Filler specification

Carnage is designed to support the complete family of Lenovo Purley PSU Power Supplies. PSU's will be typically configured to 'right size' with the system bulk power needs. There must be a portfolio of PSU's to optimize for different system configurations. Entry configuration for low cost and high efficiency to support such a lightly loaded system is a good example. PSU's carry wide range AC input capability, and all PSU's produce 12 volt main and 12 volt standby outputs for the system loads.
Note the additional system features listed below.
These PSU's are common and designed to inter-operate across the entire Lenovo Purley Portfolio product line. Mixing of vendor power supplies of the same power output is supported and validated.

Key features

Following is a list of system features supported by each Power supply across the entire Lenovo portfolio product.
EnergyStar for Server (2.0) qualified
Supporting 55C maximum inlet ambient temperature
80 Plus Platinum Standard minimum and support active power management.
Support both N+0 and N+N configurations
Support a portfolio of DC power supplies supporting 240Vdc
Hot Swap support (HS)
Support Zero-Output
Support Intel® Skylake CPU Turbo Boost 2.0 technology compatible. The power supply should be designed to support Pmax and PL2 for prescribed time period, and to support TDP for indefinite duration.
All PSUs must be able to retain line-cords to prevent unplanned disconnects, All LEDs shall protrude beyond the supply chassis surface for good visibility.

- Output Power Good Indicator

  A green Light Emitting Diode shall be mounted as indicated in mechanical drawing and shall indicate the status of the "PWR_GOOD" signal. The LED shall be lit when the "PWR_GOOD" signal is active to indicate a normally operating power supply. If this LED is not lit, the power supply is not operating properly. When the power supply is in zero-output mode, the LED shall flash at a rate of 1 Hz.
- Input Power Good Indicator

  A green Light Emitting Diode shall be mounted as indicated in mechanical drawing and shall indicate the status of the EPOW# signal. The LED shall be lit when the "EPOW#" signal is inactive to indicate the power supply is receiving normal input power. If this LED is not lit, the power supply is not receiving proper input power.
- Fault Indicator

  A yellow Light Emitting Diode shall be mounted as indicated in the mechanical drawing to indicate that the power supply is faulty. The LED shall not be lit for the following conditions:
  • 12V Over-Current Fault
  • Oversubscription fault
  • Current share Warning
  • Thermal Warning
  In the default state, the power supply is operating properly if this LED is not lit. The LED shall be solid on by default. The LED may be set to be on, off, or to blink by command FAULT_LED_CONTROL register

2.8.6.1 System Power Budget

Component and system/node level power measurements must be made to determine component power draw as function of load. Component power measurements include things like PCIe/I/O adapters, Storage subsystem, memory subsystem, and CPU subsystem, and fan subsystem. The power is measured as a function of the load placed on the server. Reference the Lenovo Power Statistics Collection Spec for more.

Carnage	8X3.5"& 8x2.5”	16x 2.5"&12x 3.5”
550W-PT	Full	NA
750W-PT	Full	Full
750W-TI	Full	Full
Full: Full configuration support		
Limited: Limited configuration support		

Based Power	Planer				12	750W(12*3.5)-HS			550W(8*3.5)-SS			550W(8*3.5)-HS			550W(8*2.5)-HS			750W(16*2.5)-HS		
	Fan					4			4			4			4			4		
Subsystem	Component	TDP Power	Conversion Efficiency	12V Power	Rating (%)	Qty	Sum (Max , Weighted)		Qty	Sum (Max , Weighted)		Qty	Sum (Max , Weighted)		Qty	Sum (Max , Weighted)		Qty	Sum (Max , Weighted)	
CPU	Skylake Server 120W CPU (120w)	120.00	90%	133.33	85%	2	266.67	226.67	2	266.67	226.67	2	266.67	226.67	2	266.67	226.67	2	266.67	226.67
	Skylake Server 105W CPU (105w)	105.00	90%	116.67	85%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	Skylake Server 85W CPU (85w)	85.00	90%	94.44	85%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	Skylake Server 65W CPU (65w)	65.00	90%	72.22	85%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	Skylake Server 55W CPU (55w)	55.00	90%	61.11	85%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	Skylake Server 45W CPU (45w)	45.00	90%	50.00	85%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
Memory	8GbB RDIMM (1DPC)	5.35	90%	5.94	70%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	16GbB RDIMM (1DPC)	6.49	90%	7.21	70%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	32GB RDIMM (1DPC)	7.40	90%	8.22	70%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	64GB RDIMM (1DPC)	10.52	90%	11.69	70%	12	140.27	98.19	12	140.27	98.19	12	140.27	98.19	12	140.27	98.19	12	140.27	98.19
	128GB LRDIMM (1DPC)	11.80	90%	13.11	70%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
LOM	2x10GbE LOM	2.00	90%	2.22	70%	1	2.22	1.56	1	2.22	1.56	1	2.22	1.56	1	2.22	1.56	1	2.22	1.56
Core chip	Lewisburg PCH (LWB-2)	17.00	90%	18.89	70%	1	18.89	13.22	1	19	13	1	19	13	1	18.89	13.22	1	18.89	13.22
Planar	Emulex Pilot 4	2.90	90%	3.22	70%	1	3.22	2.26	1	3.22	2.26	1	3.22	2.26	1	3.22	2.26	1	3.22	2.26
	1GbE Mingement Port	1.00	90%	1.11	50%	1	1.11	0.56	1	1.11	0.56	1	1.11	0.56	1	1.11	0.56	1	1.11	0.56
	EMMC	0.83	90%	0.92	70%	1	0.92	0.65	1	0.92	0.65	1	0.92	0.65	1	0.92	0.65	1	0.92	0.65
	USB 2.0	2.50	90%	2.78	50%	1	2.78	1.39	1	2.78	1.39	1	2.78	1.39	1	2.78	1.39	1	2.78	1.39
	USB 3.0	4.50	90%	5.00	50%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	FPGA	1.00	90%	1.11	70%	1	1.11	0.78	1	1.11	0.78	1	1.11	0.78	1	1.11	0.78	1	1.11	0.78
	Miscellaneous	5.80	90%	6.44	50%	1	6.44	3.22	1	6.44	3.22	1	6.44	3.22	1	6.44	3.22	1	6.44	3.22
Sub-System																				
Storage	M.2 Module ACHI	0.00	90%	0.00	70%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	M.2 Module HW RAID	2.00	90%	2.22	70%	0	0.00	0.00	1	2.22	1.56	1	2.22	1.56	1	2.22	1.56	1	2.22	1.56
	SATA M.2	4.00	90%	4.44	70%	0	0.00	0.00	2	8.89	6.22	2	8.89	6.22	2	8.89	6.22	2	8.89	6.22
	SATA 3.5" SS HDD	7.50	95%	7.89	70%	0	0.00	0.00	8	63.16	44.21	u	u	u	u	u	u	u	u	u
	SATA 3.5" HS HDD	14.00	95%	14.74	70%	u	u	u	u	u	u	0	0.00	0.00	u	u	u	u	u	u
	SAS 3.5" HS HDD	14.00	95%	14.74	70%	12.00	176.84	123.79	u	u	u	8	117.89	82.53	u	u	u	u	u	u
	SATA 2.5" HS HDD	12.00	90%	13.33	70%	u	u	u	u	u	u	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	SAS 2.5" HS HDD	12.00	90%	13.33	70%	u	u	u	u	u	u	0	0.00	0.00	8	106.67	74.67	16	213.33	149.33
	2.5" PCIe SSD	25.00	90%	27.78	100%	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u
	ODD (Optical Drive)	5.00	90%	5.56	50%	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u
RAID	8 Port HW RAID	20.00	95%	21.05	70%	u	u	u	u	u	u	1	21.05	15	1	21	15	0	0	0
	16 Port HW RAID	25.00	95%	26.32	70%	1.00	26.32	18.42	u	u	u	u	u	u	u	u	u	1	26	18
	24 Port HW RAID	25.00	95%	26.32	70%	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u
IO	PCIE slot(15W) - General Purpose	15.00	95%	15.79	50%	2	31.58	15.79	3	47.37	23.68	2	31.58	15.79	1	15.79	7.89	2	31.58	15.79
	PCIE slot(25W) - HW RAID	25.00	95%	26.32	70%	2	52.63	36.84	2	52.63	36.84	2	52.63	36.84	2	52.63	36.84	2	52.63	36.84
	PCIE slot(25W) - GPU	25.00	95%	26.32	75%	1	26.32	19.74	1	26.32	19.74	1	26.32	19.74	1	26.32	19.74	1	26.32	19.74
Network	1GbE 2 port	2.00	90%	2.22	70%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	2x10GBase-T co-planar	6.80	90%	7.56	70%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
	2x10GbE SFP+ co-planar	10.00	90%	11.11	70%	1	11.11	7.78	1	11.11	7.78	1	11.11	7.78	1	11.11	7.78	1	11.11	7.78
	ML2	25.00	90%	27.78	70%	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	1	27.78	19.44	0	0.00	0.00
Fan	2U Entry Platform - 6038 Fan	10.00	95%	10.53	50%	4	42.11	21.05	4	42.11	21.05	4	42.11	21.05	4	42.11	21.05	4	42.11	21.05
DCM	Pluggable module	1.00	90%	1.11	50%	1	1.11	0.56	1	1.11	0.56	1	1.11	0.56	1	1.11	0.56	1	1.11	0.56
Total							811.65	592.44		698.55	510.11		758.55	555.27		759	558.96		859	626

2.8.6.2 System Power Supply configurations

One or Two PSU's are supported in the Carnage system. Two PSU's can be configured as n+1 (fault tolerant hot swap), n+0 (non-redundant), and they also support Hot Standby mode for higher efficiency with very dynamic load power workloads or applications. (Selectable in BIOS/BMC)

The Carnage is always configured with same PSU type and FRU part number when two PSU's are installed (different vendors allowed). Mixing of different capacity PSU's is not supported.

Boot Sequence

The boot sequence for a system supporting CFF power supplies proceeds as follows:

1. POST begins and the BMC determines the number and size of power supplies in the system. In a system with two power supplies, the supplies should be the same size. If they are not, the user should be alerted, and the BMC should treat both supplies as though they were the size of the smaller supply.

2. The BMC reads *P_ps_nominal* and *P_ps_oversub* from the power supply VPD (where the values in question are referred to as *P_max_1_ps* and *P_max_2_ps,* respectively) and determines *P_nameplate:*

   - For a system with two power supplies in **Redundant** mode, *P_nameplate* is equal to *P_ps_oversub* (typically 1.2 times *P_ps_nominal).*
   - For a system with two power supplies in **Non-Redundant** mode, *P_nameplate* is equal to 1.9 times *P_ps_nominal.*
   - For a system with one power supply, *P_nameplate* is equal to *P_ps_nominal.*

3. If valid *P_lim[i]* values are not available for *i* = 0, ..., *n,* the BMC and UEFI cooperate to run Power Maximizer. Note that any existing Power Maximizer results must be flagged as invalid if the configuration has changed since the last POST in a way that could affect system power consumption or if there has been any change in the number or type of power supplies.

   Note: With a large number of P-states, the time to run Power Maximizer may become prohibitive. *P_lim[0]* and *P_lim[n]* must always be calculated, but the implementation may, at its discretion, calculate only a subset of the remaining *P_lim[i]* values. The trade-off is a reduction in the granularity of the static P-state limiting. Power maxmizer cannot take more than 60 seconds to run.

   There is a risk of Power Maximizer driving power consumption so high that the system shuts down during POST. (This can happen if the user has installed supplies that are smaller than officially supported.) To deal with this possibility, Power Maximizer must terminate early if power exceeds *P_nameplate.* The NM4.0 monitors power as Power Maximizer runs. If power exceeds *P_nameplate,* the NM4.0 writes a special value to the TWR interface. Power Maximizer polls the TWR interface and, if it sees the special value, terminates all threads. The elapsed time from the

BMC setting the special value to all Power Maximizer threads terminating must be no more than half-a-second. This ensures that power does not remain too high for more than a second.

If Power Maximizer terminates early, *P_lim[0]* will not have been calculated and the Power Maximizer results must therefore be flagged as invalid.

4. The BMC must now determine the maximum-power P-state, *m,* for which *P_lim[m]* is no greater than *P_ps_nominal,* and send *m* to the NM4.0. If there is no such value of *m,* as may be the case in **Non-Redundant** mode, *m* should be taken to be equal to *n.* For a system with one power supply, the P-states available to the system must be limited to the range *[m, n]* at this point (i.e., the system will be allowed to boot, but will be throttled). For a system with two power supplies (in any redundancy mode), the P-states available to the system will be limited to the range [*m, n]* if one power supply fails.

Recommended behavior for mixed PSUs:

1. Mixed matched PSU output during power on
    a. Follow boot policy.
2. Mixed PSU output during hot plug
    a. Follow boot policy
3. Mixed PSU efficiency
    a. Support with No action
4. Mixed PSU input voltage
    a. Support with No action

2.8.6.3 Intra System Power Routing

Power on motherboard/ Backplane

Once 12V power from the PSU arrives on the motherboard, fuses may need consider be added in series (If power regulator not integrated over current protected in power silicon may violate 240VA requirement), as close to the PSU's connectors as possible to limit hazardous amperage. 12V will then be distributed to the associated non-isolated buck POLs and VRs. 12 volts will also be distributed to power connectors which provide power to peripheral components within the server. All etch must be size to minimize loss and heat. Power connectors shall be sized to minimize footprint while safety supplying current with minimum loses. All POL and VRs should be capable of 90% efficiency or greater at nominal current draw with the smallest possible footprint for a low cost solution. Both modular and down designs should both be evaluated for cost and functionality.

All disk backplanes will receive power via cable(s)/connector(s) from the motherboard. The cable will provide 12 volts and 5V. Each connector from the motherboard will be capable of carrying a minimum of 240 watts of 12/5 volts and associated returns. 12/5 volts on each backplane will be routed to each disk drive location additionally to a 12 to 3.3 volt non-isolated converter. Disks will have provisions to be

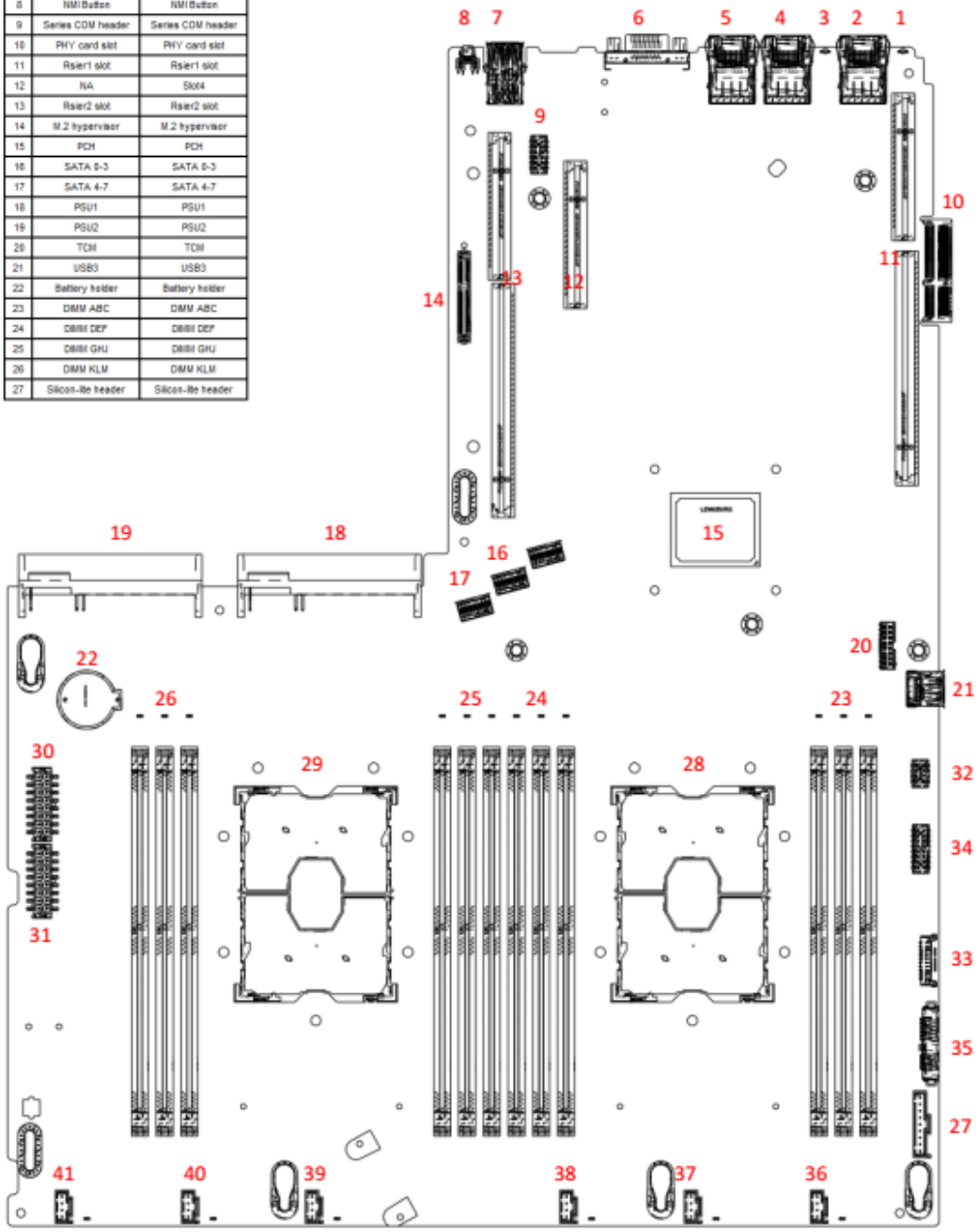
sequenced for power on. The each BPs must be sized to support a maximum current of power rails. Drive power must not exceed:

- 16 watts of combined power per drive of 12/5 volt for 3.5” drives SAS/SATA HDD
- 9 watts of combined power per drive of 12/5 volt for 2.5” drives SAS/SATA HDD

All power rails to connectors should be considered fused design with 240VA requirement and depend on real system design (Ex. HDD BP PWR Conn, Fan Conn (HS)…etc).

2.8.7 Motherboard

NO.	1U	2U	NO.	1U	2U	NO.	1U	2U
1	ID LED	ID LED	28	CPU1	CPU1	35	ODD header	ODD header
2	MGMT LAN	MGMT LAN	29	CPU2	CPU2	36	1U_FAN1	NA
3	System error LED	System error LED	30	HDD PWR1	HDD PWR1	37	1U_FAN2	2U_FAN1
4	LAN1	LAN1	31	HDD PWR2	HDD PWR2	38	1U_FAN3	2U_FAN2
5	LAN2	LAN2	32	Front USB header	Front USB header	39	1U_FAN4	2U_FAN3
6	VGA2	VGA2	33	NFC header	NFC header	40	1U_FAN5	2U_FAN4
7	USB 4-5	USB 4-5	34	Front VGA header	Front VGA header	41	1U_FAN6	NA
8	NMI Button	NMI Button						
9	Series COM header	Series COM header						
10	PHY card slot	PHY card slot						
11	Rsier1 slot	Rsier1 slot						
12	NA	Slot4						
13	Rsier2 slot	Rsier2 slot						
14	M.2 hypervisor	M.2 hypervisor						
15	PCH	PCH						
16	SATA 0-3	SATA 0-3						
17	SATA 4-7	SATA 4-7						
18	PSU1	PSU1						
19	PSU2	PSU2						
20	TCM	TCM						
21	USB3	USB3						
22	Battery holder	Battery holder						
23	DIMM ABC	DIMM ABC						
24	DIMM DEF	DIMM DEF						
25	DIMM GHJ	DIMM GHJ						
26	DIMM KLM	DIMM KLM						
27	Silicon-life header	Silicon-life header						



Refer Lenovo Carnage Motherboard specification for technical summary and design features of the motherboard.

2.8.7.1 Jumper Blocks

The Carnage Motherboard provides all jumpers and detail please refer Motherboard jumper setting table to assist in system recovery.

Table 11- Jumper Setting Table

(TBU by EE)

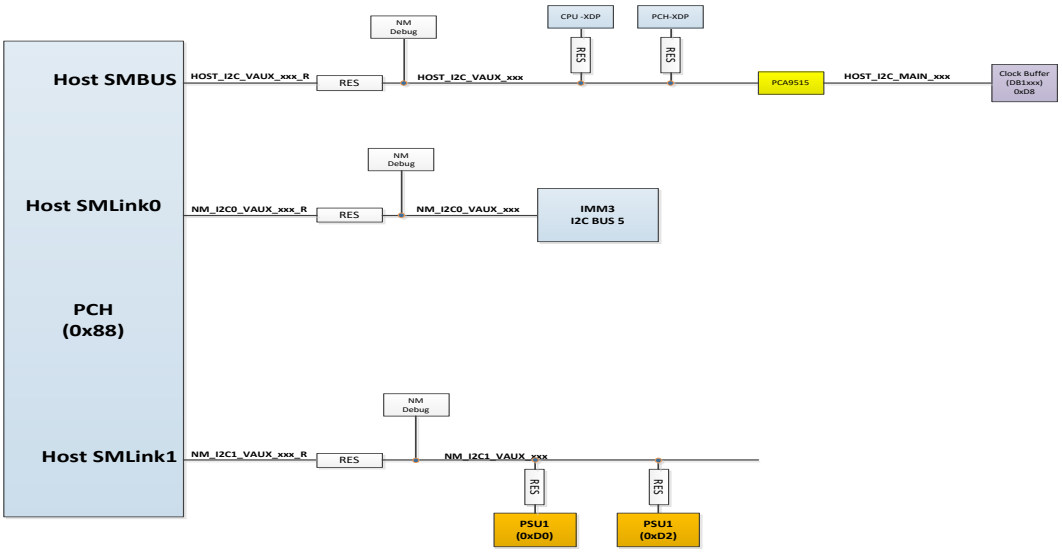
2.9 BIOS and BMC Feature

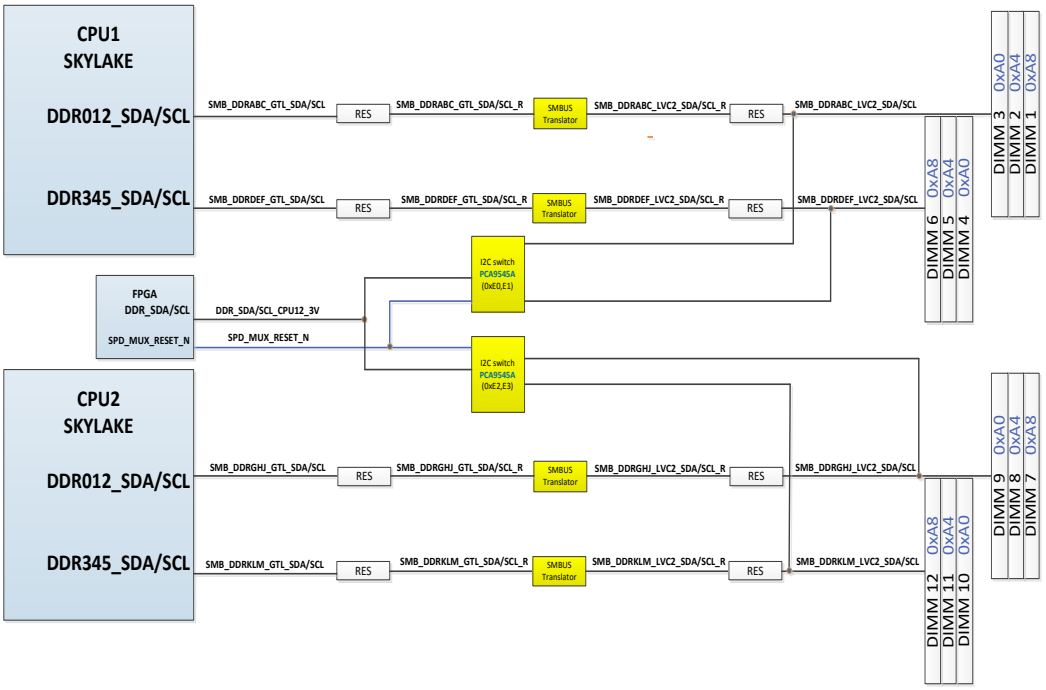
Reference Lenovo Purley UEFI Firmware SOW for detail BIOS feature information;
Reference Purley 4R1T BMC FW SOW for detail BMC feature information;
Reference CPLD Design Reference Circuit, FPGA Design Reference Circuit hardware feature

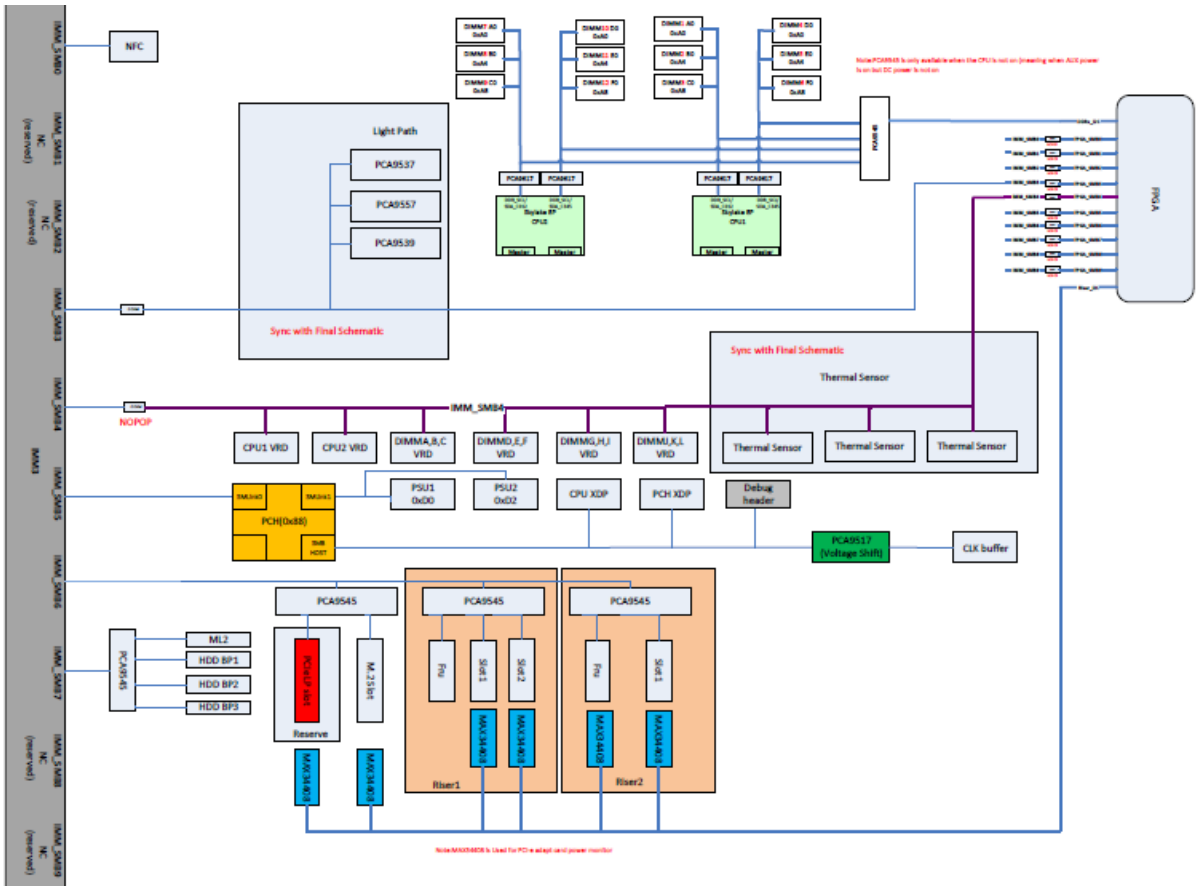
2.9.1 I2C/SMBUS Topology and Assignments

Across the Lenovo Purley portfolio it is very important that a consistent FW correlation of the I2C topology and functionality in Hardware exists. This greatly reduces development time as well as some risk. It also creates a consistent customer feature/function experience.
At the center of the I2C/SMbus management is the BMC. The following I2C/SMbus diagram shows the specific bus assignments and functions for this Server.
Individual bus connections when applicable per the following diagram are to be kept 'common' across the portfolio including port assignments, functions, and any features depicted.
Refer to Carnage Motherboard spec. for detailed I2C map.

(TBU by EE)




CPU1
SKYLAKE
DDR012_SDA/SCL
DDR345_SDA/SCL
SMB_DDRABC_GTL_SDA/SCL
SMB_DDRABC_GTL_SDA/SCL_R
SMB_DDRABC_LVC2_SDA/SCL_R
SMB_DDRABC_LVC2_SDA/SCL
SMB_DDRDEF_GTL_SDA/SCL
SMB_DDRDEF_GTL_SDA/SCL_R
SMB_DDRDEF_LVC2_SDA/SCL_R
SMB_DDRDEF_LVC2_SDA/SCL
RES
SMBUS Translator
I2C switch PCA9545A (0xE0,E1)
FPGA
DDR_SDA/SCL
SPD_MUX_RESET_N
DDR_SDA/SCL_CPU12_3V
SPD_MUX_RESET_N
I2C switch PCA9545A (0xE2,E3)
CPU2
SKYLAKE
DDR012_SDA/SCL
DDR345_SDA/SCL
SMB_DDRGHJ_GTL_SDA/SCL
SMB_DDRGHJ_GTL_SDA/SCL_R
SMB_DDRGHJ_LVC2_SDA/SCL_R
SMB_DDRGHJ_LVC2_SDA/SCL
SMB_DDRKLM_GTL_SDA/SCL
SMB_DDRKLM_GTL_SDA/SCL_R
SMB_DDRKLM_LVC2_SDA/SCL_R
SMB_DDRKLM_LVC2_SDA/SCL
DIMM 3 0xA0
DIMM 2 0xA4
DIMM 1 0xA8
DIMM 6 0xA8
DIMM 5 0xA4
DIMM 4 0xA0
DIMM 9 0xA0
DIMM 8 0xA4
DIMM 7 0xA8
DIMM 12 0xA8
DIMM 11 0xA4
DIMM 10 0xA0

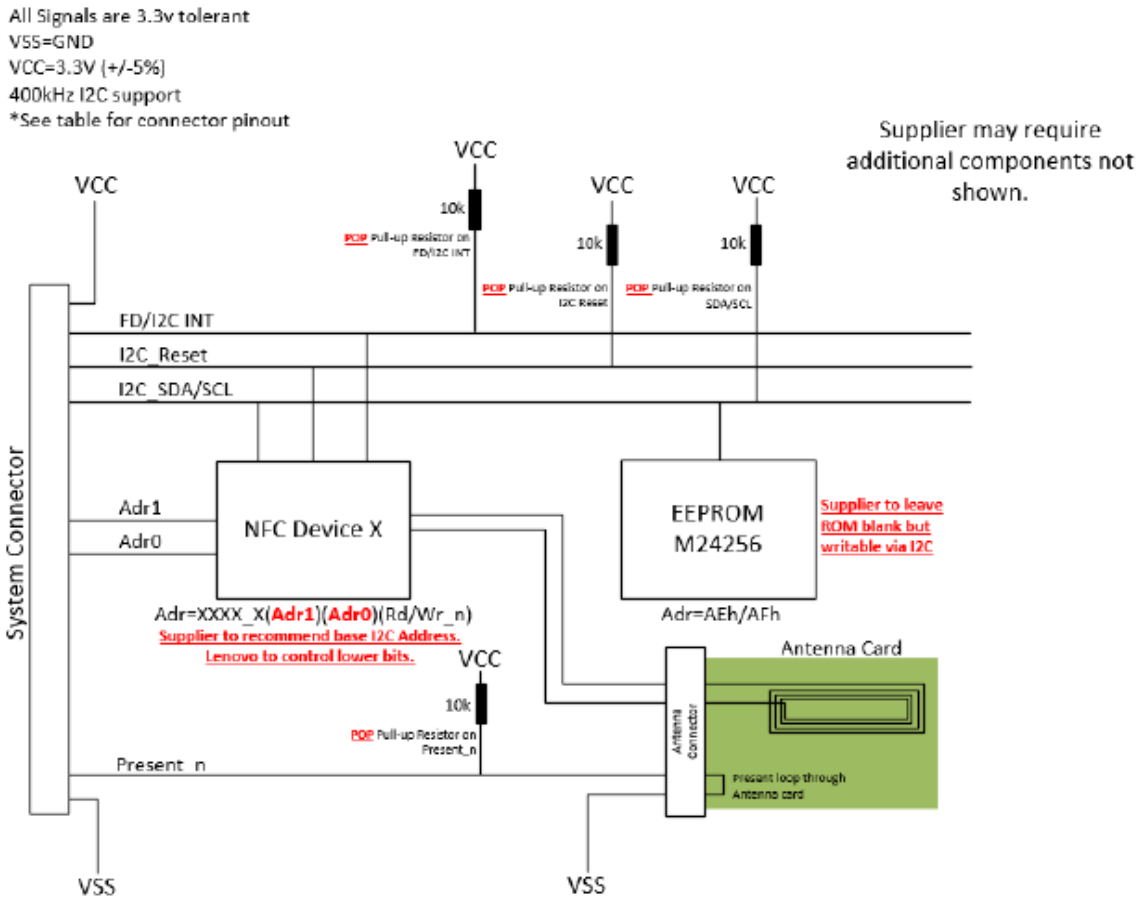

NFC
Light Path
PCA9537
PCA9557
PCA9539
Sync with Final Schematic
IMM_SMB4
NOPOP
CPU1 VRD
CPU2 VRD
DIMMA_B_C VRD
DIMMD_E_F VRD
DIMMG_H_J VRD
DIMMJ_K_L VRD
Thermal Sensor
PSU1 0xD0
PSU2 0xD2
CPU XDP
PCH XDP
Debug header
PCH(0x88)
PCA9517 (Voltage Shift)
CLK buffer
PCA9545
ML2
HDD BP1
HDD BP2
HDD BP3
PCIeIP slot
Reserve
M.2 slot
Fru
Slot 1
Slot 2
MAX34403
Riser1
Riser2
PSAA

2.10 NFC interface (GA)

Subsystem is located inside the server chassis with top and bottom shells. Antenna is attached on pull-out ID tag and connected to NFC device. A connector is used to communicate between system planar and NFC device

Below is the conceptual building block of NFC subsystem including:

- NFC device (passive/active) with supporting components
- Antenna
- Mechanical parts (connectors, wires, ID tag, shell…etc)
- Others



Connector pin definition:

10 Pin System Connector				
Pin #	Function	Signal Voltage Tol.	I/O	Pin Function Description
1	VSS	GND	I	Ground
2	VCC	3.3V	I	3.3v Power
3	SDA	3.3V	I/O	I2C Data
4	SCL	3.3V	I/O	I2C Clock
5	RST#	3.3V	I	NFC I2C Reset Signal. Active low.
6	FD/I2C INT#	3.3V	O	NFC Field Detect or I2C Interrupt. Active low.
7	Present_n	3.3V	O	Present Signal for Antenna
8	Spare0	3.3V	I	Spare Signal 0. Supplier NC.
9	A1	3.3V/GND	I	NFC I2C Address bit 1
10	A0	3.3V/GND	I	NFC I2C Address bit 0

4 Pin Antenna Connector				
Pin #	Function	Signal Voltage Tol.	I/O	Pin Function Description
1	Antenna+		I	Antenna terminal 1
2	Antenna-		I	Antenna terminal 2
3	Present1	3.3V	I	Present loop IN. On Antenna card short pins 3,4 together
4	Present2	3.3V	O	Present loop OUT. On Antenna card short pins 3,4 together

Functional Requirements

Please specify either non-support or support with the dates for each of the listed items, and add any specific details that may be pertinent to your solution in comment section. All items are required unless specified as Desired

- RF interface NFC Forum Type 2 or Type 4 Tag compliant
- ISO 14443A/B compliant
- I2C serial interface compliant, supporting Standard (100 kHz) and Fast (up to 400 kHz) mode
- Data transfer rate: 106/212/424k bps
- NDEF data format support
- Operating distance of up to 100 mm
- FAST READ command for faster data reading
- External I2C reset pin required
- Support Pass-through mode allows fast download and upload of data from RF to I²C and vice versa without the cycling limitation of EEPROM
- 2KB of Non-Volatile storage or above
- Data retention time of 5 years or above
- Operating temperature: -5°C to 55°C or better performance

- Storage/shipping temperature: -40°C to 70°C or better performance
- Detection range has to meet NFC tag class 4 antenna requirement, 20 cm is the acceptance
- criteria but negotiable

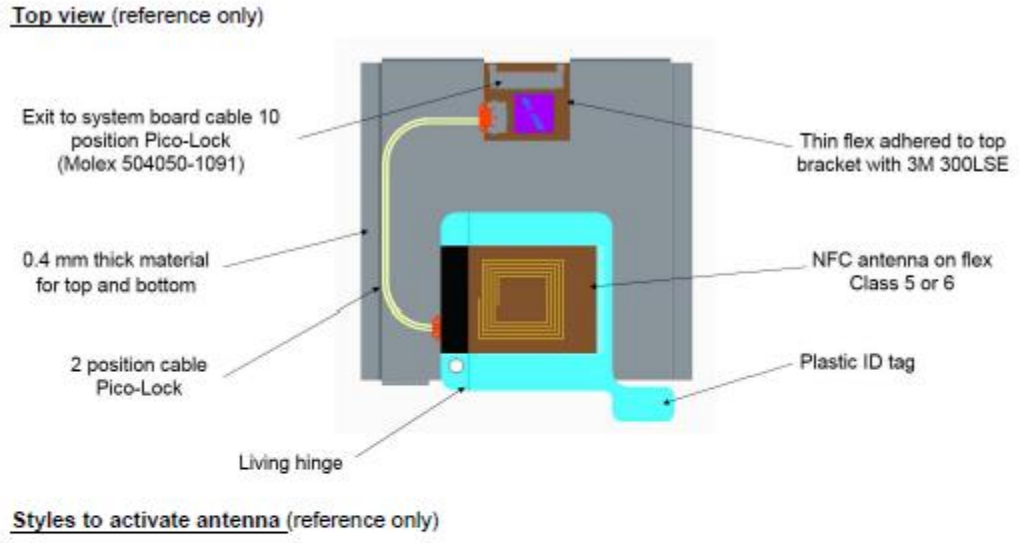
Software & Firmware Requirements

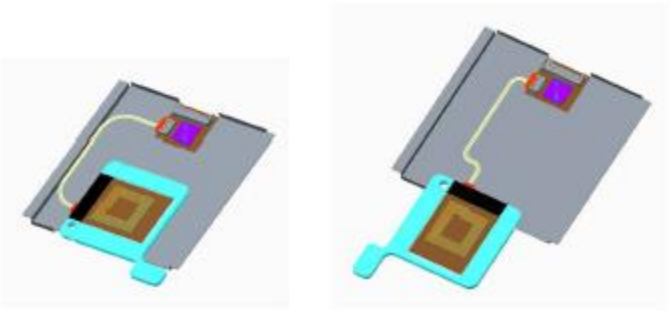
Please specify either non- support or support with the dates for each of the listed items, and add any specific details that may be pertinent. Enter N/A if response is not available. All items are required unless specified as desired.

- Provide save I2C operation for device discovery
  - "no harm" I2C transaction for device presence (expecting NACK vs ACK without side effect) and device identification
  - should be available immediately after POR or external device reset and not require any external MCU initialization
- Provide detailed device initialization sequences over I2C
  - include scenarios after all reset cases (e.g. Power on Reset, external reset, software reset, internal watchdog reset, etc…)
- Provide detailed communications flow
  - I2C commands and responses
  - RF and I2C handshaking for safely accessing RAM/NVRAM (where applicable)
- Should contain at least 2KB of Non-Volatile storage
  - must not rely on battery
  - accessible by both I2C and RF with adequate arbitration
  - I2C controllable locks for RF access control
    - e.g. Over I2C, configure a region of EEPROM as Read Only over RF
    - Configuration persistent across Reset
  - Readable and writable by RF w/o VCC
    - region locks apply regardless of VCC
- Should contain RAM for message exchange
  - read-write from I2C and RF (OK if VCC required)
- Dedicated Alert pin
  - capable of indicating message received or field detect
    It is acceptable for this to be configured over I2C as part of the initialization sequence
- Should have external reset
- Firmware/Software stacks and interface to work with IMM (BMC) has to be provided in scheduled timeframe
- Reference code and APIs of firmware/software have to be provided to Lenovo in scheduled timeframe
- Turnkey solution to develop mobile applications used in Android, iOS, and Windows systems has to be provided in scheduled timeframe

Mechanical, ID & Human factor requirements

Supplier is responsible to follow concepts below to provide proposal and design product to meet Lenovo requirements. Design and final products have to be approved by Lenovo





2.11 Vital Product Data (VPD)

BladeCenter (BC) configuration, status and control information related to a BC component is maintained in a VPD (Vital Product Data) EEPROM in Big Endian format. Each field or customer replaceable unit (FRU or CRU) contains a VPD device organized as defined below.

When a single component consumes multiple blade slots or multiple switch bays then each FRU connected to the midplane must contain a VPD device. Certain non-volatile storage within a component of BladeCenter be excluded from this format.Namely, DIMMs and PCI devices.

• All BC components (Blade, DaughterCards, Switch Modules), contain VPD accessible by the Management Module (MM).

Table 12- VPD Details

Offset	Contents	Size
0	Length of block 0 = 0x03FE	2
2	VPD version / Level = 0x0105	2
4	Block length = overall length - 4 = 0x03FC	2
6	Block ID = 00	1
7	reserved	1
8	VPD ID value = 0x0050	2

A	POSID extension = 0x0000	2
C	POSID value = 0x0002	2
E	Machine Type / Model, ascii. Updated in Box mfg	7
15	Machine Serial , ascii. Updated in Box mfg	7
1C	Asset ID , ascii.	32d
3C	Card Part # , ascii. Updated by card mfg	12d
48	Card FRU # , ascii. Updated by card mfg	12d
54	Card Serial # , ascii. Updated by card mfg	6
5A	Card Prefix Serial # , ascii. Updated by card mfg	6
60	System Manufacturing ID , ascii.	4
64	reserved	1
65	Hardware Revision Level = 0x01	1
66	Physical characteristics	5
6B	Mfg card date code , ascii. Updated by card mfg.	4
6F	reserved	48d
9F	UUID *(*Updated by box manufacture)	16d
AF	Type code = 02h (2 processor blade)	1
B0	Static component internal characteristic	16d
C0	Static component external characteristic	8d
C8	Block 1 base offset = 0400h	2
CA	Block 2 base offset = 0800h	2
CC	Block 3 base offset = 0c00h	2
CE	Block 4 base offset = 1000h	2
D0	Block 5 base offset = 1400h	2
D2	Block 6 base offset = 1800h	2
D4	Block 7 base offset = 1C00h	2
D6	reserved	1
D7	Type sub code = 20h	1
D8	IANA Enterprise # = 004A66	4
DC	Product ID = 00DCh	2
DE	reserved	2
F0	Max power	2
F2	Low capacity max short term output	2
F4	Low capacity non-recoverable over subscribe	2
F6	High capacity max power	2
F8	High capacity recoverable over subscribe	2
FA	High capacity non-recoverable over subscribe	2
FC	reserved	4
100	SubSystem Mfg ID	4
104	Common Language Equipment Identification	10d
10Eh	Resersed, ASCII blank	370d
280	OEM Base VPD	192d
340	OEM Extended VPD	128d
3c0	Reserved, ASCII blank	64d

Here are the IDs for Carnage planar, Backplane, PSU:

Table 13- VPDID/POSID table

(TBU by TPM and BB)

VPDID	POSID	Enterprise#	Product ID	Description
0050h	002Fh	00004A66h	0440h	Lenovo ThinkSystem SR550/SR530 MB
0070h	006Dh	00004A66h	0458h	Purley HV 1x8 -2.5” backplane (New 21)
0070h	006Ch	00004A66h	0457h	Purley HV 4x2 -3.5” backplane (New 30)
0070h	0070h	00004A66h	045Bh	Lenovo ThinkSystem SR650 3.5" SATA/SAS 12-Bay Backplane Kit
0080h	0063h	00004A66h		CFFv3.0 550W Platinum
0080h	0064h	00004A66h		CFFv3.0 750W Platinum
0080h	0065h	00004A66h		CFFv3.0 750W Titanium
00E0h	000Eh	00004A66h	0448h	Purley HV 2U-Riser -1A card
00E0h	000Fh	00004A66h	0449h	Purley HV 2U-Riser -1B card
00E0h	0010h	00004A66h	044Ah	Purley HV 2U-Riser -1C card
00E0h	0013h	00004A66h	044Dh	Purley HV 2U-Riser -2A card
		00004A66h		Purley HV M.2 Boot Module (Single Slot)
		00004A66h		Purley HV M.2 Boot Module (Dual Slot with HW RAID)
		00004A66h		Purley Silicon Lite Panel
		00004A66h		Purley HV PHY Module 2x 1GbE Base-T
		00004A66h		Purley HV PHY Module 2x 10GbE Base-T
		00004A66h		Purley HV PHY Module 2x 10Gbs SFP+

3 System Mechanical and Thermal

3.1 Chassis Mechanical Feature

For detailed Chassis, Mounting and FRU details refer to the following Mechanical Design Guidelines & Acceptance Criteria;

- 2U Value_Carnage_Mechanical Design Guidelines.
- Rack ID template for RFQ.
- 2U Value_Carnage_Mechanical Feature List and Design Requirement.
- Basalt Slide Rail Design Requirement.
- Mario and Luigi CMA Design Requirement.
- SOW for Rail and CMA Design Guidelines

3.2 Expansion PCIE Slots and Bracket

There are 3 Riser types on Carnage motherboard and 2 Riser type can be plugged into system at the same time to support 6 Expansion Slots in max(include vertical PCIe slot).

3.3 Thermal Management Solution

- Refer to the “Lenovo EBG Acoustic Specification” for additional design and acceptance requirements.
- Refer to the “Lenovo Portfolio Thermal Management Specification” for additional design and acceptance requirements.
- Refer to the “Lenovo Portfolio Thermal Performance Specification” for additional design and acceptance requirements.
- Refer to the “Lenovo Thermal-Acoustic SOW” for additional design and acceptance requirements.
- Refer to the “Lenovo PCIe Card SV Thermal Requirements” for additional design and acceptance requirements

3.3.1 Fan Configuration

There are four 60mm x 60mm x 38mm system + 12 Volt, Direct Current (DC) fans supported in Carnage. Refer to Lenovo Portfolio Thermal Management Specification

These fans shall have the following electrical input, monitoring and control connections:

- 12V DC Power
- DC Power Return
- Tachometer Output
- Pulse Width Modulation Control

3.3.2 Thermal Monitoring

Refer to Lenovo Portfolio Thermal Management Specification for locations of these sensors and thermal design details.

4 System Management and Diagnostics

4.1 System Management

System Management features include IMM3 and IPMI feature, iKVM feature, Node Management and DCM feature; see IMM3 SPEC and DCM SPEC for detail information. Please refer to Purley 4R1T IMM3 FW SOW.

5 Packaging

System packaging will be qualified in accordance with Lenovo Environmental requirements Specification For detailed packaging requirements

- Refer to the “Package SOW for Purley” for additional design and acceptance requirements
- Refer to the “41A0612 Lenovo Packaging Specification” for additional design and acceptance requirements.
- Refer to the “45J5388 Lenovo OEM/ODM Packaging Requirements” HHD Filler Design Guidelines & Acceptance Criteria” for additional design and acceptance requirements.
- Refer to the “Lenovo 1-3600-002L-Product Fragility and Packaging Tests” for additional design and acceptance requirements.
- Refer to the “Lenovo 1-9711-004L-Product Fragility Distribution Environment (Unpackaged Product)” for additional design and acceptance requirements.
- Refer to the “Lenovo 1-9711-005L-Packaged Products, Testing for Shipment” for additional design and acceptance requirements
- Refer to the “Lenovo 1-9711-008L- Minimum Shock Resistance Levels” for additional design and acceptance requirements.
- Refer to the “Lenovo C-H 1-9711-015L Distribution and Fragility Tests for Rack Products” for additional design and acceptance requirements

6 Restrictions and Limitations

- Value Rack No Cooling Redundancy Claim for A3/A4
- No AEP DIMM support on Value rack
- No NVMe support on Value rack
- PCIe x16 Graphic card support only on 2U-Riser-1C system configurations.
- CPU can’t support over TDP 125W (Max)
- COM module install will occupy Vertical PCIe slot 4
- There are no RAID /HBA-SAS 16i adapter support on 8 HDD (LFF, SFF) bay.
- There are no RAID basic +HBA-SAS 8i adapter support on 16 HDD (SFF) bay.
- There are no PCIe M.2 support on SS
- There are no NSCI and WOL support with ML2 x8

7 Environmental Specification

The environmental envelopes of CARNAGE is specified to be in accordance with the requirements of ASHRAE's 2011 Thermal Guidelines for Data Processing Equipment and fall into operational classes of Class A2, A3, and testing to the requirements for Class A4.

For detailed environmental requirements;

- Refer to the "Desktop Assembly Dynamic Strain Measurement Specification" for additional design and acceptance requirements.
- Refer to the "Lenovo 1-3600-002L-Product Fragility and Packaging Tests" for additional design and acceptance requirements.
- Refer to the "Lenovo 1-9711-004L-Product Fragility Distribution Environment (Unpackaged Product)" for additional design and acceptance requirements.
- Refer to the "Lenovo 1-9711-005L-Packaged Products, Testing for Shipment" for additional design and acceptance requirements
- Refer to the "Lenovo 1-9711-008L- Minimum Shock Resistance Levels" for additional design and acceptance requirements.
- Refer to the "Lenovo C-H 1-9711-015L Distribution and Fragility Tests for Rack Products" for additional design and acceptance requirements
- Refer to the "Lenovo Enterprise Operational Shock" for additional design and acceptance requirements
- Refer to the "LENOVO Enterprise Operational Vibration" for additional design and acceptance requirements.
- Refer to the "LENOVO Enterprise Performance Loss Verification" for additional design and acceptance requirements.
- Refer to the "SV-ODM-SOW" for additional design and acceptance requirements.
- Refer to the "Lenovo PCIe Card SV Thermal Requirements" for additional design and acceptance requirements

8 Regulatory and Certification Specification

8.1 Product Regulatory Compliance

This product is to be evaluated and certified as Information Technology Equipment (ITE), which may be installed in offices, schools, computer rooms, and similar commercial type locations. The suitability of this product for other product certification categories and/or environments (such as: medical, industrial, telecommunications, residential, alarm systems, test equipment, etc.), other than an ITE application, will require further evaluation and may require additional regulatory approvals. The use and/or integration of telecommunication devices such as modems and/or wireless devices have not been planned for with respect to these systems. If there is any change of plan to use such devices, then telecommunication type certifications will require additional planning. Please refer to Lenovo Purley Compliance requirements document for detailed requirement.

8.2 SCRL

CARNAGE will be compliant to the Lenovo Standards Compliance Reference List (refer to Lenovo regulatory certification list doc, P/N).

8.3 Environmental

Energy Star – Select models will meet the Energy Star Server 2.0 requirements.
Supports Climate Savers Initiatives

8.4 EMI and Safety Certifications

Reference EMI and Safety compliance included in specification package.

9 Performance worksheet

Benchmark	Publish Date	OS DB	Target	Result	Comments
SPECcpu	June/July, 2017	Linux	int_rate_base: TBD Int_rate_peak: TBD fp_rate_base: TBD fp_rate_peak: TBD	Comp->NC Comp->NC Comp->NC Comp->NC	MI assessment competition will support 135W Non-Competitive vs. competition using 135W Competitive vs. competition using 120W or lower
SPECpower_ssj2008	May, 2017	Windows 2012 R2 / 2016	TBD	Marginal-> Non-competitive	Non-competitive if 135W sku yields best performance; otherwise marginal to non-competitive since design not optimized for SPECpower JVM performance with Windows 2012R2 25-28% lower than Windows 2012 base/2008