Clarification for MTN Group

Hybrid Cloud Service Provider RFP
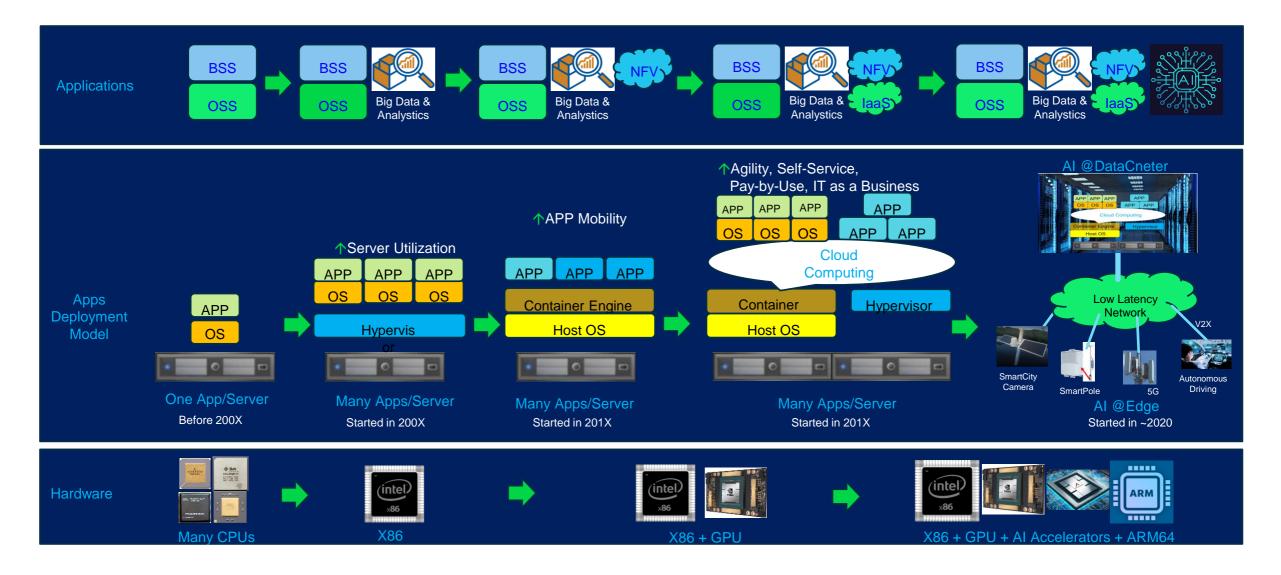
-Common Infrastructure

Agenda

- Project Scope and Huawei Understandings

- Core Network and OSS on Cloud

- Cloud MEC Solution

- SDN

- Common Infrastructure

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Telco Computing Evolution: Cloud, 5G, AI, Intelligent Edge

Applications

| BSS | | BSS | Big Data & Analytics | | BSS | Big Data & Analytics | NFV | | BSS | Big Data & Analytics | NFV | | BSS | Big Data & Analytics | NFV | AI |
| OSS | | OSS | | | OSS | | IaaS | | OSS | | IaaS | | OSS | | IaaS | |

Apps Deployment Model

↑Agility, Self-Service, Pay-by-Use, IT as a Business

AI @DataCneter

↑Server Utilization

↑APP Mobility

| APP | | APP | | APP |
| OS | | OS | | OS |

APP

APP   APP

Cloud Computing

| APP | APP | APP |
| OS | OS | OS |

| APP |
| APP   APP |

| Container | Hypervisor |
| Host OS | |

| APP |
| OS |

| APP | APP | APP |
| Hypervis or |

| APP | APP | APP |
| Container Engine |
| Host OS |

One App/Server
Before 200X

Many Apps/Server
Started in 200X

Many Apps/Server
Started in 201X

Many Apps/Server
Started in 201X

Low Latency Network

SmartCity Camera

SmartPole

5G

V2X

Autonomous Driving

AI @Edge
Started in ~2020

Hardware

Many CPUs

X86

X86 + GPU

X86 + GPU + AI Accelerators + ARM64

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Huawei "Big Plane" for Building Future-Oriented ICT Infrastructure

1 Cloud, 2 Wings, 2 Engines, plus Open Ecosystem

Open ecosystem

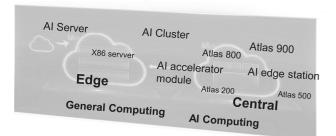Open hardware | Open-Source software | Partner enablement

HUAWEI CLOUD

Basic | EI | Applications

Intelligent Computing

General purpose | AI | Edge

Data Storage and Intelligent Vision

Data storage | Intelligent vision | Intelligent collaboration

General Computing X86

AI Computing Ascend + GPU

Workloads-driven **Diversified Computing**

X86 + Kunpeng + Ascend

AI Server
AI Cluster
X86 servver
Atlas 900
Atlas 800
AI accelerator module
AI edge station
Edge
Atlas 200
Atlas 500
Central
General Computing
AI Computing

Data-driven **Unified Data Infra.**

All Flash + Hybrid +Distributed storage

Converged Storage Pool   Intelligent Data Lake

Architecture | Performance & Reliability | Data Density | Data Value

5X Mgmt. Efficiency   20M IOPS   , 99.99999%   2400TB / 5U   5X Data Utilization

Best-Suited IT Architecture

Service-driven **Cloud-AI Alignment**

5G + Cloud + AI

MEC AI CDN Diversified Computing
APP Eco AI PaaS
Edge Cloud   **Hybrid Cloud**

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20-Year Continuous Innovations for Industry Leading Infrastructure

Server

2002	2004	2007	2008	2010
R&D Start Partner w/ Intel in 2001	T8000 Telecom standard computing platform of the ATCA architecture	Industry's first PCIe SSD Provides compute power for Internet search engines	12-drive RH2285 Industry's first large-capacity storage rack server	X8000, China's first rack-level server For high-density deployment in Internet data centers

2020/2021	2019	2018	2016	2012
Upgraded to the latest Cascade & Cooper Lake Processors	FusionServer Pro intelligent servers	Atlas AI computing platform Powered by Ascend AI processors	KunLun Meets critical system requirements with compute power rivaling UNIX servers	E9000 & Hyper-Converged FusionCube Eliminates compute bottlenecks for traditional storage controllers

Storage

Start

- 2002 — Storage R&D Kick-Off
- 2003 — FC SAN
- 2006 — IP SAN
- 2007 — Storage Virtualization Product
- 2008 — 2nd FC SAN Huawei-Symantec
- 2009 — Scale-out NAS

Grow

- 2011 — Gen1 SSD for all-flash storage
- 2012 — Unified Storage
- 2013 — Gen1 High-End storage
- 2014 — OceanStor V3 Unified SAN & NAS
- 2015 — Gen2 High-End Storage — DCIG Recommended Class

Lead

- 2016 — Named a Leader in Gartner MQ
- 2017 — Industry-Leading Performance OceanStor Dorado — Interop Prize
- 2018 — First full NVMe series
- 2019 — AI Powered

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Huawei Servers Powering Global Tier-1 Telcos & Other Industries

Global **Tier-1** Telco Customers

211 G500

48 G100

170+ Electric power companies

120+ Smart City projects

200+ Safe City project

300+ Financial institutions

1,000+ Manufacturing companies

300+ Telecom carriers

5+ Million Units

Shipped (2012-2020)

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Huawei Servers & Storages Serving Various Systems of MTN OPCOs

Server

Ghana
Nigeria
Congo-B
Uganda
Rwanda
Zambia
Swaziland
South Africa

Storage

Benin
Cote d'Ivoire
Liberia
Ghana
Nigeria
Cameroon
Congo-B
Uganda
Rwanda
Zambia
Swaziland
South Africa

Applications Powered
VAS Service: VAS Cloud, Voice mail
BSS & OSS: Billing, CRM, MV-OSS, CEM
Core Network: vEPC, vMSE, vIMS, vSBC
ITSS: Email, DNS cache, DMS, VDI, REMEDY, Load Runner, DMS, Reporting, Domain Controller, Audit Tracker, File Server

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Understanding of the RFP Common Infrastructure Requirements

- **Standardize** to **support both IT and CT Workloads**
- **Future-Oriented** and **Long-Term Evolution** to support Telco 5G and Digital Business
- **Open and Flexible** to support MTN Cloud Transformation
- **High Reliability & Scalability** to support explosive data growth

Based on our understanding of MTN's RFP, and its key drivers:

➢ Support **smoothly scale** with current MTN Hardware;

➢ Uses standard components for **flexible replacement** and **capacity expansion**;

➢ Support **different network adapters** capacity connectivity;

➢ **High-availability** requirements;

➢ Complies with related **standard protocols** and industry standards;

➢ Deliver best in class **energy and cooling** efficiency;

➢ Support the migration to flexible, agile and on-demand networks through the support of optimum **automation based on open APIs**;

➢ **Optimize the economics** to build a cost-effective infrastructure to support **profitable network growth**;

➢ Support the **Edge computing** solutions for Edge computing scenario;

➢ **Openness** to software, OS and hypervisor OS;

➢ Rich **AI, Cloud, Container NFV and SDN** experience, bringing value to MTN.

Huawei common infrastructure offers the following key advantages:

➢ Support **smoothly scale** with current MTN Hardware;

➢ Uses standard components for **flexible replacement** and **capacity expansion**;

➢ **High-availability** hardware design and software features;

➢ Support **rich network adapters** capacity connectivity;

➢ Complies with related **standard protocols** and industry standards;

➢ Deliver **best in class energy and cooling** efficiency;

➢ Support the migration to flexible, agile and on-demand networks through the support of optimum **automation based on open APIs**;

➢ **Optimize the economics** to build a cost-effective infrastructure to support **profitable network growth**;

➢ Huawei own R&D **Edge Computing** solution combining Huawei FusionServer and Atlas AI components, data will be processed at the remote side before transporting to data centers;

➢ **Openness** to industry mainstream **software**, **OS and Hypervisor OS**;

➢ **Future-oriented AI, Cloud, Container, NFV and SDN** experience in Telco industry.

HUAWEI

Understanding of the RFP Common Infrastructure Requirements

Key Technical Requirements

- **Standardize** to **support both IT and CT Workloads**
- **Future-Oriented** and **Long-Term Evolution** to support Telco 5G and Digital Business

- **Open and Flexible** to support MTN Cloud Transformation
- **High Reliability & Scalability** to support explosive data growth

Scopes

Rack- Mount Servers

Description	Entry Server1	Entry Server2	Entry Server3	Mid Server1	Mid Server2	Mid Server3	High Server1	High Server2	High Server3
CPU (cores)	2x12	2x16	2x20	2x16	2x20	2x24	4x16	8x24	8x26
RAM	4x 32GB	8x 32GB	8x 32GB	16x 32GB	12x 32GB	16x 32GB	32x 32GB	12x 128GB	12x 128GB
HDD SATA 6G	4x 4TB	4x 4TB	6x 4TB	20x 4TB	6x 4TB	6x 4TB	20x 4TB	24x 4TB	24x 4TB
SSD SATA 6G	2x 240GB	2x 240GB	2x 240GB	2x 960GB	2x 960GB	2x 960GB	2x 3.84TB	2x 3.84TB	2x 3.84TB

Server Form-Factor	1U Server	1U Server	2U Server	2U Server	2U Server
NIC Configuration	3x(2x25GE)	1x (4x1GE)	2x(2x25GE)	2x(2x100GE)	1x(4x1GE)

✓ Huawei X86 Servers could meet or exceed ALL Your RFP's Requirements

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Understanding of the RFP Common Infrastructure Requirements

Key Technical Requirements

- **Standardize** to **support both IT and CT Workloads**
- **Future-Oriented** and **Long-Term Evolution** to support Telco 5G and Digital Business

- **Open and Flexible** to support MTN Cloud Transformation
- **High Reliability & Scalability** to support explosive data growth

Scopes

Storage Systems

Description	Entry level1	Mid Tier1	Mid Tier2	File & Object Platform	High End
Traditional	15k RPM SAS SFF, SATA 6G SFF	15k RPM SAS SFF, SATA 6G SFF	15k RPM SAS SFF, SATA 6G SFF	NFS, SMB, FTP, iSCSI; HTTP; Cloud	15k RPM SAS SFF, SATA 6G SFF
All Flash	Native All Flash Architecture	Native All Flash Architecture	Native All Flash Architecture	The same as above	Native All Flash Architecture
Combination (50/50) Split	100%	100%	100%	100%	100%
Effective Capacity	200TB	400TB	600TB	600TB	600TB
Main Use	Cloud Storage			Unstructured Data & Archiving	Hot Storage

✓ Huawei OceanStor Storage Systems could meet or exceed ALL Your RFP's Requirements

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Understanding the RFP: 100% Fully Compliant with ALL RFP-SOCs

SOC No.	Description	Compliance	Notes
1	The common infrastructure platform must be able to manage on-premise hardware resources for the consumption of on-premise IT and core network workloads	YES	1. Huawei servers & storages have been powering IT & Core network workloads extensively by 83% Global Tier1 Telcos
2	The Solution should incorporate the existing hardware resources where possible, or strategy should be mentioned on how best to service the business case around already invested hardware through re-use or buy-back options.	YES	1. Huawei Cloud is Supporting servers from other vendors
3	The x86 hardware is the preferred on-premise common infrastructure platform for both IT and network workloads. The bidder must be able to cater for 64-bit x86 dual/quad-socket multi-core high performance server microprocessors introduced which can offer the highest performance and high scalability with up to 4-way multiprocessing.	YES	1. 1288H V5 in 1RU for Dual-Socket; 2. 2288H V5 in 2RU for Dual-Socket; 3. 2488H V5/V6 in 2RU for Quad-Socket; 4. 9008H V5 in 8RU for max 8-socket. 5. All Huawei servers demo industry-leading performance
4	The CPU core must support vector instruction set for integer and floating-point (SSE: 128-bit integer, AVX1:128-bit integer, AVX2: 256-bit integer).	YES	1. Provided by Intel Xeon CPUs & Skylake CPUs & after support all these features; Huawei V5 servers use Skylake/Cascade, and V6 uses Cooper / Ice Lake CPUs
5	The server CPU and Memory configuration will be certified to run both IT and Core network workloads (VNF)	YES	1. Huawei servers have been serving 83% Global Tier 1 Telcos for both IT & Core Network VNF workloads
6	Please refer to table in section 6.1 for compliance to Server configurations	YES	1. Huawei V5/V6 Servers meet or exceed the requirements
7	Please refer to table in section 6.2 for compliance to Storage configurations	YES	1. Huawei OceanStor Storage meet or exceed the requirements
8	Network adapters will have the capability to route I/O traffic directly to L3 cache, reducing unnecessary trips to system memory, providing more throughput while further reducing power consumption and I/O latency as per the IT and core network workload requirements	YES	1. This feature is provided by Intel CPUs starting from Sandy Bridge (Xeon V2) and Huawei servers naturally support
9	The bidder shall ensure the platform can run on the following network configuration i.e., connectivity (Network interface) capacity requirements , refer to section 6.3 in RFP Document	YES	1. Huawei Servers & Storage supports All Required Network Types and Speeds.

✓ For technical part, there are total **9** SOCs, and Huawei fully compliant with all the SOC items.

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Huawei Cloud Support Server Re-use
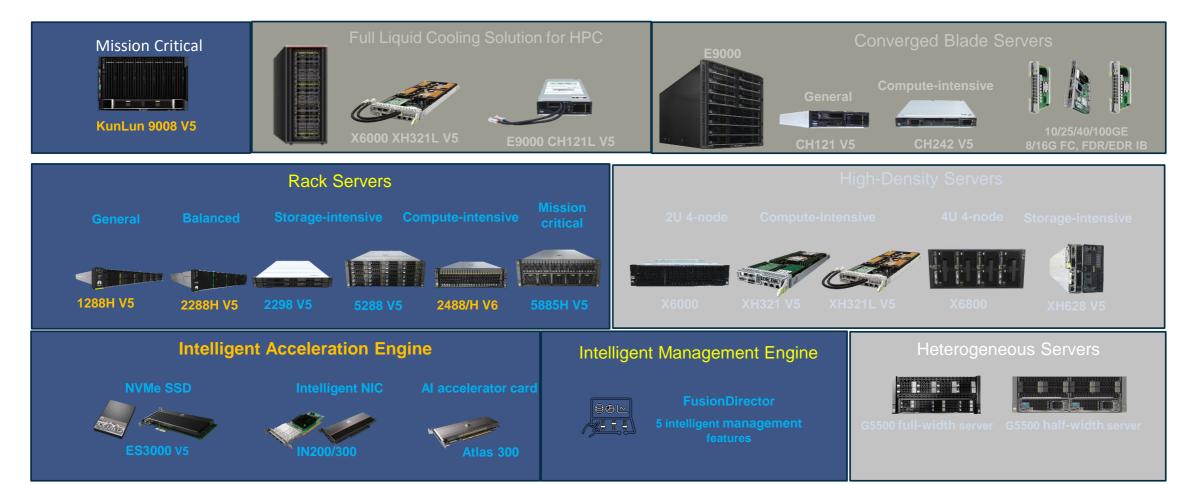
✓ Huawei Cloud based on X86 server, supports total 20 server models, both from Huawei, HPE, Dell, H3C and Inspur

Compute node	huawei	2288H V5	Size: 2 U CPU:2 x Intel Skylake-SP Xeon Gold 6151-18Core(with heatsink) Memory: 20 x 32GB RDIMM-32GB-288pin-0.68ns Hard disk: 2 x 600GB SAS HDD,8 x 1.6TB NVME RAID: 3408 RAID NIC: 8 x 25GE Power: 900 W
Compute node	huawei	2288X V5	Size: 2 U CPU:2 x Intel Xeon Gold 6278C(2.6GHz/26-core/35.75MB/185W) Memory: 16 x 32GB RDIMM-32GB-288pin-0.68ns Hard disk: 1 x 480 GB SATA SSD, 4 x 1.6 TB NVME NIC: 8 x 25GE Power: 900 W
Compute node	huawei	5288 V5	Size: 4 U CPU:2 x Intel Xeon Gold 6278C(2.6GHz/26-core/35.75MB/185W) Memory: 12 x 32GB RDIMM-32GB-288pin-0.68ns Hard disk: 2 x 480GB SATA SSD,36 x 4TB SATA HDD RAID: 3408 RAID NIC: 8 x 25GE Power: 900 W
Compute node	HPE	DL380 Gen10	Size: 2 U CPU: Intel Xeon Gold 6248(2.5GHz/20-Core/27.5MB/150W) Memory: 12 x 16 GB RDIMMs, 32 GB, 2933 MT/s Hard disk: 1 x SSD-480GB-SATA 6Gb/s RAID: 3408 RAID/RAID-LSI-9460-8i(2G) NIC: 4 x 10GE onboard + 2 x 10GE 82599 dual-port NIC Power: 800 W
Compute node	DELL	PowerEdge R740	Size: 2 U CPU: Intel Xeon Gold 6248(2.5GHz/20-Core/27.5MB/150W) Memory: 12 x 16 GB RDIMMs, 32 GB, 2933 MT/s Hard disk: 1 x 480 GB SSD SATA 6 Gbit/s 2.5-inch hot swap RAID: 3408 RAID/RAID-LSI-9460-8i(2G) NIC: 4 x 10GE onboard + 2 x 10GE 82599 dual-port NIC Power: 750W
Compute node	H3C	UniServer R4900 G3	Size: 2 U CPU: Intel Xeon Gold 6248(2.5GHz/20-Core/27.5MB/150W) Memory: 12 x 16 GB RDIMMs, 32 GB, 2933 MT/s Hard disk: 1 x SSD-480GB-SATA 6Gb/s RAID: 3408 RAID/RAID-LSI-9460-8i(2G) NIC: 2 x 10GE onboard + 2 x 10GE 82599 dual-port NIC Power: 800 W
Compute node	Inspur	NF5280M5	Size: 2 U CPU: 2 x Intel Xeon Gold 6248(2.5GHz/20-Core/27.5MB/150W) Memory: 12 x 16 GB RDIMMs, 32 GB, 2933 MT/s Hard disk: 1 x SSD-480GB-SATA 6Gb/s RAID: 3408 RAID/RAID-LSI-9460-8i(2G) NIC: 4 x 10GE onboard + 2 x 10GE 82599 dual-port NIC Power: 2 x 800 W

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FusionServer Pro Intelligent Servers

✓ Rich Product Portfolio to meet your needs for different application scenarios:
  - Balanced, Computing or Storage Intensive, Air or Liquid Cooling, Rack or Blade, etc.
✓ Full series upgraded to the latest Intel Cascade Lake Refresh / Cooper processor, synchronous to Intel CPU Release Schedule

Mission Critical
KunLun 9008 V5

Full Liquid Cooling Solution for HPC
X6000 XH321L V5   **E9000 CH121L V5**

Converged Blade Servers
E9000

General — **CH121 V5**
Compute-intensive — **CH242 V5**
10/25/40/100GE 8/16G FC, FDR/EDR IB

Rack Servers

General	Balanced	Storage-intensive	Compute-intensive	Mission critical
1288H V5	**2288H V5**	**2298 V5** **5288 V5**	**2488/H V6**	**5885H V5**

High-Density Servers

2U 4-node	Compute-intensive		4U 4-node	Storage-intensive
X6000	**XH321 V5**	**XH321L V5**	**X6800**	**XH628 V5**

Intelligent Acceleration Engine

NVMe SSD — **ES3000 V5**
Intelligent NIC — **IN200/300**
AI accelerator card — **Atlas 300**

Intelligent Management Engine

FusionDirector
5 intelligent management features

Heterogeneous Servers

G5500 full-width server   G5500 half-width server

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Quality Product by Design, Process, Sourcing and Testing

✓ Over 30 years of hardware design, development, and manufacturing capabilities coupled with complete product R&D and test processes to maximize server reliability, reduce downtime and data loss, and enhance device maintainability
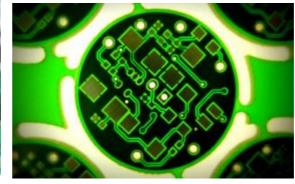
Component Selection and Process Technique	High Reliability Design	Strict Test and Certification	Enhanced O&M Features

Hard Disk Failure rate

40% ⬇

Source: Per Internal Testing & O&M Data Collections

Working Temperature

45°C

Source: Internal Lab Tested for most products

Machine Failure rate

15% ⬇

Source: Per a Large Customer Statistics

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Full-Lifecycle Management Enabling Intelligently O&M

7–30 days earlier prediction of risks

O&M time per 100 servers reduced from 1 week to hours

15% better energy efficiency

10x deployment efficiency

Automatic inventorying in seconds, with 100% accuracy

93% Fault Locating Accuracy

DEMT

FDM

Intelligent maintenance

Intelligent upgrade

Intelligent energy saving

Intelligent deployment

Intelligent discovery

Intelligent Fault Diagnosis

AI-enabled fault warning and diagnosis

Automatic version matching, unattended upgrade

Energy saving at 3 levels: single-node, cabinet, and data center

Pipeline-style deployment

Server model, configuration, inventorying, and retirement

FusionDirector

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Embedded Security Features to Enable Secure Computing

Contents

2 Management Software Security Design

2.1 Account Security

The server outband management software iBMC supports management interfaces such as CLI, SNMP, Web, IPMI, and Redfish, and provides unified user management functions. A maximum of 16 users can be added, modified, or deleted.

Account security includes: password complexity check, historical password disabling, password validity period, minimum password validity period, anti-brute force cracking, manual account lockout, and online user logout.

Password complexity check: The complexity of the password configured by the user is checked to prevent the user from setting a simple password. The password must meet the following complexity requirements:

- Contains 8 to 20 characters.
- Contains at least one space or the following special characters: `~!@#$%^&* () -_=+\|[ ];: '", <>/"
- Contains at least two of the following combinations: lowercase letters a-z, uppercase letters A-Z, and digits 0-9
- Cannot be the same as a user name or the user name in reverse order.
- Contains at least two characters different from the old password.

History password disabling: You can set the number of historical passwords that can be retained. The new password cannot be the same as the history passwords.

- Huawei iBMC supports **15 kinds of security** ,including Account Security, Authentication Management, Authorization Management, Certificate Management, Session Management, Security Protocol, Data Protection, Access Policy, Key Management, System Hardening, Log Audit, Trusted Boot, Secure Boot, BIOS Firmware Security, Security Tool Scanning and End-to-End Assurance.
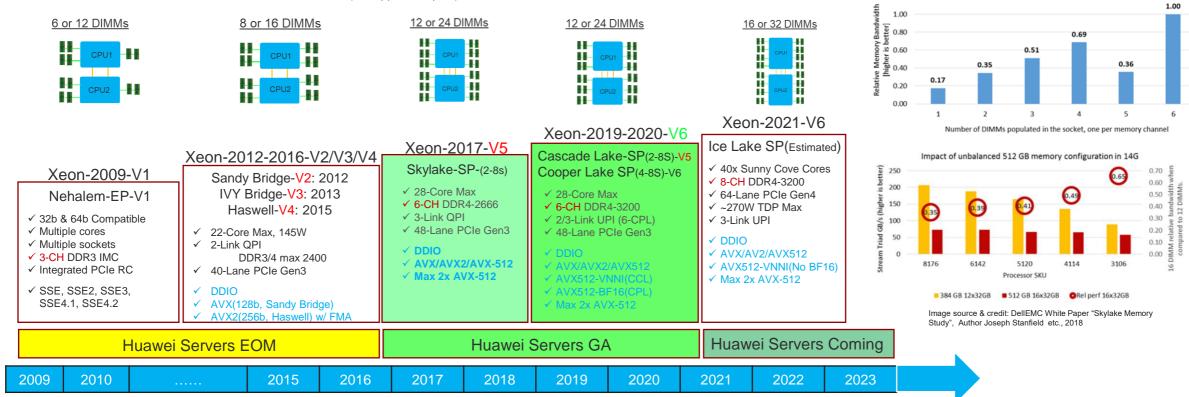
- Huawei FusionServer supports hardware level security, provides **TPM 2.0 for data encryption**.

Security White Paper

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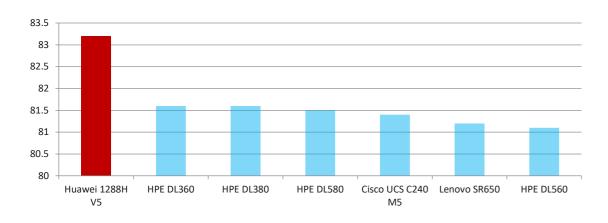# Optimized DIMM Configurations for Best Performance Gen-by-Gen

✓ Intel SSE, AVX, AVX2 & AVX-512 SIMD Instruction Extensions Deliver High Performance for a lot of Applications
✓ Balanced Memory Configuration w/ the same DIMM on every Channel is Crucial to Application Performance
✓ Huawei X86 Servers Support all Intel Xeon CPUs & Memory Configurations, Exceed or Meet your RFP's SSE/AVX & Memory Requirements

1. DDIO – NIC/IO to place data to L3/LLC Cache directly;
2. CPUs w/ AVX-512 Support AVX2(-256b) & AVX(-128b)
3. CPUs w/ AVX also Support SSE,SSE2,SSE3, SSE4.1,SSE4.2
4. Intel DL Boost: AVX-512-VNNI, AVX-512-BF16 & AMX(in Sapphire Rapids)

6 or 12 DIMMs — CPU1 / CPU2

8 or 16 DIMMs — CPU1 / CPU2

12 or 24 DIMMs — CPU1 / CPU2

12 or 24 DIMMs — CPU1 / CPU2

16 or 32 DIMMs — CPU1 / CPU2

Relative Memory bandwidth of one socket with different DIMMs

Number of DIMMs populated in the socket, one per memory channel

Xeon-2009-V1
Nehalem-EP-V1
- ✓ 32b & 64b Compatible
- ✓ Multiple cores
- ✓ Multiple sockets
- ✓ 3-CH DDR3 IMC
- ✓ Integrated PCIe RC

- ✓ SSE, SSE2, SSE3, SSE4.1, SSE4.2

Xeon-2012-2016-V2/V3/V4
Sandy Bridge-V2: 2012
IVY Bridge-V3: 2013
Haswell-V4: 2015

- ✓ 22-Core Max, 145W
- ✓ 2-Link QPI
  DDR3/4 max 2400
- ✓ 40-Lane PCIe Gen3

- ✓ DDIO
- ✓ AVX(128b, Sandy Bridge)
- ✓ AVX2(256b, Haswell) w/ FMA

Xeon-2017-V5
Skylake-SP-(2-8s)
- ✓ 28-Core Max
- ✓ 6-CH DDR4-2666
- ✓ 3-Link QPI
- ✓ 48-Lane PCIe Gen3

- ✓ **DDIO**
- ✓ **AVX/AVX2/AVX-512**
- ✓ **Max 2x AVX-512**

Xeon-2019-2020-V6
Cascade Lake-SP(2-8S)-V5
Cooper Lake SP(4-8S)-V6
- ✓ 28-Core Max
- ✓ 6-CH DDR4-3200
- ✓ 2/3-Link UPI (6-CPL)
- ✓ 48-Lane PCIe Gen3

- ✓ DDIO
- ✓ AVX/AVX2/AVX512
- ✓ AVX512-VNNI(CCL)
- ✓ AVX512-BF16(CPL)
- ✓ Max 2x AVX-512

Xeon-2021-V6
Ice Lake SP(Estimated)
- ✓ 40x Sunny Cove Cores
- ✓ 8-CH DDR4-3200
- ✓ 64-Lane PCIe Gen4
- ✓ ~270W TDP Max
- ✓ 3-Link UPI

- ✓ DDIO
- ✓ AVX/AV2/AVX512
- ✓ AVX512-VNNI(No BF16)
- ✓ Max 2x AVX-512

Impact of unbalanced 512 GB memory configuration in 14G

Processor SKU

384 GB 12x32GB | 512 GB 16x32GB | Rel perf 16x32GB

Image source & credit: DellEMC White Paper "Skylake Memory Study", Author Joseph Stanfield etc., 2018

| Huawei Servers EOM | Huawei Servers GA | Huawei Servers Coming |

| 2009 | 2010 | …… | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |

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Industry-Leading Computing Performance
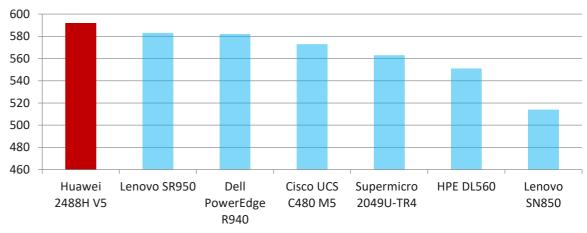
1288H V5 SPECint_base2006 Test Result
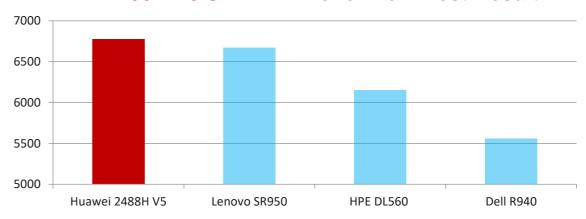
2488H V5 SPECrate2017_int_base Test Result

2288H V5 SPECint_base2006 Test Result

2488H V5 SAP B4H Benchmark Test Result

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Industry-Leading Energy-Efficiency

2288H V5 SPECpower-ssj2008 Test Result

Data released on http://www.spec.org/ as of Apr 2019

2288H V5 SPECpower-ssj2008 Test Result

Data released on http://www.spec.org/ as of Apr 2018

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Rack Server: FusionServer Pro 1288H V5

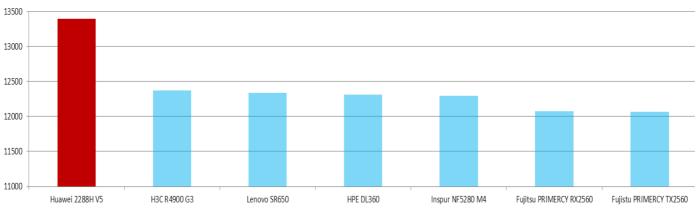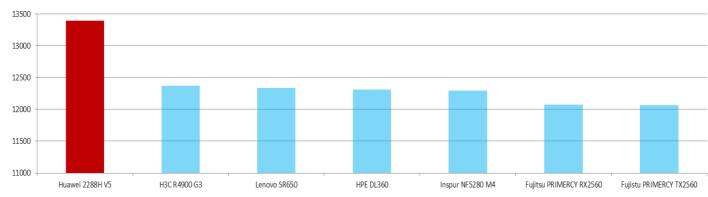✓ **2S+24-DIMM in 1RU** w/ Intel Xeon Cascade Lake for Ultimate Computing Performance

✓ **Max 10x2.5" SATA 6G HDDs/SSDs or 8x NVMe** SSDs on front for high performance storage

✓ For General Computing w/o Requiring Large Local Storage

✓ 2x10GE SFP+ & 2x1GE RJ45 LOM Ports

✓ 2*25GE OCP Flexible NIC

✓ Max 3x External PCIe 3.0 slots, not including RAID card slot:
  ❑ **2** Slots are PCIe x16 for 2x (2x10/25/100GE)
  ❑ **1** slots PCIe x8 for 1x (2x10/25GE)

➢ Max 10/25GE Ports: 3x (2x10/25GE) + 2*25GE OCP Flexible NIC = **5 x (2x 10/25GE)**

High reliability	Ultimate performance	Unique value	Innovative design
• **Carrier-class component** specifications and **100% derating design** • **Redundancy design**: PSU modules in 1+1 mode, fan modules in N+1 mode, and memory module sparing/mirroring • **99.99% availability** • **15% fewer failures** than the industry average	• 2 x 2nd Gen Intel® Xeon® Scalable processors, up to 28 cores **and TDP 205 W per CPU** • **24 DDR4 DIMMs**, up to 2933 MT/s; total memory capacity up to 3 TB on a single server • **No. 1 in SPECint®_base2006** performance test • **No. 1 in SPECpower ssj2008** Benchmark energy efficiency test	• **FDM:** The patented Fault Diagnosis & Management (FDM) technology provides the fault locating **accuracy up to 93%** and predicts a **fault 7 to 30 days before it occurs**, reducing OPEX • **DEMT:** The patented Dynamic Energy Management Technology (DEMT) **reduces energy consumption by 15%** without compromising services • **BSST:** Boot Speedup Storage Technology (BSST), 2 M.2 SSDs as high-speed OS boot drives, **industry-unique hot plug** and hardware RAID	• **2 x 10GE/GE and 2 x GE LOM** ports, reducing CAPEX • **Flexible NIC** for higher networking capabilities, support 2*25GE;

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Rack Server: FusionServer Pro 2288H V5

✓ **2S+24-DIMM in 2RU** w/ Intel Xeon Cascade Lake for Ultimate Computing Performance

✓ **Max 25x2.5" or 12x3.5" SATA 6G HDDs/SSDs or 24x NVMe** SSDs on front for high performance storage

✓ Many Storage Configurations Available

✓ For General Computing w/ Balanced Compute & Storage

✓ 2x10GE SFP+ & 2x1GE RJ45 LOM Ports

✓ 2*25GE OCP Flexible NIC

✓ Max 8x External PCIe 3.0 slots, not including RAID card slot
  - ❑ **3** Slots are PCIe x16 for 3x (2x10/25/100GE)
  - ❑ 2 slots PCIe x8 for 2x (2x10/25GE)
  - ❑ Some slots could be used for Storage Expansion

➢ Max 10/25GE Ports: 9x (2x10/25GE)

➢ Max 100GE Ports: 3x (2x100GE)

High Reliability

- **Carrier-class component** specifications and **100% derating design**
- **Redundancy design**: PSU modules in 1+1 mode, fan modules in N+1 mode, and memory module sparing/mirroring
- **99.99% availability**
- **15% fewer failures** than the industry average

Ultimate Performance

- 2 x 2nd Gen Intel® Xeon® Scalable processors, up to 28 cores **and TDP 205 W per CPU**
- **24 DDR4 DIMMs**, up to 2933 MT/s; a maximum of 12 Optane™ Persistent Memory (PMem), up to 2666 MT/s; total memory capacity up to 7.5 TB on a single server
- **No. 1 in SPECint®_base2006** performance test
- **No. 1 in SPECpower ssj2008** Benchmark energy efficiency test

Unique Value

- **FDM:** The patented Fault Diagnosis & Management (FDM) technology provides the fault locating **accuracy up to 93%** and predicts a **fault 7 to 30 days before it occurs**, reducing OPEX
- **DEMT:** The patented Dynamic Energy Management Technology (DEMT) **reduces energy consumption by 15%** without compromising services
- **BSST:** Boot Speedup Storage Technology (BSST), 2 M.2 SSDs as high-speed OS boot drives, **industry-unique hot plug** and hardware RAID

Innovative Design

- **2 x 10GE/GE and 2 x GE LOM** ports, reducing CAPEX
- **Flexible NICs** for higher networking capabilities, support 2*25GE
- **20 x 3.5"** or **31 x 2.5"** drives for industry-leading storage capability
- **28 NVMe SSDs** for optimal service experience
- 7 Atlas 300 inference cards/NVIDIA Tesla T4 GPUs for AI inference
- 2 NVIDIA Tesla V100 cards for AI training

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2488H V6: Stable and Reliable Mission Critical Server

✓ **4S+48-DIMM in 2RU** w/ Intel Xeon Cooper Lake for Ultimate Computing Performance

✓ **25x2.5" SATA 6G HDDs/SSDs or 24x NVMe** SSDs for high performance storage

✓ For Computing Applications Requiring 4-Socket & Large Memory in 2RU Space

✓ 2x10GE SFP+ & 2x1GE RJ45 LOM Ports

✓ 1x OCP 3.0 NIC Slot for 2x25/100GE

✓ 9x additional External PCIe 3.0 slots:
  - ❑ **4** Slots are PCIe x16 for 4x (2x10/25/100GE)
  - ❑ 5 slots PCIe x8 for 5x (2x10/25GE)

➢ Max 10/25GE Ports: 10 x (2x10/25GE)

➢ Max 100GE Ports: 5x (2x100GE)

High reliability

- Carrier-class component specifications and 100% derating design
- Redundancy design: PSUs in 1+1 mode, fan modules in N+1 mode, and memory module sparing/mirroring
- 69 RAS features
- 99.999% availability
- 15% fewer failures than the industry average

Ultimate performance

- 4 x 3rd Gen Intel® Xeon® Scalable processors (Cooper Lake), up to 28 cores and TDP 250 W per CPU
- 48 DDR4 DIMMs, up to 3,200 MT/s; 24 Intel® Optane™ persistent memory (Optane™ PMem) modules (200 series), up to 2,666 MT/s; total memory capacity of a single server up to 18 TB
- 2 x 300 W high-performance dual-width GPU accelerator cards, providing powerful computing for AI inference and training

Unique value

- **FDM:** The patented Fault Diagnosis & Management (FDM) technology provides the fault locating accuracy up to 93% and predicts a fault 7 to 30 days before it occurs, reducing the OPEX
- **DEMT:** The patented Dynamic Energy Management Technology (DEMT) reduces energy consumption by 15% without compromising services
- **BSST:** The Boot Speedup Storage Technology (BSST) uses 2 M.2 SSDs as high-speed OS boot drives, supporting the hardware RAID and the industry-unique hot plug for M.2 SSDs

Innovative design

- 2 FHFL dual-width GPU AI accelerator cards, such as Tesla V100
- 4 HHHL single-width GPU AI accelerator cards, such as Tesla T4
- 11 PCIe 3.0 slots, including one dedicated PCIe slot for the OCP 3.0 NIC (hot-swappable)
- 25 x 2.5'' SAS/SATA drives, up to 24 NVMe SSDs[1]
- Access to iBMC using Type-C, enabling agile O&M

[1] The configuration of 24 NVMe SSDs is estimated to be released in Q4 2020.

HUAWEI

8-Socket X86 Server - 9008 V5

- ✓ Max **8S**+**96-DIMM** Scalable Ultimate Performance & Large Memory Capacity in 8RU
- ✓ Max **40**x 2.5" NVMe SSDs or **48** 2.5" SAS/SATA SSDs or HDDs
- ✓ Ultimate Performance, Reliability and Scalability with Modular Design

- ✓ 2*10GE SFP+ + 2*1GE RJ45 LOM
- ✓ Max **10** PCIe Gen3 Expansion Slots for Networking Expansion for **6x (2x10/25GE) + 4x (2x100GE) or 10x (2x10/25GE),** not including extra 8 expansion slots for RAID or other accelerators

High Reliability

- **Carrier-class** component specifications and **100% derating design**
- **Redundancy design**: PSU modules in 1+1 mode, fan modules in N+1 mode, and memory module sparing/mirroring
- **99.99% availability**
- **15% fewer failures** than the industry average

Ultimate Performance

- 2/4/6/8 Xeon Skylake Lake & Cascade Lake Scalable Processors, up to 28 cores/processor, **TDP max 205 W**
- **96 DDR4 DIMMs**, up to 2933 MT/s; 48 channels
- Up to **40pcs NVMe** or **48pcs** SAS/SATA HDD/SSD

Unique Value

- **FDM:** The patented Fault Diagnosis & Management (FDM) technology provides the fault locating **accuracy up to 93%** and predicts a **fault 7 to 30 days before it occurs**, reducing OPEX
- **DEMT:** The patented Dynamic Energy Management Technology (DEMT) **reduces energy consumption by 15%** without compromising services
- **BSST:** Boot Speedup Storage Technology (BSST), 2 M.2 SSDs as high-speed OS boot drives, **industry-unique hot plug** and hardware RAID

Innovative design
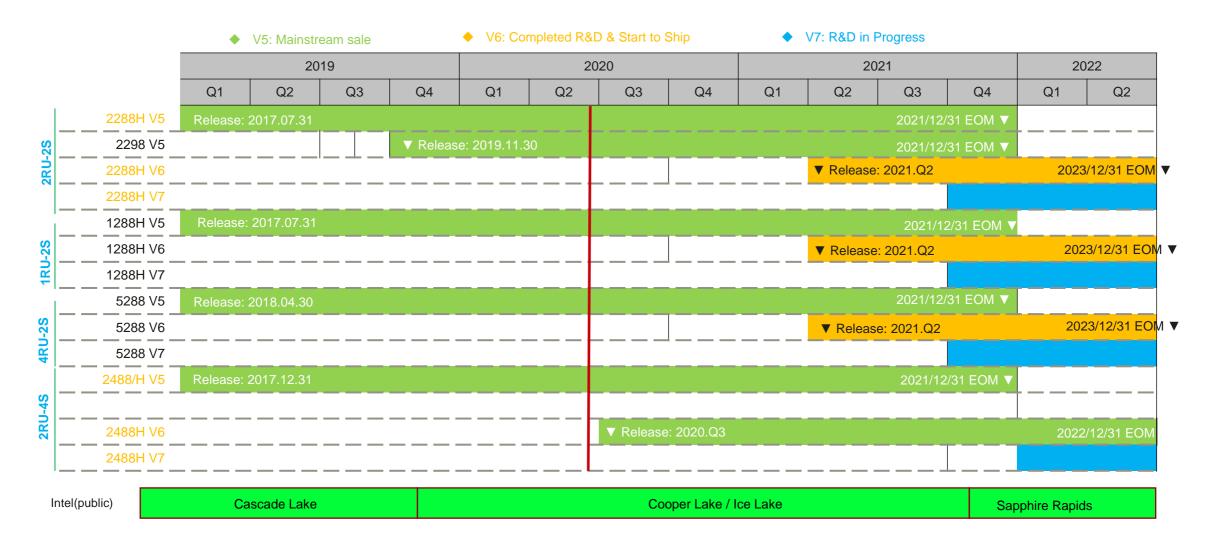
- **Modular Design for High Reliability & Easy Operation and Maintenance**
- **2*10GE optical + 2*GE RJ45 ports，** reducing CAPEX
- Max 10 PCIe Slots for Networking w/ 6 slots are PCIe Gen3 X8 for 2x25GE/each and 4 slots are PCIe Gen3 X16 for 2x100GE/each
- 40 x 2.5" SSDs, or 48 SAS/SATA HDDs;
- Support 2 M.2 storage, **hot-plug**

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Continuous Roadmap Synchronous to Intel Release Schedule

✓ Huawei FusionServer Pro X86 Servers Synchronous to Intel Processor Release Schedule & Subject to Change

◆ V5: Mainstream sale ◆ V6: Completed R&D & Start to Ship ◆ V7: R&D in Progress

		2019				2020				2021				2022	
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
2RU-2S	2288H V5	Release: 2017.07.31										2021/12/31 EOM ▼			
	2298 V5				▼ Release: 2019.11.30							2021/12/31 EOM ▼			
	2288H V6									▼ Release: 2021.Q2		2023/12/31 EOM ▼			
	2288H V7														
1RU-2S	1288H V5	Release: 2017.07.31										2021/12/31 EOM ▼			
	1288H V6									▼ Release: 2021.Q2		2023/12/31 EOM ▼			
	1288H V7														
4RU-2S	5288 V5	Release: 2018.04.30										2021/12/31 EOM ▼			
	5288 V6									▼ Release: 2021.Q2		2023/12/31 EOM ▼			
	5288 V7														
2RU-4S	2488/H V5	Release: 2017.12.31										2021/12/31 EOM ▼			
	2488H V6							▼ Release: 2020.Q3					2022/12/31 EOM ▼		
	2488H V7														

Intel(public)	Cascade Lake	Cooper Lake / Ice Lake	Sapphire Rapids

HUAWEI

Huawei Comprehensive Storage Solutions Supporting All Scenarios

Solutions

Data Protection Solutions

Disaster Recovery

Backup

Archiving

Data Management

Intelligent Device management

DeviceManager

Intelligent storage Management platform

OceanStor DME

Intelligent O&M

eService

Intelligent storage

All-flash storage

OceanStor Dorado 18000 V6

OceanStor Dorado 8000 V6

OceanStor Dorado 6000 V6

OceanStor Dorado 5000 V6

OceanStor Dorado 3000 V6

Hybrid flash storage

OceanStor 18500/18800 V5

OceanStor 5300/5500/5600/5800 V5

OceanStor 6800 V5

OceanStor 2200/2600 V5

Distributed storage

OceanStor 100D

OceanStor 9000

HUAWEI

Ever Solid: Five Layers for Extreme Reliability

99.9999%
System-level reliability

99.99999%
Solution-level reliability

Cloud backup
- Gateway-free cloud backup
- 30x higher backup frequency
- 20x faster backup speed

Replication Solution
- HyperMetro Gateway-free active-active solution (1ms latency)
- FlashEver without data migration

System
- Comprehensive enterprise-class features
- Tolerance for simultaneous failures of 3 disks
- Reconstruction of 1 TB data in 15 minutes

Architecture
- Tolerance for failures of 7 out of 8 controllers with SmartMatrix fully-interconnected architecture
- E2E active-active design

SSD
- Global wear leveling
- Huawei-patented global anti-wear leveling

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Industry Leading Reliability by Drive w/ 6 Core SSD Technologies

SSD wear leveling and Huawei-patented anti-wear leveling

LDPC + SmartFSP 3.0 for error correction granularity 10x superior to competitors

Intra-disk DIF preventing silent data corruption

Data inspection algorithm preventing data distortion

Built-in dynamic RAID improving utilization

RAID at the SSD and system levels

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Industry Leading Reliability by Storage System Architecture
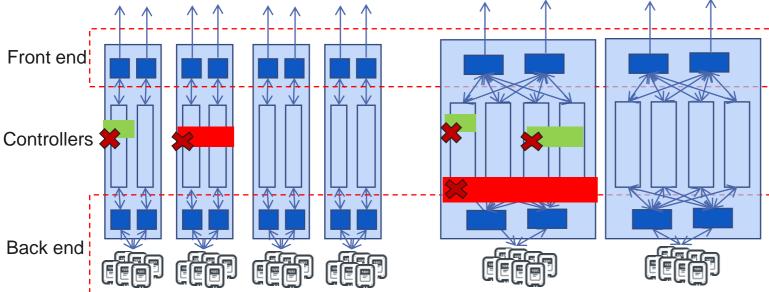
Vendor E
2 controllers, Scale-out

- I/O interface module connected to 1 controller
- Controller failure: front-end link switching

Vendor H
4 Controllers, Scale-out

- Interface module shared by controllers
- Controller failure: 0 front-end link switching

OceanStor Dorado
8 controllers, Scale-out

- Interface module shared by controllers
- Controller failure: 0 front-end link switching, 0 impact on hosts

Front end

Controllers

Back end

- SSD enclosure connected to 2 controllers (1 controller enclosure)
- **Max 1-Controller failure: Some Service Disruption**
- **2 Controller Failure: Service Interrupt**

- SSD enclosure connected to 4 controllers (1 controller enclosure)
- **Max 3-controller failure: 0 service disruption**

- **Global cache:** continuous mirroring, 3 copies across controller enclosures
- SSD enclosure connected to 8 controllers (2 controller enclosures)
- **Max 7-Controller failure: 0 service disruption**

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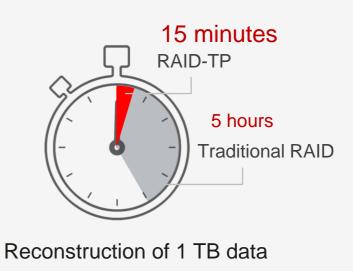
Industry Leading Reliability by Data Redundancy & Reconstruction

Large-capacity SSDs lead to double the capacity (up to 32 TB) & 5x to 10x the failure rate

Simultaneous 3-disk failure without service interruption

15 minutes
RAID-TP

5 hours
Traditional RAID

Reconstruction of 1 TB data

SSD Failure Toleration

Traditional RAID: up to 2 SSDs (RAID-6)
Huawei RAID-TP: simultaneous 3-SSD failure
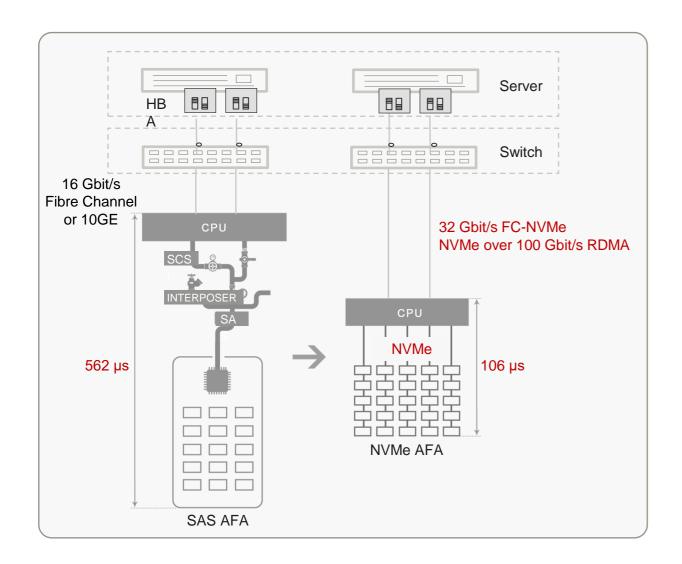
Data Reconstruction

Traditional RAID: 5 hours
RAID-TP: 1 TB of data within 15 minutes

RAID-TP: Erasure Coding with Triple-Parity

HUAWEI
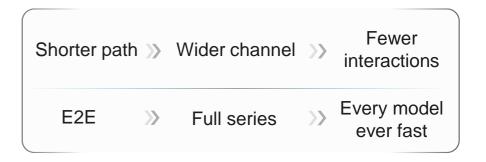
Ever Faster: E2E NVMe for All Storage Series

16 Gbit/s
Fibre Channel
or 10GE

HBA

Server

Switch

CPU

SCS

INTERPOSER

SA

562 µs

SAS AFA

32 Gbit/s FC-NVMe
NVMe over 100 Gbit/s RDMA

CPU

NVMe

106 µs

NVMe AFA

0.1 ms

Test model: 7:3 read/write, 130µs read

latency, 50µs write latency

Time = 130 x 0.7 + 50 x 0.3 = 106 µs

Shorter path » Wider channel »	Fewer interactions
E2E » Full series »	Every model ever fast
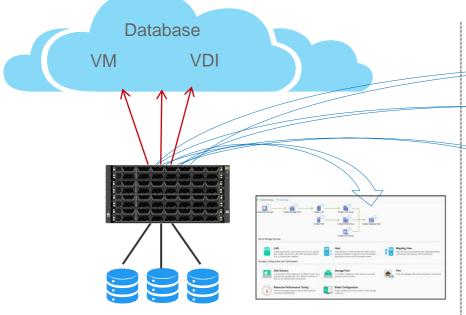
*Front-end NVMe over 100 Gbit/s RDMA will be available in the next version.
*Deployment of FC NVMe or NVMe over ROCE due to the maturity of ecosystem.

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Device-Cloud Full Stack Management

OceanStor Dorado V6

DeviceManager
- Web-based GUIs
- Step-by-step guide for FCAPS management
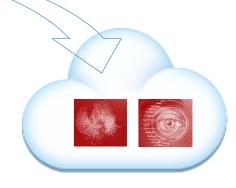
SmartConfig
- 3-step host configuration
  - Add a storage device.
  - Set the IP address.
  - Set the capacity.

DME
- Unified storage management
- Topology and data path analytics
- Long-term log and performance storage and analytics

eService
- Cloud-based remote AI services
- 24/7 monitoring
- 5-min service ticket creation
- All-round health check
- Regular performance analytics

Four-Level Security Ensuring System and Data Security

Storage Service Security

- Resource access control
- Resource access authentication and authorization
- Data encryption
- Data destruction

Storage Network Security

- Network isolation
- Transmission security

Management Security

- Role-based access control
- User security policies
- Password security
- Authentication and authorization
- Log and alarm management

Storage System Security

- Storage OS security hardening
- Security patches
- Web security
- Secure boot and software integrity protection

Security Features and Protocols Supported
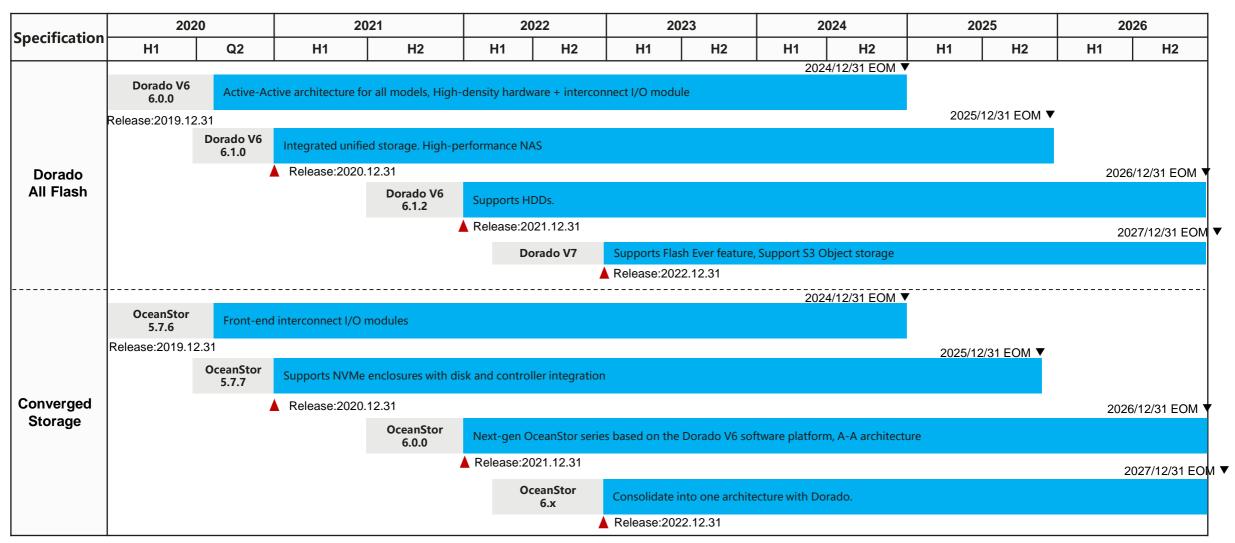
- **ITU-T X.805 telecom network security architecture-based model**
- **Management Security**
  - ✓ Role-based access control
- **Storage Service Security**
  - ✓ Data at rest encryption
  - ✓ DoD standard data destruction

- **Storage Network Security**
  - ✓ Secure transmission protocols (SSH, SFTP, HTTPS, and SNMPv3)
- **Storage System Security**
  - ✓ The RSA 2048/4096 algorithm is used, which has the top security level in the industry

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Roadmap: All-Flash, All-NVMe, All-IP and All-Intelligent

Specification	2020		2021		2022		2023		2024		2025		2026	
	H1	Q2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2

Dorado All Flash

Dorado V6 6.0.0 — Active-Active architecture for all models, High-density hardware + interconnect I/O module
Release:2019.12.31
2024/12/31 EOM ▼

Dorado V6 6.1.0 — Integrated unified storage. High-performance NAS
▲ Release:2020.12.31
2025/12/31 EOM ▼

Dorado V6 6.1.2 — Supports HDDs.
▲ Release:2021.12.31
2026/12/31 EOM ▼

Dorado V7 — Supports Flash Ever feature, Support S3 Object storage
▲ Release:2022.12.31
2027/12/31 EOM ▼

Converged Storage

OceanStor 5.7.6 — Front-end interconnect I/O modules
Release:2019.12.31
2024/12/31 EOM ▼

OceanStor 5.7.7 — Supports NVMe enclosures with disk and controller integration
▲ Release:2020.12.31
2025/12/31 EOM ▼

OceanStor 6.0.0 — Next-gen OceanStor series based on the Dorado V6 software platform, A-A architecture
▲ Release:2021.12.31
2026/12/31 EOM ▼

OceanStor 6.x — Consolidate into one architecture with Dorado.
▲ Release:2022.12.31
2027/12/31 EOM ▼

The roadmap is for reference only and may be adjusted according to market requirements.

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Huawei Professional Service Team

- ✓ 39 HCIAs, HCIPs, HCIEs at Certified Services Partners (CSP) in South Africa
- ✓ 8 HCIAs, HCIPs, HCIEs at Certified Services Partners (CSP) in North Africa

Services at your hand		One-Stop Services		Professional service teams		Strategic service cooperation	
1	Shenzhen HQ	**5**	Stages	**100+**	Experts for consulting	**200+**	Value-added service partners
4	Regional COEs	**8+**	Service domains	**26000+**	Professional service teams	**2000+**	Partners
32	Regional technical support centers	**10+**	Expert groups	**300+**	Professional service supervisors	**4**	Training centers
140+	Cities covered	**1**	Service contract	**300+**	Spare parts center	**1700+**	Professional lecturers

Consultation ➤ **Design** ➤ **Implementation** ➤ **O&M** ➤ **Improvement**

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Key Take-Aways

- **R&D Capabilities:**

  1) All Self-developed, Not OEM

  Best compatibility and performance, Industry leading Computing Reliability and 99.9999% reliability Storage

  2) Long-term evolution guarantee:

  Huawei continuous strategic investment in ICT ,10000+ R&D Engineers, 7 Global R&D centers.

  3) Huawei has rich experience in Telecom Industry, understand Carrier demand better and we understand MTN MUNIC strategy very well.

- **Services:**

  ✓ End-to-End global service guarantee Fastest Response and High-Quality Maintenance & Support.

- **Delivery:**

  ✓ Stable supply, supporting MTN digital transformation;

  ✓ Quick response due to plentiful local resource to cover MTN OPCOs

- **Global Customers:**

  ✓ Currently, Short list members of **83%** global tier-1 carriers

Thank you.

把数字世界带入每个人、每个家庭、每个组织,构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.
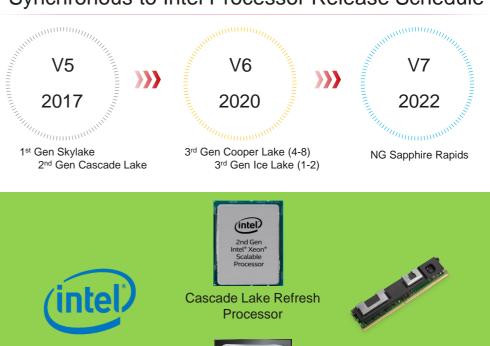
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Strategic Partnership with Intel, Continuously Providing the Latest Technology and Products

20-Year Partnership

Total **5M+** Units Shipped from 2012 to 2020

2001

In 2001, signed a strategic partnership.

......

2016

Joint launch of KunLun, 32-socket mission-critical server.

Set up a joint innovation computing center in Hangzhou.

2017

Jointly hold CTO summits to start strategic cooperation in AI, edge computing, and cloud computing.

2019

Jointly released the second-generation Intel Xeon scalable processor-based FusionServer Pro intelligent server.

2020

FusionServer Pro intelligent server based on Intel 3rd Generation Xeon Scalable Processor Cooper Lake.

Synchronous to Intel Processor Release Schedule

V5 2017	V6 2020	V7 2022
1st Gen Skylake 2nd Gen Cascade Lake	3rd Gen Cooper Lake (4-8) 3rd Gen Ice Lake (1-2)	NG Sapphire Rapids

Intel's latest technologies and products

Cascade Lake Refresh Processor

Intel® Optane™ Persistent Memory

3rd Generation Intel ® Xeon ® Scalable Processor

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VMware Continues Compatibility Certification & Technical Support

✓ Partners such as **VMware**, **SUSE** and **Ubuntu** will continue to work with Huawei to provide compatibility certification and technical support for **FusionServer Pro** servers.

On May 23, 2020, VMware announced that Huawei FusionServer Pro 2288H V5 and other servers have passed the latest VMware vSphere 7.0 compatibility certification.

*VMware vSphere, vSAN, and vCenter will continue to provide compatibility certification and technical support for Huawei FusionServer Pro servers.

The latest 2488H V6 (Copper Lake) has been certified

Partner	Model	CPU	Type				
Huawei Technologies Co., Ltd.	2488 V5	Intel Xeon Platinum 8200 (Cascade-Lake-SP) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	2488H V5	Intel Xeon Gold 6100/5100, Silver 4100, Bronze 3100 (Skylake-SP) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	2488H V5	Intel Xeon Gold 6200/5200 (Cascade-Lake-SP/Refresh) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	2488H V5	Intel Xeon Platinum 8100 (Skylake-SP) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	2488H V5	Intel Xeon Platinum 8200 (Cascade-Lake-SP) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	2488H V6	Intel Xeon Gold 6300/5300 (Cooper-Lake-SP) Series	ESXi	7.0 U1			
Huawei Technologies Co., Ltd.	2488H V6	Intel Xeon Platinum 8300 (Cooper-Lake-SP) Series	ESXi	7.0 U1			
Huawei Technologies Co., Ltd.	5288 V5	Intel Xeon Gold 6100/5100, Silver 4100, Bronze 3100 (Skylake-SP) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	5288 V5	Intel Xeon Gold 6200/5200 (Cascade-Lake-SP/Refresh) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	5288 V5	Intel Xeon Platinum 8100 (Skylake-SP) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	5288 V5	Intel Xeon Platinum 8200 (Cascade-Lake-SP) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	5288 V5	Intel Xeon Silver 4200, Bronze 3200 (Cascade-Lake-SP/Refresh) Series	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2
Huawei Technologies Co., Ltd.	5288X V5	Intel Xeon Gold 6200/5200 (Cascade-Lake-	ESXi	⊞ 7.0 U1	7.0	6.7 U3	6.7 U2

https://www.vmware.com/resources/compatibility/search.php?deviceCategory=server&details=1&partner=242&evcModes=19&page=1&display_interval=50&sortColumn=Partner&sortOrder=Asc

HUAWEI