Building All-Scenario Intelligent Computing Solutions

-- Computing Business Update

Date: July, 2020

HUAWEI

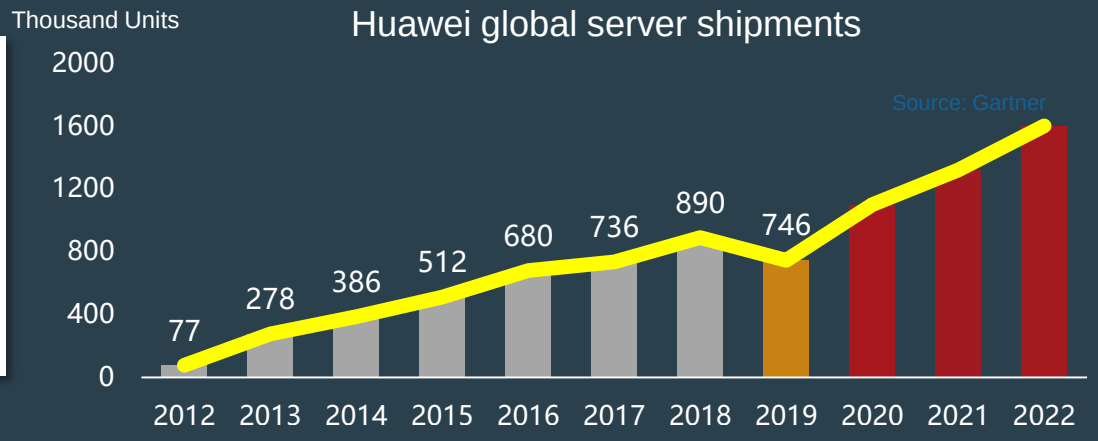
FUTUREWEI Technologies

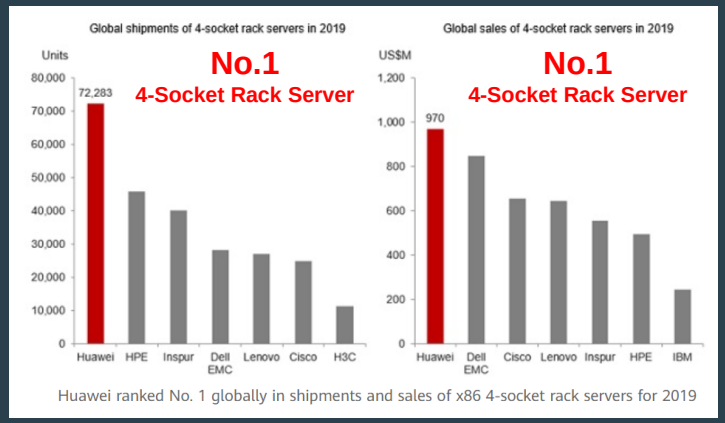
Continuous Innovation with Intel

- ✓ 19 Years Strategic Partnership since 2001, over 4.31M Units Shipped
- ✓ FusionServer/Pro X86 Products Synchronous to Intel Processor Release Schedule

Total shipments

4.31M units





Huawei ranked No. 1 globally in shipments and sales of x86 4-socket rack servers for 2019

2001

In 2001, strategic partnership Signed, and Huawei started server R&D.

…

High-level interaction for a long time, continuing to jointly release new products and solutions

2016

2016 HCC Conference, jointly released the RSD server

2016, jointly released KunLun, the 32-socket mission critical server

2016, jointly built the innovation computing center in Hangzhou

2017

2017, Jointly held CTO technical forums about AI, edge computing, and cloud computing

2017, HPC innovation MoU Signed

2019

2019, jointly released the FusionServer Pro server based on 2nd generation Intel Xeon processors

2020

June 2020, AI-Optimized Cooper Lake Processor based Server 2488H V6 Launched

More Coming

2021 …

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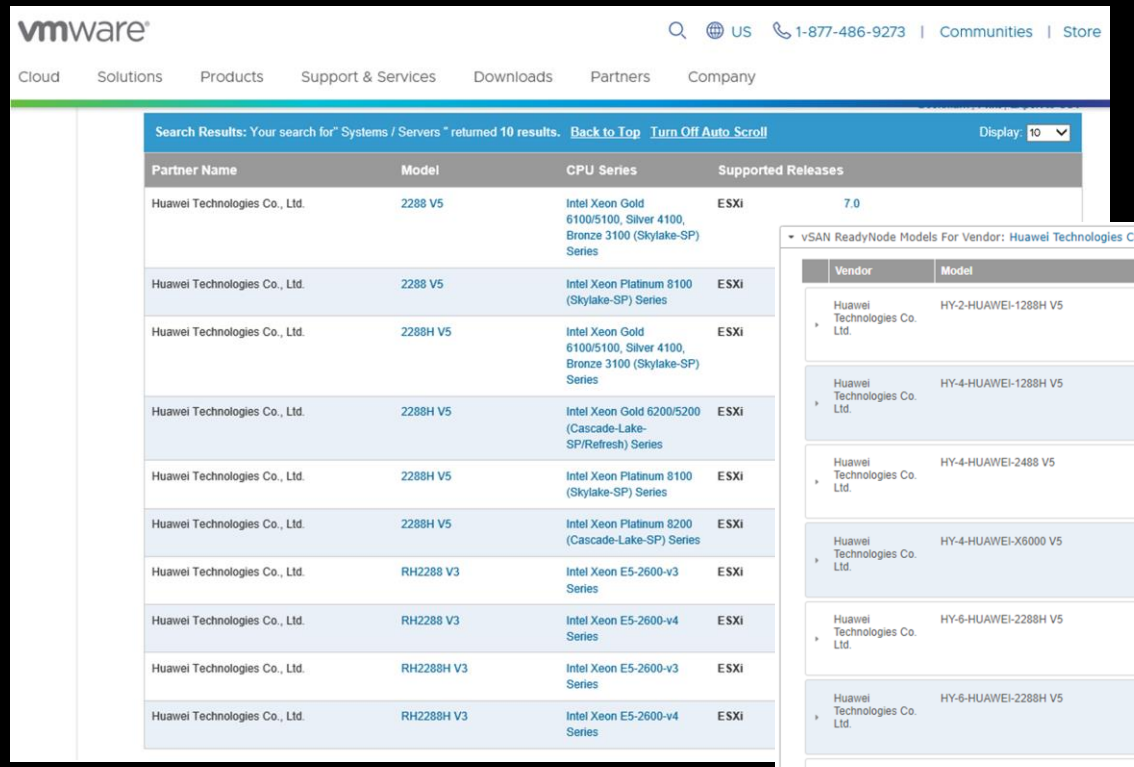
Partners Will Continue to Provide Compatibility Certification and Technical Support for Huawei Servers

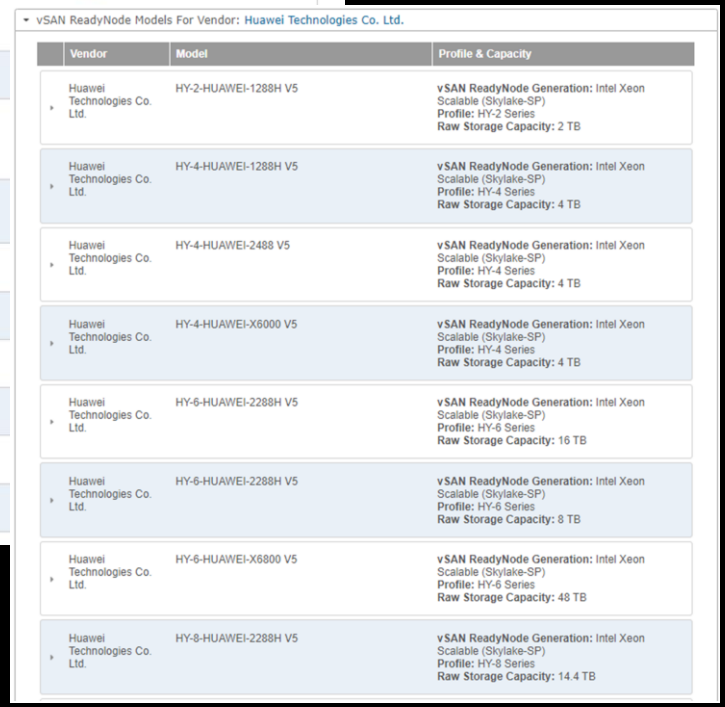
- ✓ Partners such as **VMware**, **SUSE**, **CentOS**, and **Ubuntu** will continue to work with Huawei to provide compatibility certification and technical support for **FusionServer Pro** servers.

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.

Certification results are available on the VMware official website:
https://www.vmware.com/resources/compatibility/search.php?deviceCategory=server&details=1&partner=242&releases=448&keyword=2288&page=1&display_interval=10&sortColumn=Partner&sortOrder=Asc

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





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Leading Big Data Solutions with SAP

✓ Our Strategic Partner **SAP** will continue provide compatibility certification and technical support for **FusionServer Pro** servers.

SAP® Certified
Hardware for SAP HANA®

Scale-Up Single-node Solution

KunLun 9008 V5 (2P/4P/6P/8P)

2488H V5 (2P/4P) / E9000 V5 (2P/4P)

2288H V5 (2P)

192 GB … 1.5 TB 3 TB 4.5 TB 6 TB 9 TB 12 TB

2S (56 cores)

4S (112 cores)

6S (168 cores) / 8S (224 cores)

Scale-Out Cluster Solution

KunLun 9008 V5 for S/4HANA (8P)

KunLun 9008 V5 for BW/4HANA (4P/8P)

2488H V5/E9000 V5 (4P)

3 TB … 3 TB 48 TB (16 nodes) … 6 TB 96 TB (16 nodes) … 12 TB 60 TB* (4+1 nodes)

4S (112 cores)

8S (224 cores)

8S (224 cores)

* S/4HANA Scale-out maximum 4+1 nodes, single node minimum size is 6 TB and maximum size is 12 TB

HANA TDI Solution
Support larger memory with Intel PMEM

KunLun 9008 V5 (2P/4P/6P/8P)

2488H V5 (2P/4P)

2288H V5 (2P)

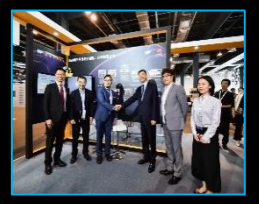
1920 GB … 6 TB **9** TB 12TB 15 TB 18 TB 22.5 TB 24 TB

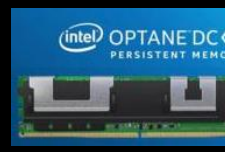
2S (56 cores)

4S (112 cores)

6S (168 cores)

8S (224 cores)





512GB/DIMM max
3TB/CPU max

2012 SAP's first global technology partner in China

2013 Jointly launched the first server for SAP HANA: Tecal RH5885 V2

2014 Strategic alliance partnership & launch of FusionCube for SAP HANA solution at CeBIT

2015 MOU on IoT and joint innovation at CeBIT

2016 **Top-Class Sponsor at SAP SAPPHIRE in Orlando**

2017 SAP HANA Innovation Award at SAP SAPPHIRE, Orlando

2018 SAP as Diamond Sponsor & Key Partner at HUAWEI CONNECT 2018

2019 Introduction of PMem-based Large Capacity HANA solution

2020 … Continuous certification and technical support

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Continuous Evolution Roadmap Synchronous to Intel Release Schedule

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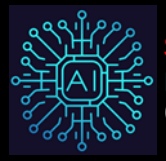
Monetize the New "Oil" with Real-Time Analytics, HPC & AI

Market Opportunities

$717B Smart Cities Market by 2023 (M&M)

$484B Global MaaS Market Value by 2024 (MRFR)



$391B Global AI Market Size by 2025 (Grand View Research)

$103B Big Data Analytics Market by 2027 (Wikibon)

6.9M Units of Autonomous Driving Vehicles by 2030 (M&M)

Data Generated & Projected

40 ZettaBytes in 2020
175 ZettaBytes in 2025
80 ZettaBytes by IoT Devices in 2025(IDC)

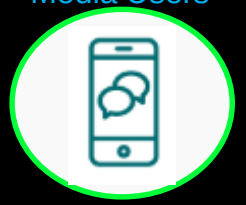
2.5 Exabytes data generated everyday by Internet users by 2020 (iorgforum.org)

Nearly 30% of the data to be processed in real-time in 2025 (IDC)

97.2% of organizations are investing in big data and AI

63% Americans would give up cars for UBER & Lyft (investors.com)

Digital around the World in 2019 (source: most datareportal.com)

World's Population	Unique Mobile Users	Internet Users	Active Social Media Users	Mobile Social Media Users	Facebook Active Users	Active IoT Devices	Estimated Data / AD
							
7.676 Billion	5.112 Billion	4.388 Billion	3.484 Billion	3.256 Billion	2.3 Billion	9.5 Billion	4TB/day
Urbanization	Penetration	Penetration	Penetration	Penetration	Generated a	Generated a	3000X of
56%	67%	57%	45%	42%	Lot of data	Lot of data	People

Source: Datareportal.com, IDC, EMC, UN, Data Never Sleeps, Global Web Index, New Vantage, IDTechEx, Investors.com, MRFR Analysis(MaaS), MarketsandMarkets(AD), Grand View Research(Smart Cities, AI), IoT Analytics

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Real-Time Interactive Network Usage Analytics & Prediction

A Multi-Service Network Operator in USA

- 25M subscribers
- 500,000 LTE towers
- 10,000 WiFi APs added every month to offload LTE
- 1TB Network Usage log data Per Day in different formats

? Where to place the WiFi Access Points to offload LTE traffic most effectively & efficiently?

Use GPU-Accelerated Data Query, Visualization & AI

- Real-time & Interactive Network Usage Analytics to any detail, any location/area and Any time frame
- Deep-Learning based AI to Predict Network Usage in the future to any detail
- ✓ With 500M Rows of Network Usage Logs Data, and 10s-100s Billions Rows of data could be analyzed in Real-Time

GPU-Accelerated Data Query & Analystics & Visualization in Real Time, 500M Rows of Data

Predictive Network Usage Analytics & Visualization in Real-Time

https://www.youtube.com/watch?v=VgjP0ZcEu7E&feature=youtu.be, Video Source: Nvidia & OmniSCI

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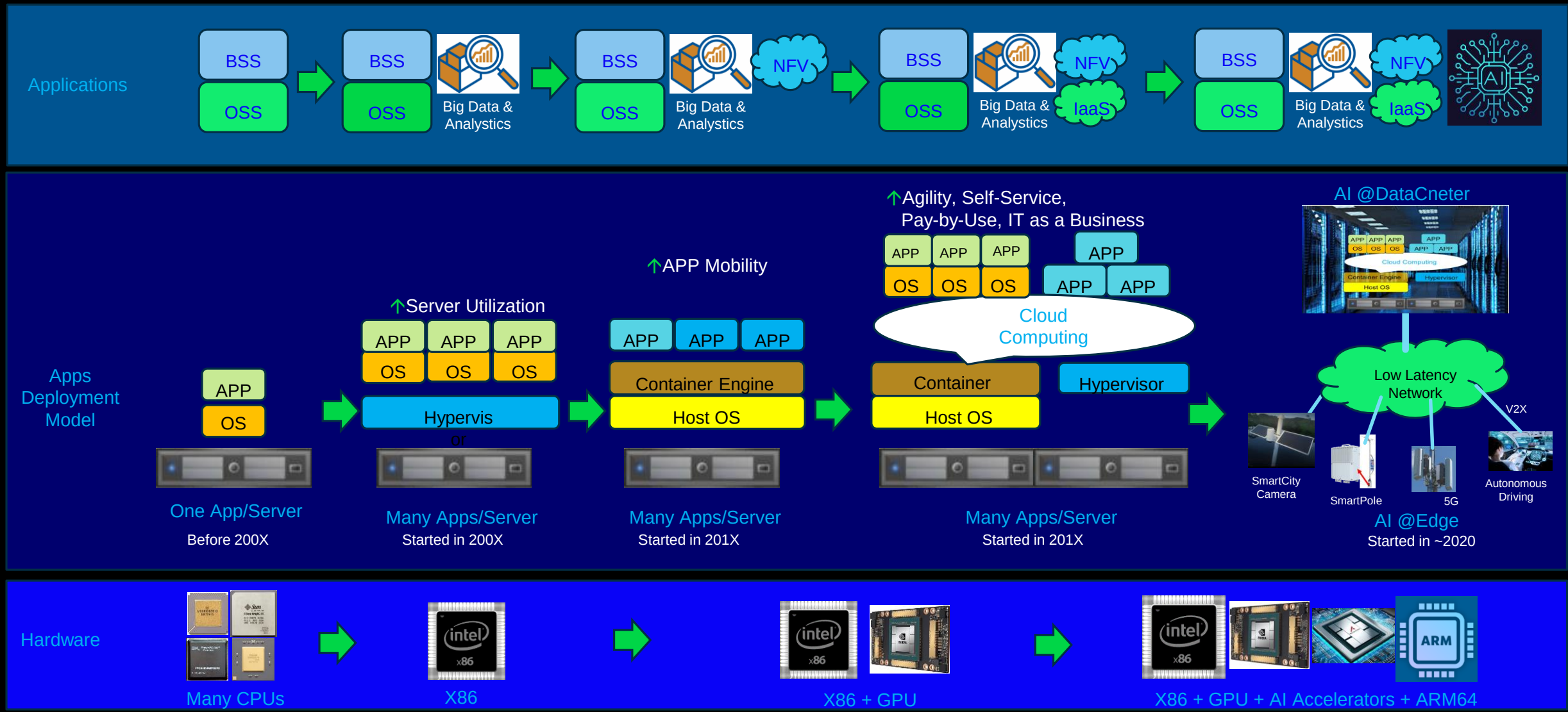
Telco Computing Evolution: Cloud, 5G, AI, Intelligent Edge



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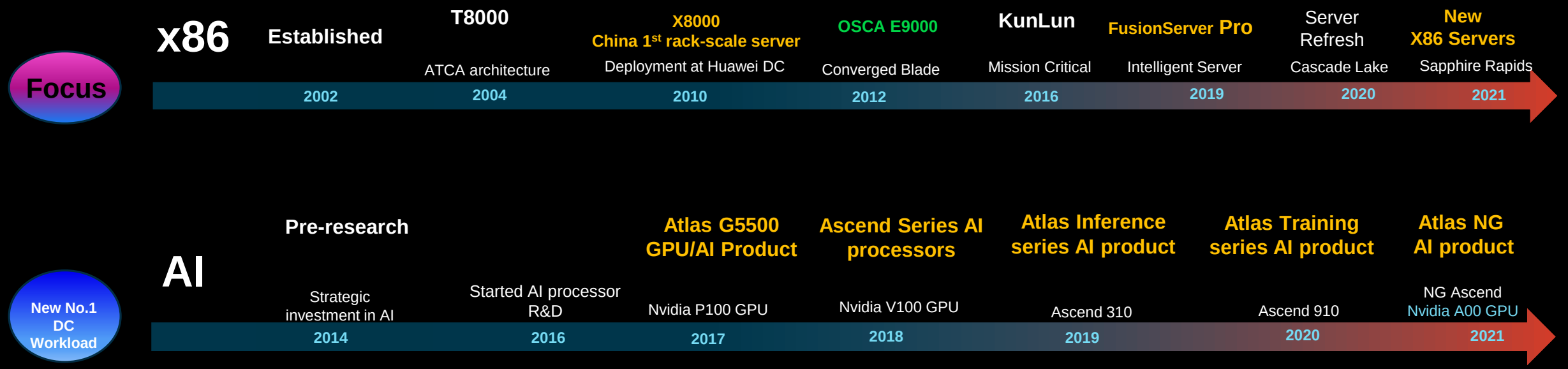
The Best Platform for the Most Suitable Applications

- ✓ No One Fits All: New Applications Need Optimized Hardware Platform for the Best Efficiency & TCO
- ✓ FusionServer/Pro X86 Products Synchronous to Intel Processor Release Schedule
- ✓ **Ai Servers with Nvidia GPU and In-House Developed Ascend AI SoC**



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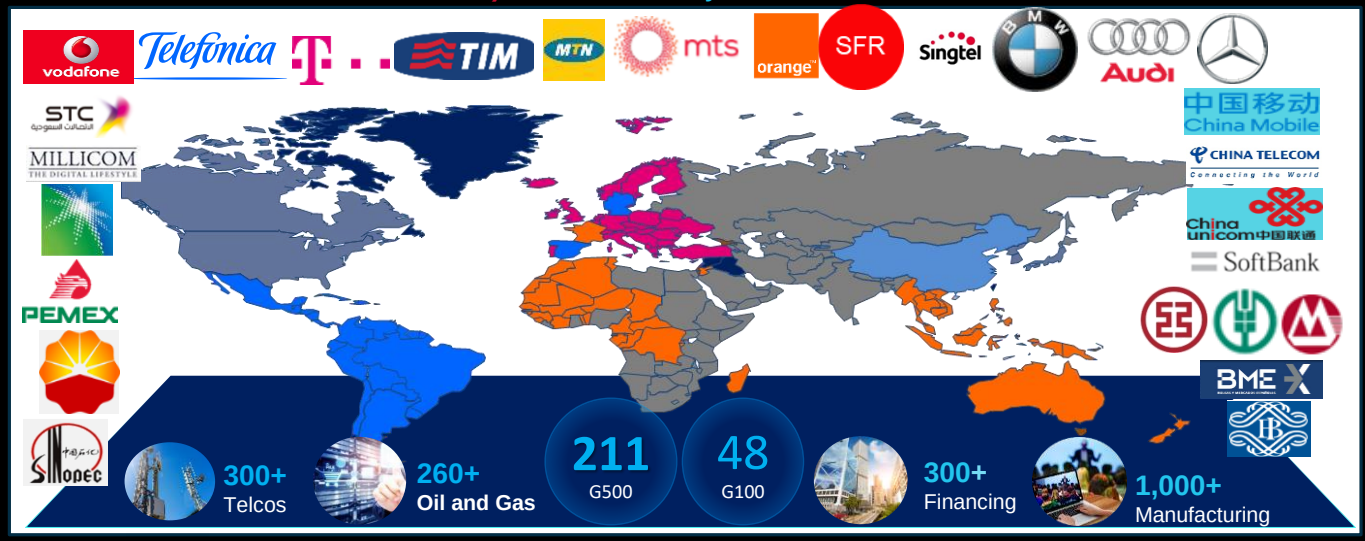
What Customers Considered When Choosing Huawei Computing

- ✓ **Quality Products**
  - DNA of Telecomm Products, E2E Quality Control
- ✓ **Innovative Product Features**
  - Enabled by Self-Developed ASICs for Management, Perf, Deployment & Diagnosis
- ✓ **Knowledgeable & Experienced Team**
  - Both Hardware & Software, Applications & Operations
- ✓ **Long-Term Commitment & Support**
  - Both spare Parts & Software
- ✓ **Secure & Reliable Supply Chain**
  - Quickly Delivery, Security & Source Quality Control
- ✓ **Local Support**
  - Quick response & Easy to reach
- ✓ **Competitive Pricing for TCO**
  - Not Only CAPEX, but also OPEX
- ✓ **Partnership & Ecosystem**
  - Strategic Partnership with key players, X86 ecosystem
- ✓ **Rich Product Portfolio**
  - No One Fits All, Rich Models to choose
- ✓ **Consolidation of Suppliers**
  - The same supplier for CT & IT, fewer suppliers to Manage

Serves **10,000+** industry customers worldwide



Key Partners & Ecosystem

HUAWEI

Rich Portfolio to Meet Your Every Intelligent Computing Need

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

Mission Critical

KunLun 9008 V5

Full Liquid Cooling **Solution**

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

1288H V5

Balanced

2288H V5

Storage-intensive

New

2298 V5

5288 V5

Compute-intensive

New

2488H V6

Mission critical

5885H V5

High-Density Servers

2U 4-node

X6000

Compute-intensive

XH321 V5

XH321L V5

4U 4-node

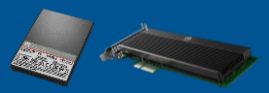
X6800

Storage-intensive

XH628 V5

Intelligent Acceleration Engine

NVMe SSD

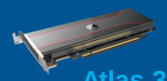


ES3000 V5

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

Nvidia V100 GPU shipping
Ampere GPU coming

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Our X86 Flagship FusionServer Pro Products: RH2288 & E9000

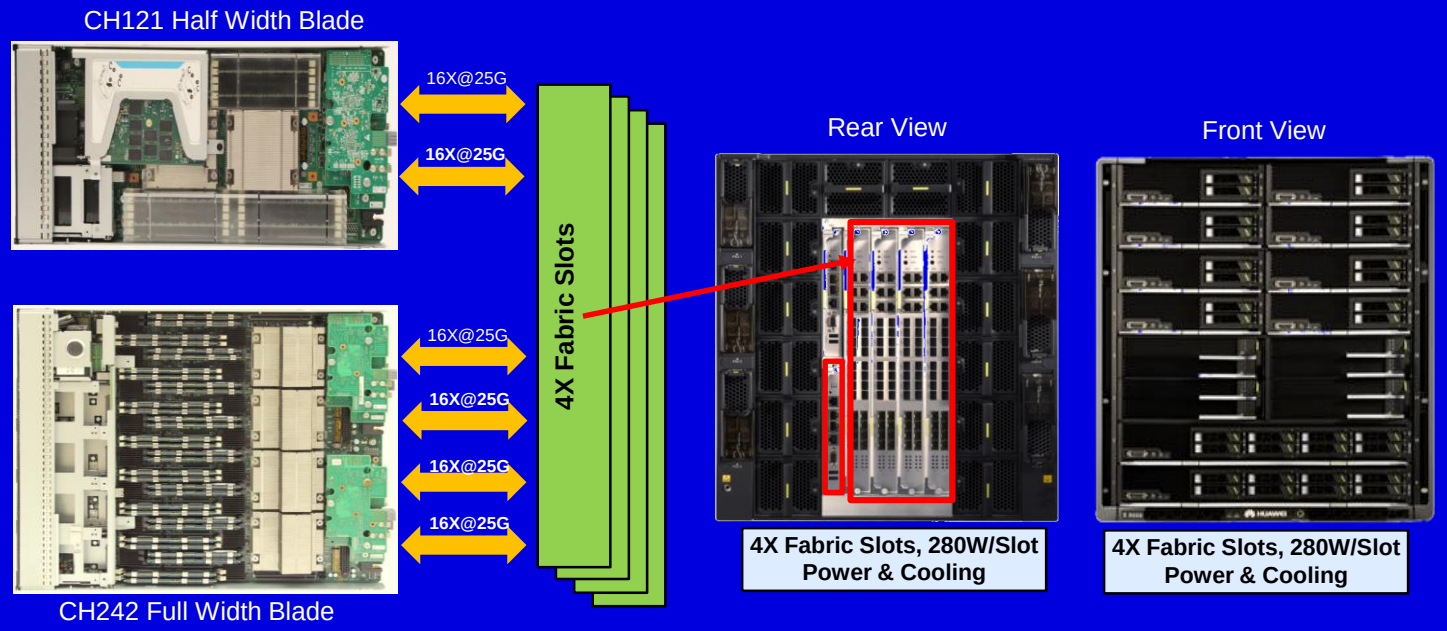
RH2288H V5: 2U Rack Server

Key Features:

- ✓ 1-2 Sockets in 2U, any TDP X86 CPU;
- ✓ 24x-DDR4-2933 Memory
- ✓ 8x External PCIe Gen3 Expansion Slots
- ✓ 2x Internal PCIe Gen 3 Expansion Slots
- ✓ 2x10GE+2xGE LOM
- ✓ Max. 20x 3.5” or 31x 2.5” SATA/SAS HDDs
- ✓ 4/8/12/24/28 2.5” NVMe SSD
- ✓ 1+1 Redundant 96% efficiency PSUs
- ✓ 3+1 Redundant Cooling Fans

https://support-it.huawei.com/server-3D/res/server/2288hv5/index.html?lang=en

E9000 Scalable, Reliable & Converged Blade Server



Feature	Cisco UCS	Huawei E9000	HPE S-12000
Max Number of Blades / Chassis	8	16	12
25G/56G SerDes Backplane for 100/200GE	NO	YES	Likely
8x 4-Socket Xeon SP + 48-DIMM in one chassis	NOT	YES	NOT
900W/Slot Powering & Cooling Scalable to V6/V7	High Risk	YES	High Risk
Switch Slot Power & Cooling Capability for 100GE & 200GE Evolution	No Built-in SW, <100W	Yes, > 280W for 100/200GE	150W (E), high Risk for 100GE
Physically isolated Network Planes for Telco	NO	YES, max 3-Plane	YES, up to 3-Planes
NVMe Storage Blade / GPU Blade	NO	YES, CH225/CH221	NO
Single Chassis Deployment	NO, must w/ Fabric Inter	YES	NO
Native FC Support (FCOE is dead)	NO	YES	YES

https://support-it.huawei.com/server-3D/res/server/e9000/index.html?lang=en

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E9000: Better Utilize Your Rack Power Budget w/ Lower Cost

Average Data Center Rack Power Density Going Up

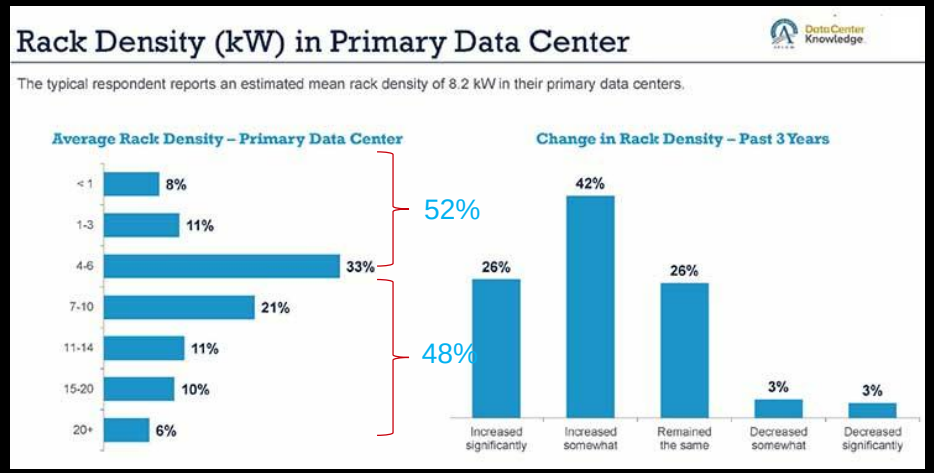
- 8.2kW/Rack in 2019
- 7.3kW/Rack in 2018
- 7.2kW/Rack in 2017
- ~68% of respondents reported that rack density has increased over the past three years,
- ~26% saying the increase was "significant."
- 1kW/U is the current trend for HPC/AI servers

Source: AFCOM 2020 State of the Data Center report

✓ Driven by AI Workloads & X86 CPU TDP growth

AFCOM DC Power Density Definition

- Low: <=4kW/Rack
- Medium: 5kW-8kW/Rack
- High: 8kW-15 kW/Rack
- Extreme: >=16kW/Rack



Huawei E9000

- 12U-16 Blades
- 9KW Max Capability

HPE S-12000

- 10U-12 Blades
- 7.5KW Max Capability

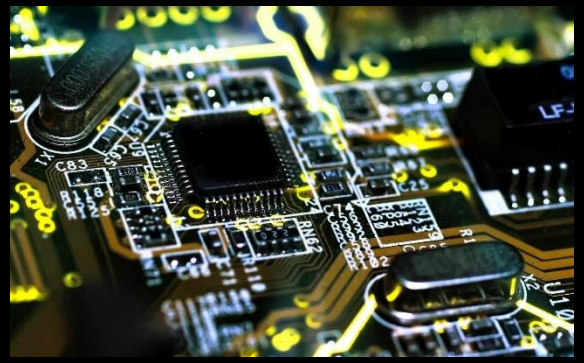
Rack Power Density	HPE S12000	Huawei E9000	E9000 Advantages
<=7.5KW/Rack	1 chassis /rack	1 chassis / rack	Higher energy efficiency
7.5KW-9KW/Rack	2 chassis /rack	1 chassis /rack	1 chassis saving
9KW-15KW/Rack	2 chassis / rack	2 chassis /rack	Higher energy efficiency
15KW-18KW/Rack	3 chassis / rack	2 chassis / rack	1 chassis saving

https://datacenterfrontier.com/rack-density-keeps-rising-at-enterprise-data-centers/

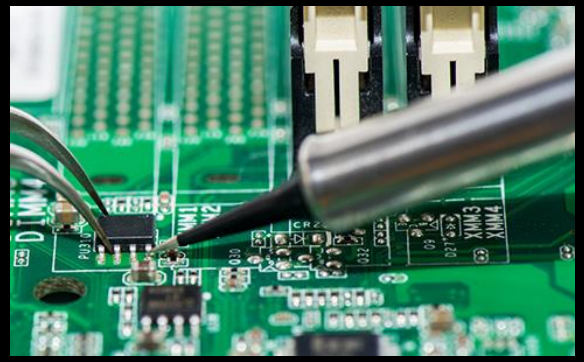
Quality Product is our DNA from Telecom Products

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

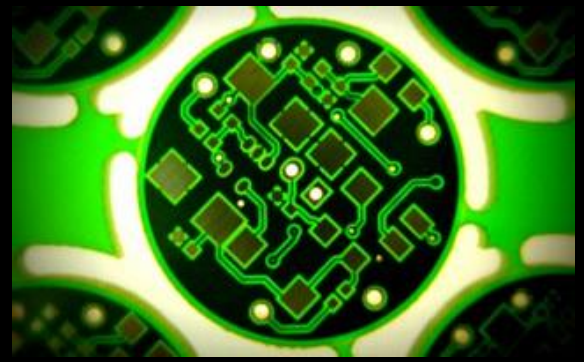
Component Selection and Process Technique



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

Accelerating X86 Server Performance

ES3000 series intelligent SSDs

- Optimal performance: PCIe Gen4 1.66M Random read IOPS, 7.0GB/s sequential read bandwidth
- All-scenarios: low latency, high performance, large capacity
- Service-aware: intelligent multi-stream, SR-IOV, atomic write

Performance 100% up

Service life 20% longer

IN200/300 series intelligent NICs

- Converged: 10GE/25GE/40GE/100GE, 8G/16G/32G FC
- Accelerated: RoCE
- Reliable: industry unique to support firmware upgrade without service interruption

CPU offload 15%

Latency 30% less

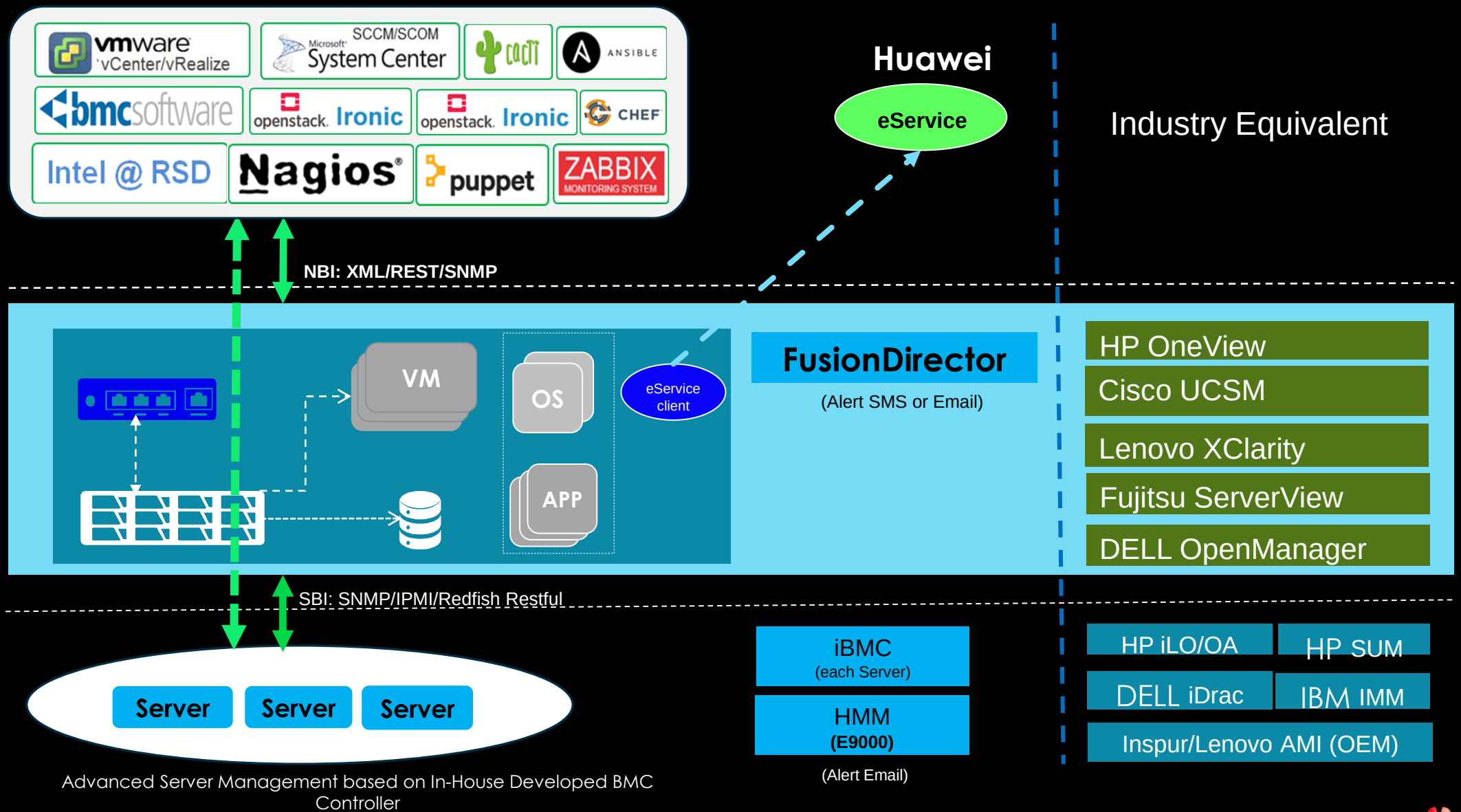
Atlas 300 AI accelerator card

- Powerful computing: 64 TOPS of INT8
- High-density video parsing: 64-channel HD video real-time analytics

CPU offload 15%

Performance 64-Ch HD

Open & Standard-Based Server Management



Advanced Server Management based on In-House Developed BMC Controller

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FusionDirector: 5 Intelligent Management Features Reduce OPEX

Intelligent Asset Management

Server model, configuration, inventorying, and retirement
Inventorying in seconds, improving space utilization by 10%+

Intelligent Deployment Management

Automatic deployment in data center cabinets
10x device rollout efficiency

FusionDirector

Intelligent Management Engine

Intelligent Version Management

Automatic version matching, one-click update
Preparation done in seconds, reducing update steps from 20 to 3

Intelligent Fault Management

Fault prewarning, diagnosis, and locating
7–30 days in advance for fault prediction,
93% fault locating accuracy

Intelligent Energy Efficiency Management

Server DEMT, cabinet power capping, and data center linked control
10% server energy saving, 20% higher deployment density

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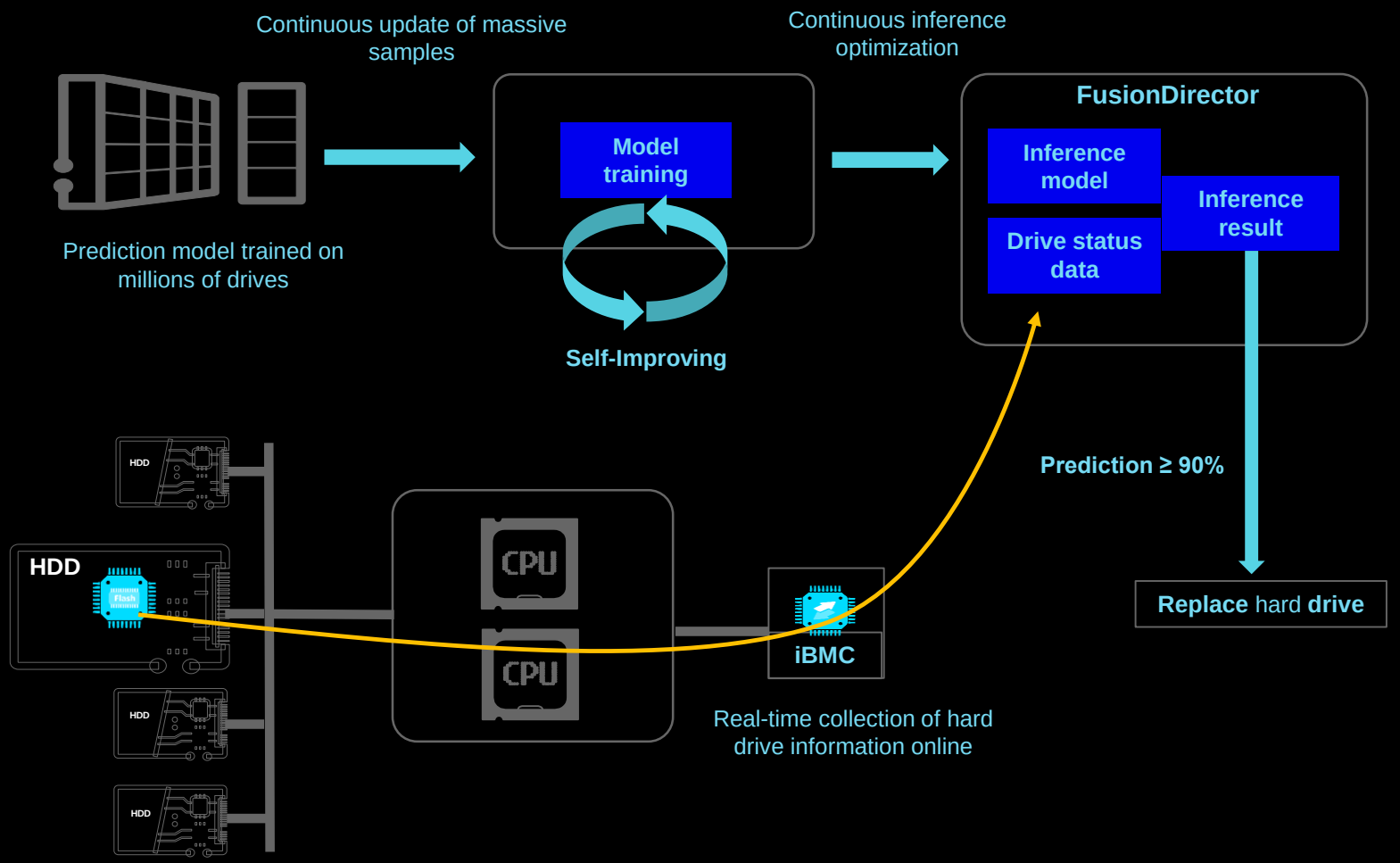
Intelligent Fault Prediction: Predicts Risky Hard Drives 7–30 Days in Advance



Real-time — Real-time collection of drive SMART information for model analysis on the cloud

Accurate — Prediction Accuracy ≥ 90%

Reliable — Lower multi-drive simultaneous failure rate

Efficient — 90% less manpower for fault locating

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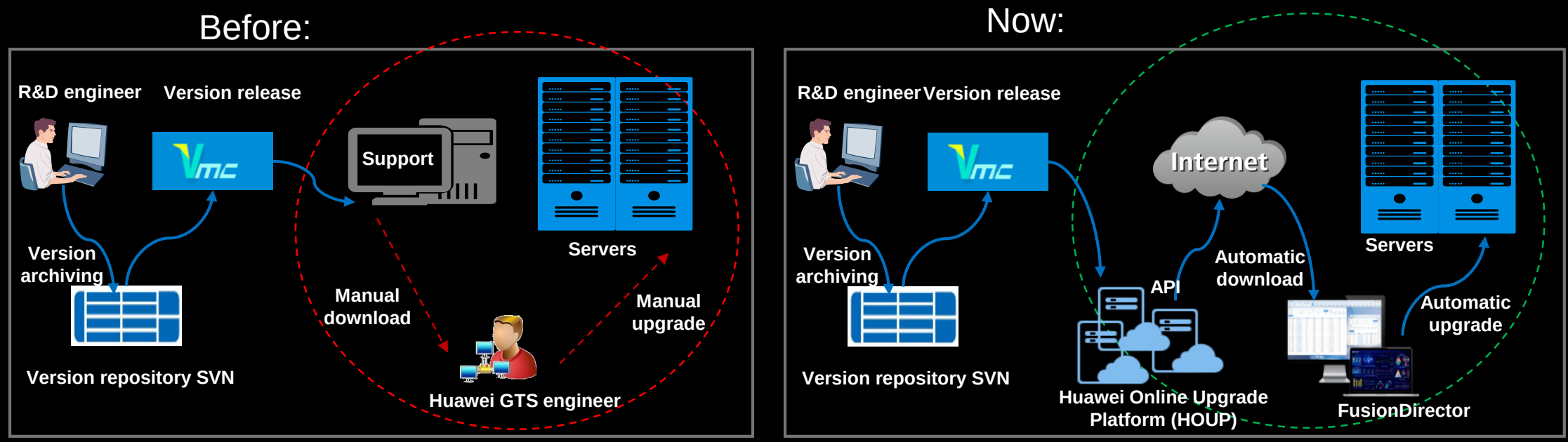
Intelligent Version Management: Automatic Upgrade Of Device Software



- Automatic download: Automatically detects the firmware and drivers of servers of different models and manages firmware versions comprehensively
- O&M engineers do not need to manually download, upload, or upgrade firmware
- Independent out-of-band upgrade, without occupying service bandwidth

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Powerful AI Computing Platform to Enable Intelligent Transformation

Intelligent Edge Solution

Atlas intelligent edge platform

Industry SDK/Container engine/Basic service repository

Data Center Solution

Atlas distributed training platform

Cluster management/Model management/Data preprocessing

Framework MindSpore /TensorFlow /PyTorch /etc.

Chip Enablement CANN

Common components

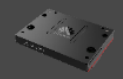
AXE toolchain/Security subsystem/Unified O&M system

Device

Intelligent device chips
2–4 TOPS INT8

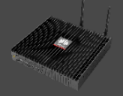
Smartphones
< 2 TOPS INT8

Edge



Atlas 200
16 TOPS INT8

Atlas 300
64 TOPS INT8



Atlas 500
16 TOPS INT8

Atlas 500 Pro
256 TOPS INT8

Cloud

Atlas 800
512 TOPS INT8

Atlas 800
2 PFLOPS FP16

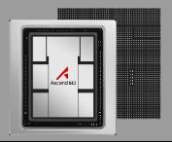
Atlas 300T
256 TFLOPS FP16

Atlas 900
256–1024 PFLOPS FP16

Da Vinci architecture

Ascend 310

Ascend 910



300+ Partners

100+ Solutions

Safe-city

Manufacturing

Transportation

Energy

Finance

Internet

Telcos

HUAWEI

Huawei Server Helps Spain to Build 5G Core Network (2019)

The Vodafone Group, the world's second largest mobile communications company, is a multinational mobile phone operator. Headquartered in Newbury, Berkshire, UK and Düsseldorf, Germany. It is one of the world's largest mobile operators, with a network covering 26 countries and providing network services with its partners in 31 other countries. Vodafone has the world's most complete enterprise information management system and customer service system, and has a strong advantage in increasing customers, providing services and creating value. Vodafone's global strategy is to cover voice, data, Internet access services and provide customer satisfaction. Vodafone Group has more than 100,000 employees worldwide

Challenges

- **Spain's VDF 5G subnet is an important position for VDF Group's 5G strategy. It needs to rapidly deploy 5G networks and quickly occupy the 5G market.**
- **The deployment scale is large and involves many business modules.**

Solution

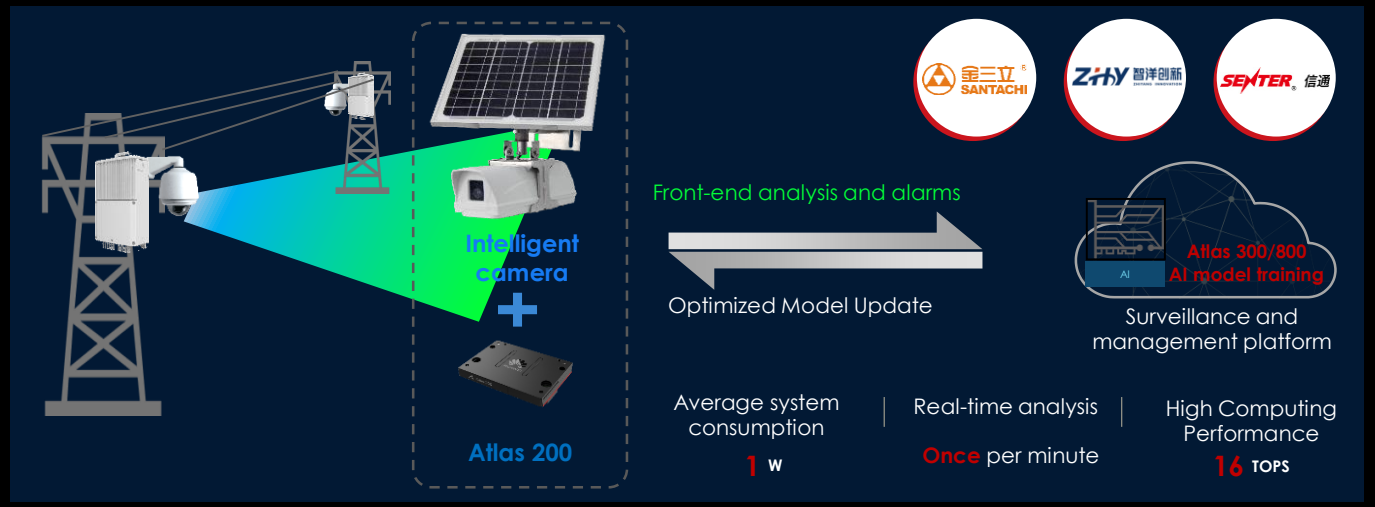
- **Huawei provides 2S FusionServer Pro 2288H V5 rack servers and E9000 blade servers (2S CH121 V5 blade nodes).**
- **Huawei's next-generation V5 server with Intel Cascade CPU provides a stronger computing power, while supporting GPU cards to meet customers' desire to deploy GPU heterogeneous computing power.**
- **The eSight management system provides unified intelligent operation and maintenance of servers, storage, and networks.**

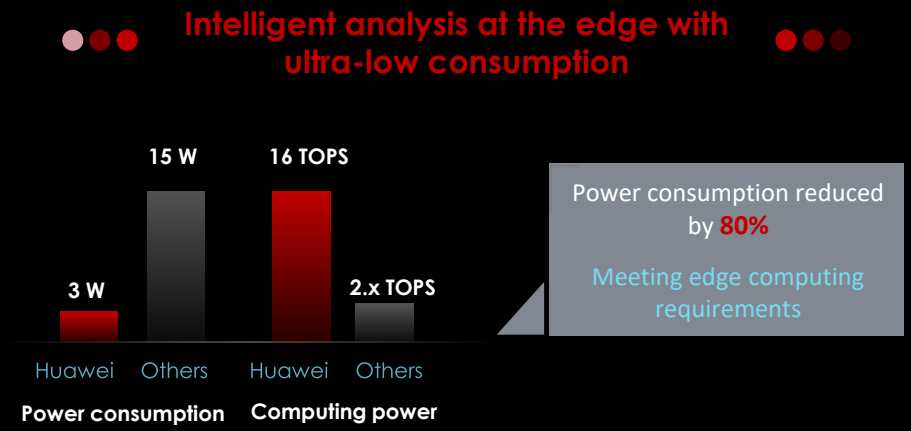
Customer Benefits

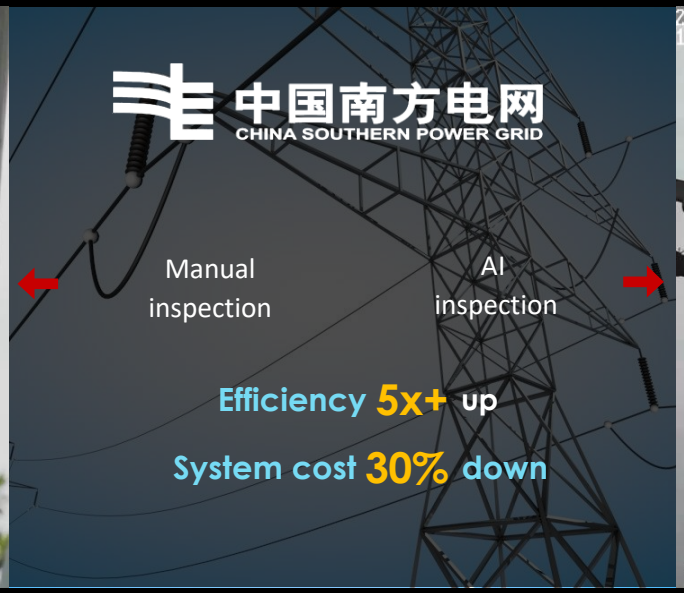
- **The modular design of the blade Server greatly simplifies maintenance and allows for flexible expansion.**
- **Server with heterogeneous computing capabilities, saving customers' investment.**
- **eSight enhances the O&M capabilities of customer and unified management of IT infrastructure such as servers, storage, and networks to improve customer operation and maintenance efficiency.**

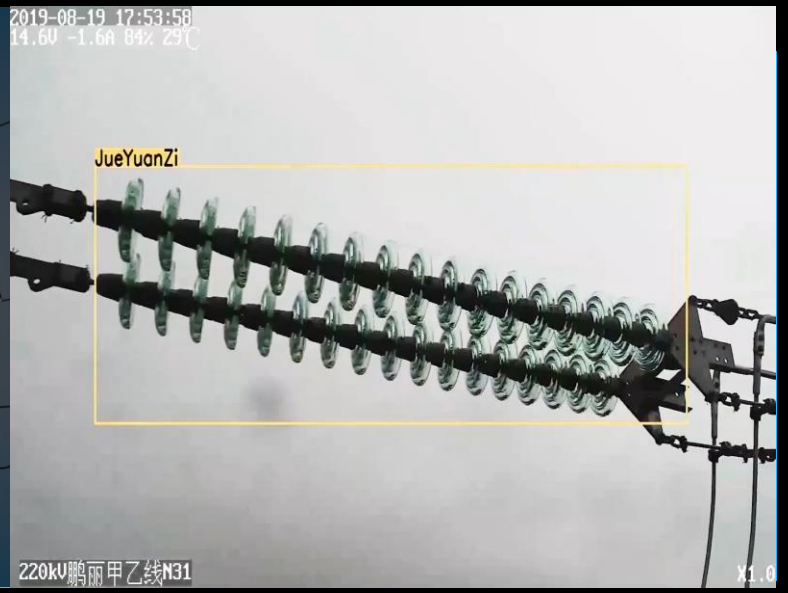
HUAWEI

Power Grid: Industry's 1st Intelligent Unattended Inspection Solution, 5x Efficiency









Take-Aways

- ✓ Big Data Analytics, Infrastructure as a Service, AI, Intelligent Video Analysis and Autonomous Driving will be ubiquitous in the new era. Telco must be ready to support these new workloads to keep competitive.
- ✓ In working with partners like Intel, VMware, SAP and Nvidia, Huawei has been offering a rich and innovative X86 and AI Product Portfolio, and is ready to support your needs for the transformation to the Era of Digital & AI.
- ✓ E9000 and 2288H V5 are Huawei's current mainstream server products, which meet the need of operator's mainstream computing scenarios. Compared with other vendors, it has great performance and reliability advantages
- ✓ Huawei Atlas AI series products span cloud and edge with choices of Nvidia GPUs or In-House Developed Ascend AI ASICs, and can provide customer the E2E solutions

Thank you