Building All-Scenario Intelligent Computing Solutions
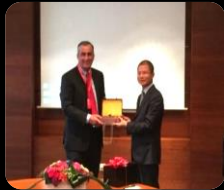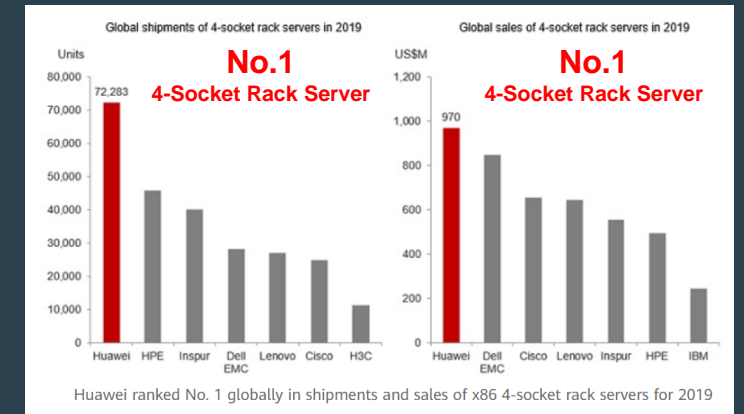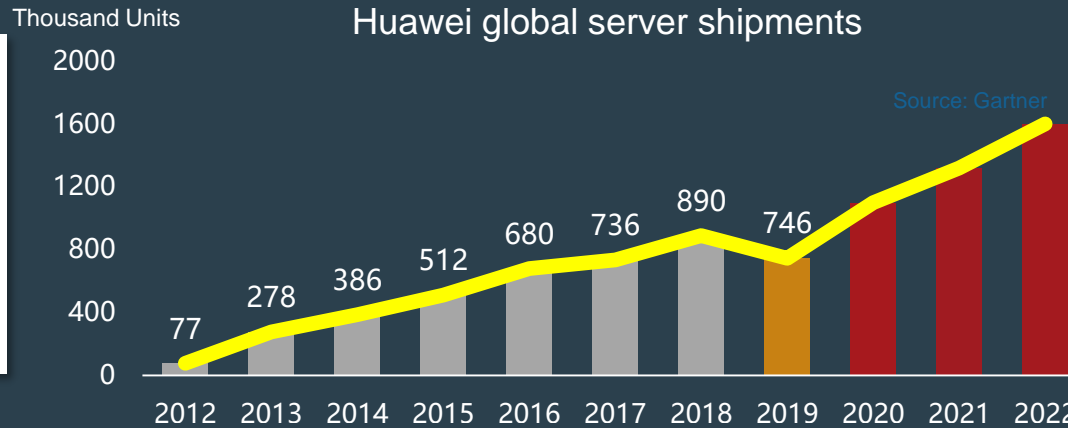
-- Computing Business Update

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 global server shipments

Thousand Units

Source: Gartner

Year	Value
2012	77
2013	278
2014	386
2015	512
2016	680
2017	736
2018	890
2019	746

Global shipments of 4-socket rack servers in 2019

No.1 4-Socket Rack Server

Units — 72,283 (Huawei)
Huawei, HPE, Inspur, Dell EMC, Lenovo, Cisco, H3C

Global sales of 4-socket rack servers in 2019

No.1 4-Socket Rack Server

US$M — 970 (Huawei)
Huawei, Dell EMC, Cisco, Lenovo, Inspur, HPE, IBM

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
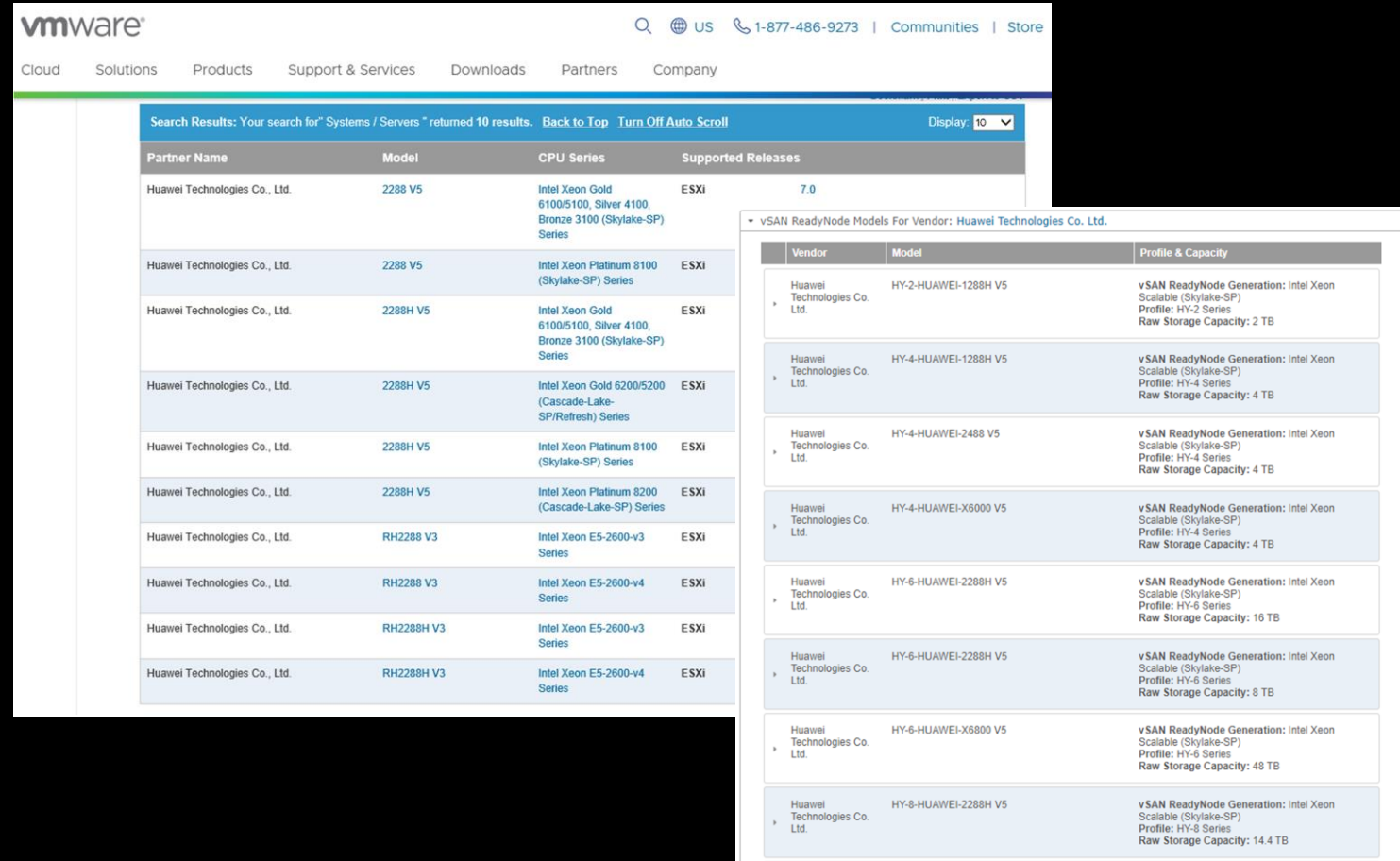
More Coming

2021
…

2

HUAWEI

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.

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®

intel OPTANE
PERSISTENT MEMORY

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)

60 TB*
(4+1 nodes)

96 TB
(16 nodes)

48 TB
(16 nodes)

| 3 TB | ... | 3 TB | ... | 6 TB | ... | 12 TB |

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)

Intel OPTANE DC
PERSISTENT MEMORY

512GB/DIMM max
3TB/CPU max

2288H V5
2488H V5
KunLun 9008 V5
CH121 V5
CH242 V5

https://www.sap.com/dmc/exp/2014-09-02-hana-hardware/enEN/appliances.html

2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	...
SAP's first global technology partner in China	Jointly launched the first server for SAP HANA: Tecal RH5885 V2	Strategic alliance partnership & launch of FusionCube for SAP HANA solution at CeBIT	MOU on IoT and joint innovation at CeBIT	**Top-Class Sponsor at SAP SAPPHIRE in Orlando**	SAP HANA Innovation Award at SAP SAPPHIRE, Orlando	SAP as Diamond Sponsor & Key Partner at HUAWEI CONNECT 2018	Introduction of PMem-based Large Capacity HANA solution	Continuous certification and technical support	

4

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Continuous Evolution Roadmap Synchronous to Intel Release Schedule

◆ V5: Mainstream sale ◆ V6: Completed R&D ◆ V7: Started planning

▼Release EOM
Sales cycle ▼
Developing
Planning

	2019				2020				2021				2022	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
2288H V5	Release: 2017.07.31											2021/12/31 EOM ▼		
2298 V5			▼ Release: 2019.11.30									2021/12/31 EOM ▼		
2288H V6								▼ Release: 2021.Q1					2023/12/31 EOM ▼	
2288H V7														
1288H V5	Release: 2017.07.31											2021/12/31 EOM ▼		
1288H V6								▼ Release: 2021.Q1					2023/12/31 EOM ▼	
1288H V7														
5288 V5	Release: 2018.04.30											2021/12/31 EOM ▼		
5288 V6								▼ Release: 2021.Q1					2023/12/31 EOM ▼	
5288 V7														
2488/H V5	Release: 2017.12.31											2021/12/31 EOM ▼		
5885H V5	Release: 2018.03.31											2021/12/31 EOM ▼		
2488H V6						▼ Release: 2020.Q3							2022/12/31 EOM ▼	
2488H V7														
E9000 CH121 V5	Release: 2017.Q3											2021/12/31 EOM ▼		
E9000 CH121 V6								▼ Release: 2021.Q1					2022/12/31 EOM ▼	
E9000 CH121 V7														
E9000 CH242 V5	Release: 2017.Q4											2021/12/31 EOM ▼		
E9000 CH242 V6/7				Investigating Market Demands										
Intel(public)	Cascade Lake				Cooper Lake / Ice Lake				Sapphire Rapids				Next Generation	

HUAWEI

5

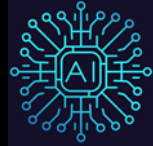# Monetize the New "Oil" with Real-Time Analytics, HPC & AI

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)

UBER lyft

Digital around the World in 2019 (source: most datareport.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 Lot of data	Generated a Lot of data	3000X of People
56%	67%	57%	45%	42%			

HUAWEI

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
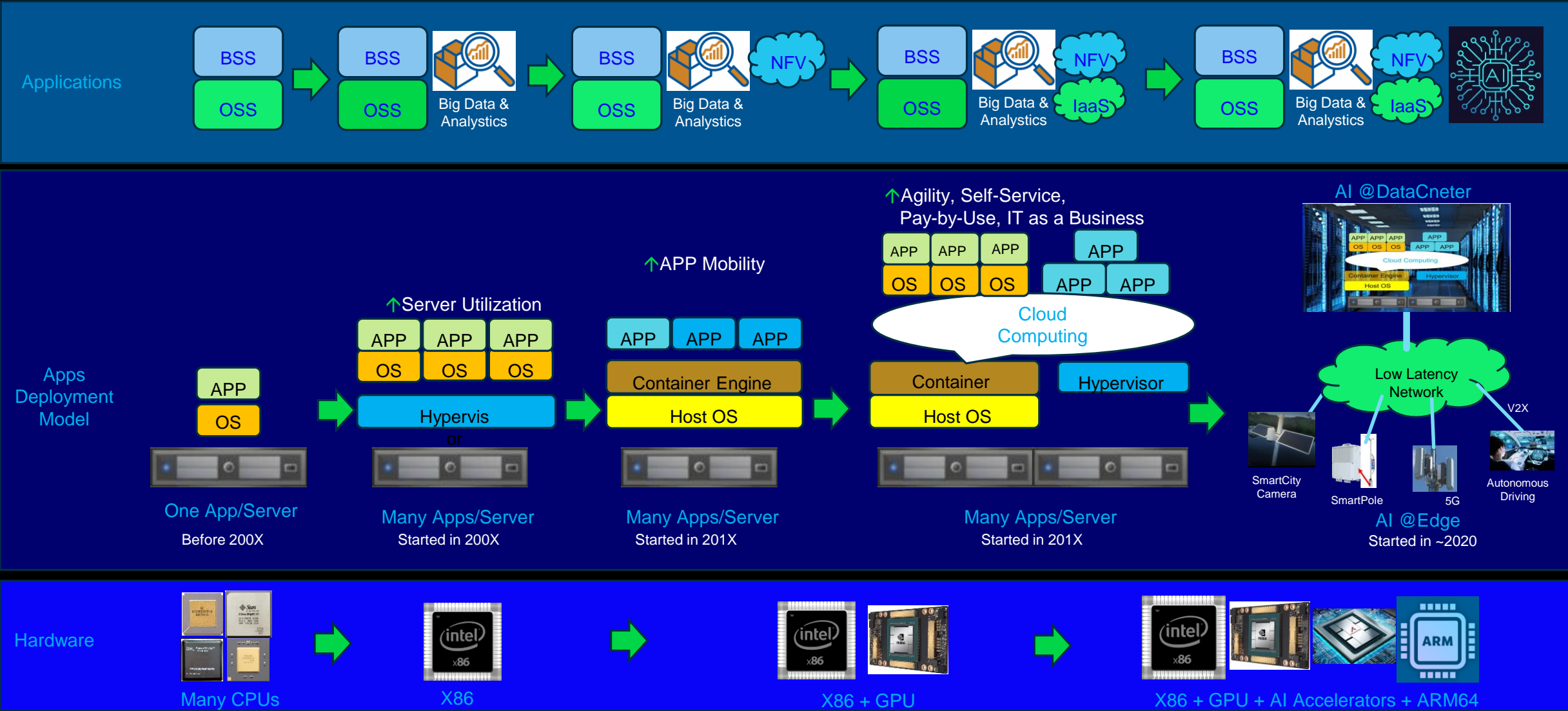

GPU-Accelerated Data Query & Analytics & Visualization in Real Time, 500M Rows of Data

Predictive Network Usage Analytics & Visualization in Real-Time

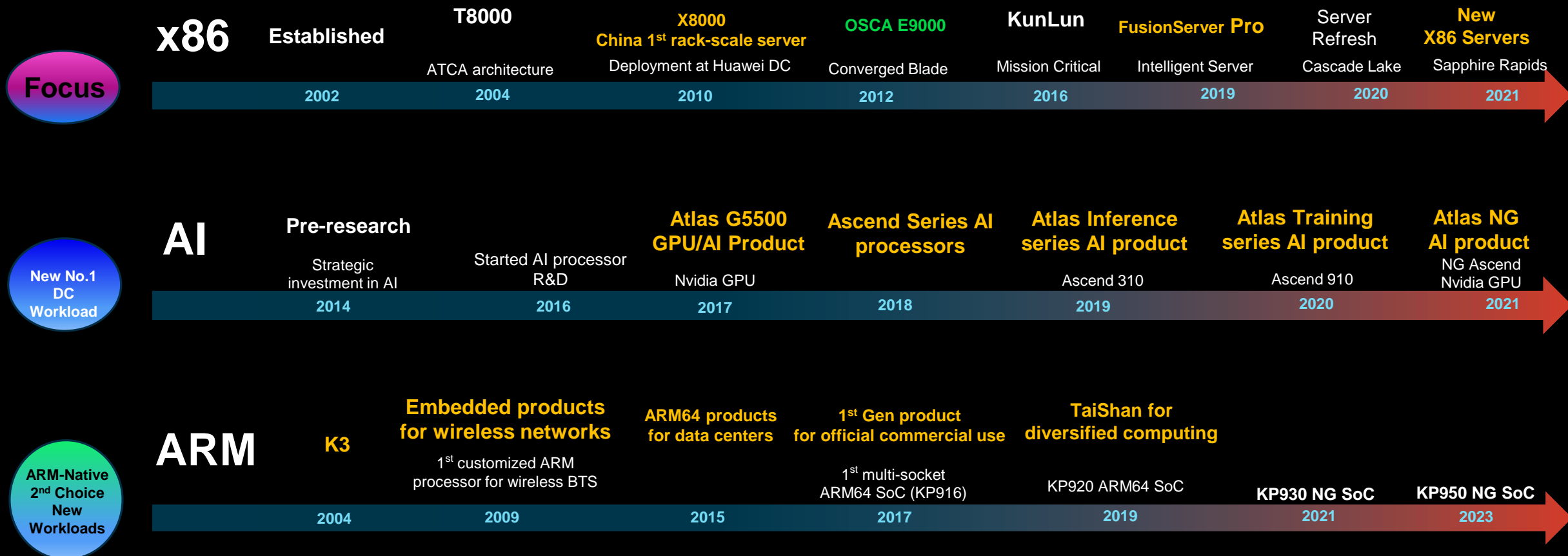https://www.youtube.com/watch?v=VgjP0ZcEu7E&feature=youtu.be, Video Source: Nvidia & OmniSCI

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

Applications

| BSS | OSS | → | BSS | OSS | Big Data & Analystics | → | BSS | OSS | Big Data & Analystics | NFV | → | BSS | OSS | Big Data & Analystics | NFV | IaaS | → | BSS | OSS | Big Data & Analystics | NFV | IaaS | AI |

Apps Deployment Model

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

AI @DataCneter

↑APP Mobility

↑Server Utilization

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

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

| APP | APP | APP |

Cloud Computing

| APP | APP | APP |

| APP | APP |

Cloud Computing

| APP |
| OS |

Hypervis
or

| APP | APP | APP |

Container Engine

Host OS

| Container | Hypervisor |

Host OS

Low Latency Network

V2X

SmartCity Camera

SmartPole

5G

Autonomous Driving

AI @Edge

One App/Server
Before 200X

Many Apps/Server
Started in 200X

Many Apps/Server
Started in 201X

Many Apps/Server
Started in 201X

Started in ~2020

Hardware

Many CPUs → X86 → X86 + GPU → X86 + GPU + AI Accelerators + ARM64

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8

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

x86 — Focus

Established	**T8000**	**X8000** **China 1st rack-scale server**	**OSCA E9000**	**KunLun**	**FusionServer Pro**	**Server Refresh**	**New X86 Servers**
	ATCA architecture	Deployment at Huawei DC	Converged Blade	Mission Critical	Intelligent Server	Cascade Lake	Sapphire Rapids
2002	2004	2010	2012	2016	2019	2020	2021

AI — New No.1 DC Workload

Pre-research		**Atlas G5500** **GPU/AI Product**	**Ascend Series AI** **processors**	**Atlas Inference** **series AI product**	**Atlas Training** **series AI product**	**Atlas NG** **AI product**
Strategic investment in AI	Started AI processor R&D	Nvidia GPU		Ascend 310	Ascend 910	NG Ascend Nvidia GPU
2014	2016	2017	2018	2019	2020	2021

ARM — ARM-Native 2nd Choice New Workloads

K3	**Embedded products** **for wireless networks**	**ARM64 products** **for data centers**	**1st Gen product** **for official commercial use**	**TaiShan for** **diversified computing**	**KP930 NG SoC**	**KP950 NG SoC**
	1st customized ARM processor for wireless BTS		1st multi-socket ARM64 SoC (KP916)	KP920 ARM64 SoC		
2004	2009	2015	2017	2019	2021	2023

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	Balanced	Storage-intensive	Compute-intensive	Mission critical
1288H V5	2288H V5	2298 V5 (New) / 5288 V5	2488H V6 (New)	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
Nvidia V100 GPU shipping
Ampere GPU coming

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
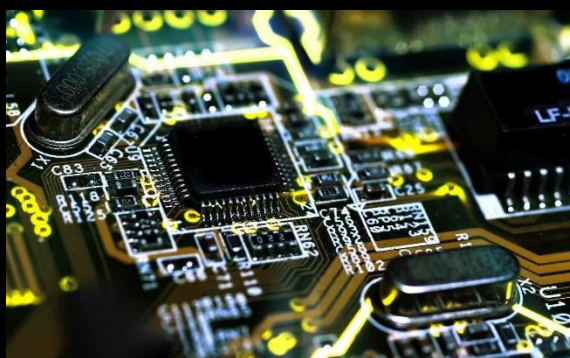
✓ **Consolidation of Suppliers**
- The same supplier for CT & IT, fewer suppliers to Manage

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

300+ Telcos
260+ Oil and Gas
211 G500
48 G100
300+ Financing
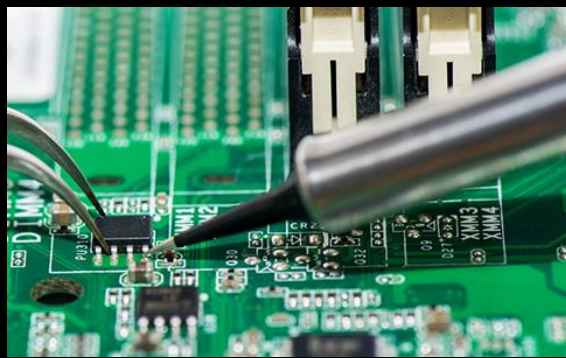1,000+ Manufacturing

Key Partners & Ecosystem

HUAWEI
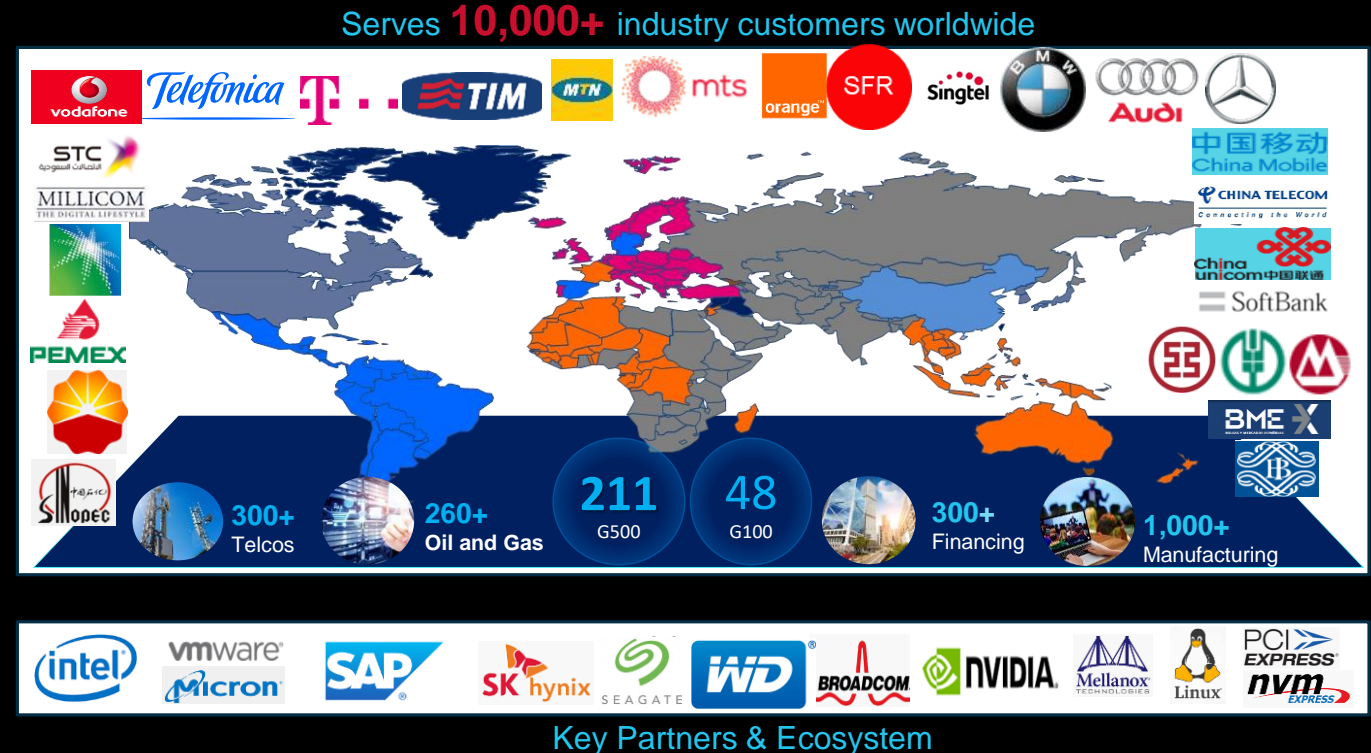
Quality Product is our DNA from Telecom Products

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

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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

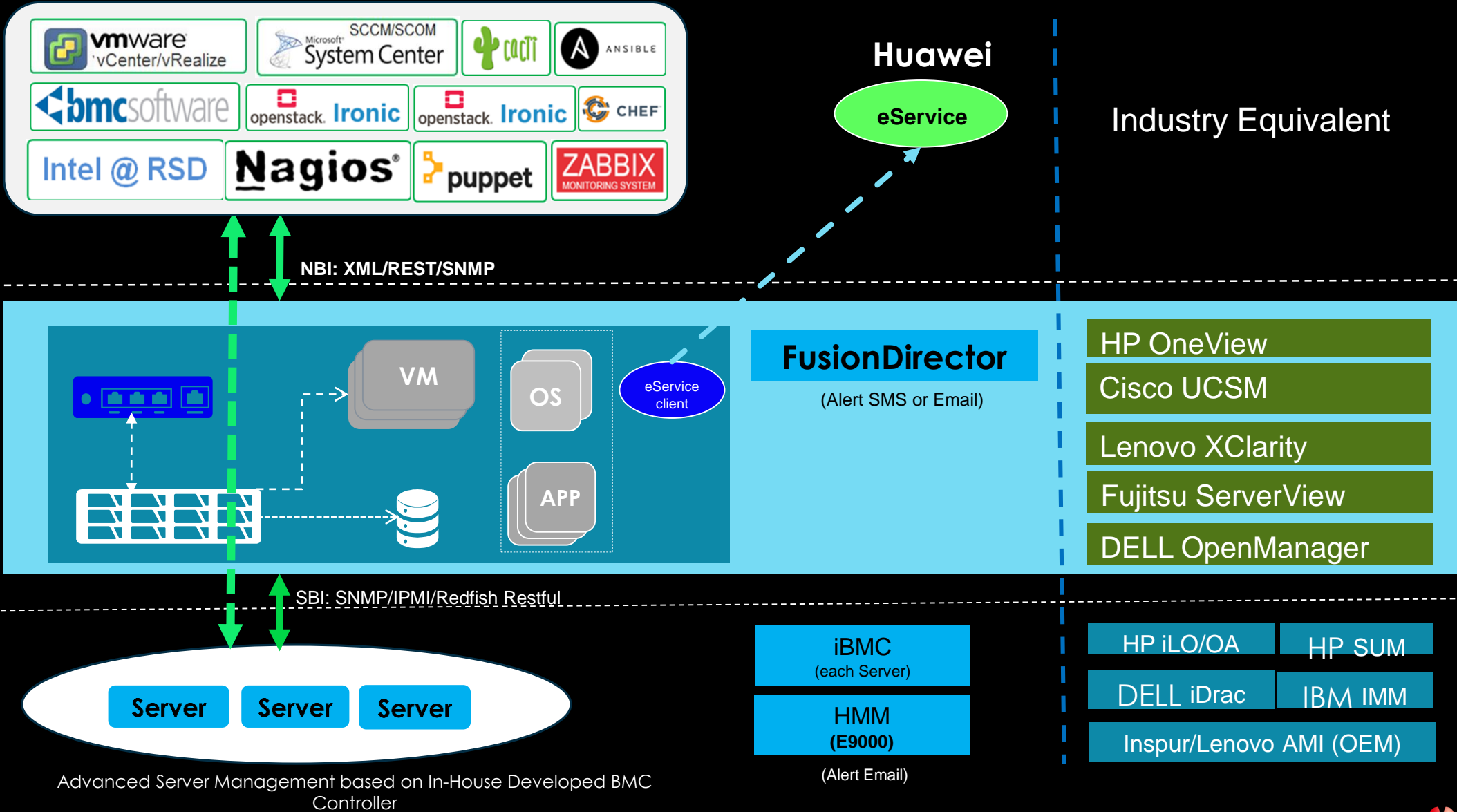

- Powerful computing: 64 TOPS of INT8
- High-density video parsing: 64-channel HD video real-time analytics

CPU offload 15%

Performance 64-Ch HD

HUAWEI

Open & Standard-Based Server Management

Huawei

eService

Industry Equivalent

NBI: XML/REST/SNMP

VM

OS

APP

eService client

FusionDirector

(Alert SMS or Email)

HP OneView

Cisco UCSM

Lenovo XClarity

Fujitsu ServerView

DELL OpenManager

SBI: SNMP/IPMI/Redfish Restful

Server   Server   Server

iBMC
(each Server)

HMM
(E9000)

(Alert Email)

HP iLO/OA   HP SUM

DELL iDrac   IBM IMM

Inspur/Lenovo AMI (OEM)

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
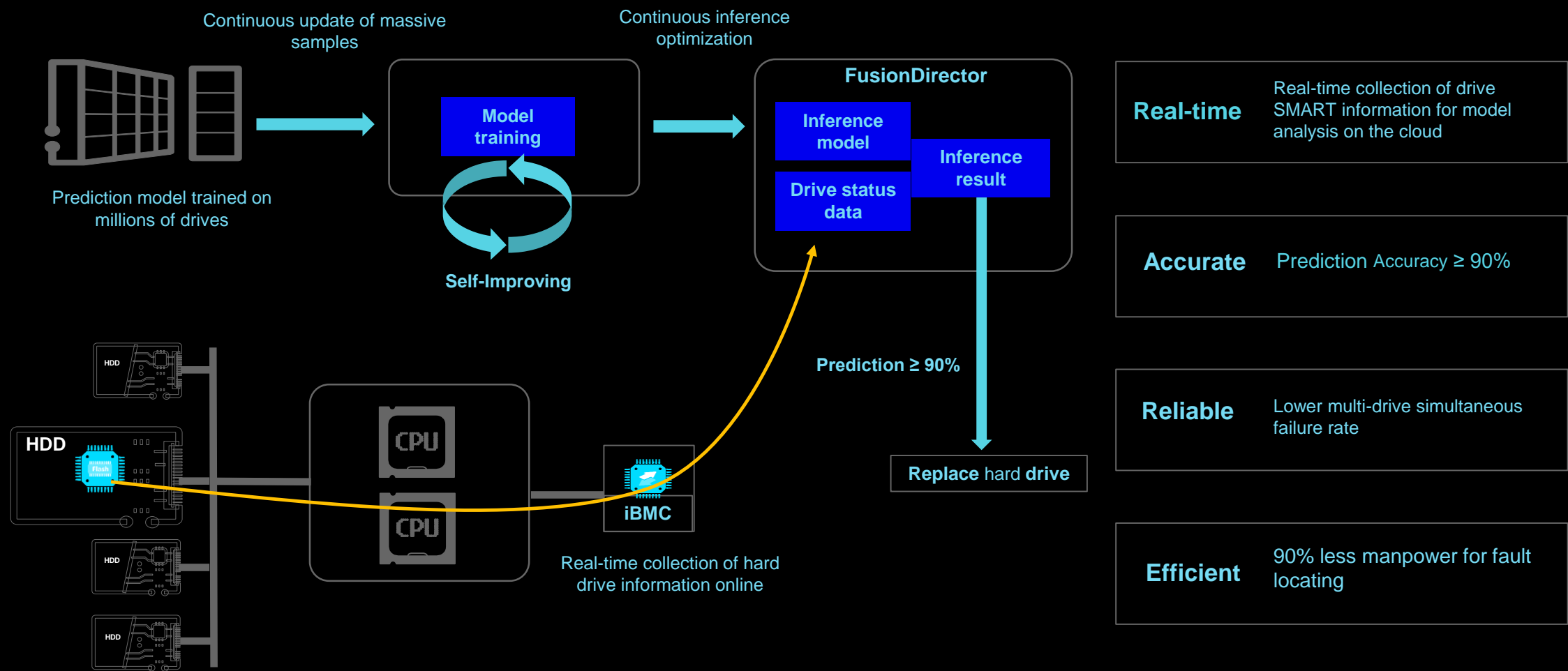**7–30 days** in advance for fault prediction,
93% fault locating accuracy
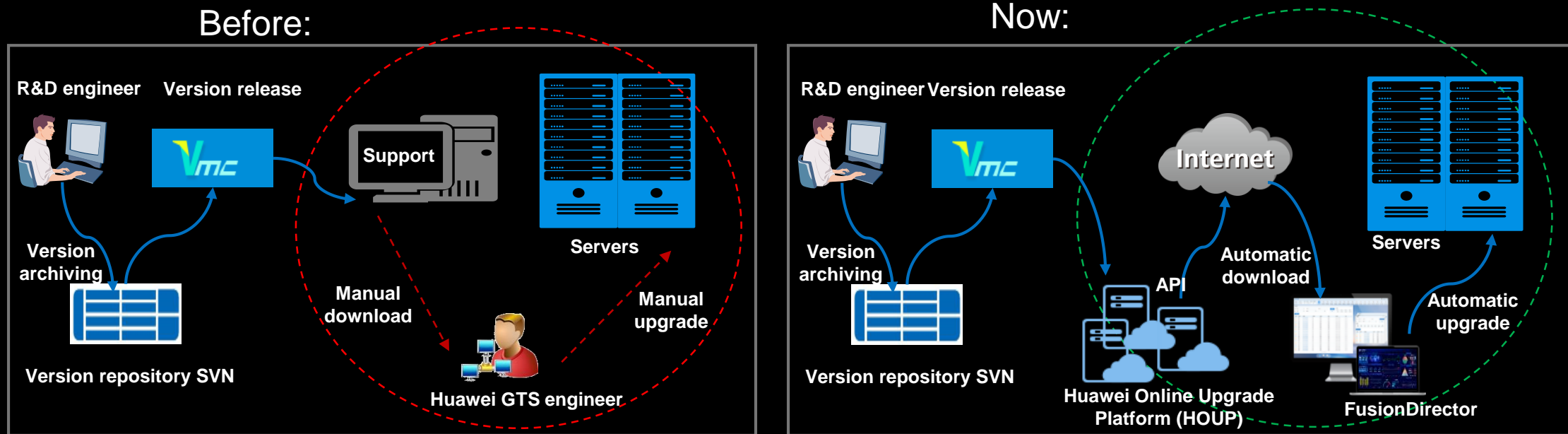
Intelligent Energy Efficiency Management

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

15

HUAWEI

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

Continuous update of massive samples

Continuous inference optimization

Prediction model trained on millions of drives

Model training

Self-Improving

FusionDirector

Inference model

Drive status data

Inference result

Prediction ≥ 90%

Replace hard **drive**

HDD

CPU

CPU

iBMC

Real-time collection of hard drive information online

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

HUAWEI

Intelligent Version Management: Automatic Upgrade Of Device Software

Before:

R&D engineer   Version release

Vmc

Support

Servers

Version archiving

Version repository SVN

Manual download

Manual upgrade

Huawei GTS engineer

Now:

R&D engineer Version release

Vmc

Internet

Servers

Version archiving

Version repository SVN

API

Automatic download

Automatic upgrade

Huawei Online Upgrade Platform (HOUP)

FusionDirector

- 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

HUAWEI

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.

Common components

AXE toolchain/Security subsystem/Unified O&M system

Chip Enablement **CANN**

Device

Intelligent device chips
2–4 TOPS INT8

Smartphones
< 2 TOPS INT8

Edge
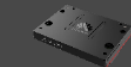
Atlas 200
16 TOPS INT8

Atlas 300
64 TOPS INT8
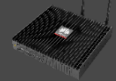
Atlas 500
16 TOPS INT8

Atlas 500 Pro
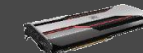256 TOPS INT8

Cloud
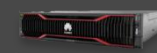
Atlas 800
512 TOPS INT8

Atlas 300T
256 TFLOPS FP16

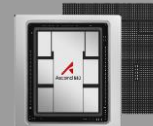**Atlas 800**
2 PFLOPS FP16

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.
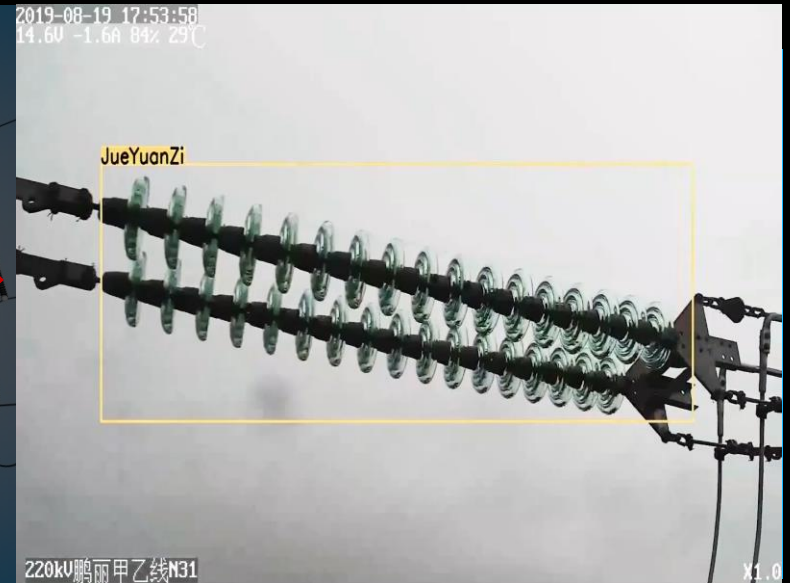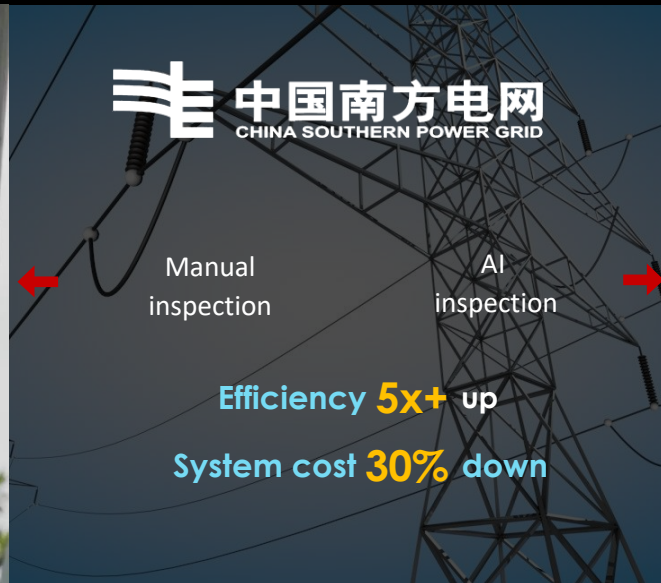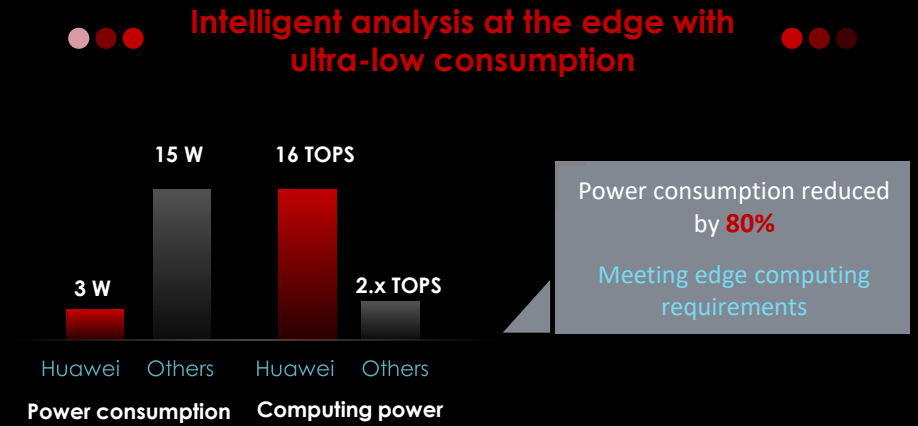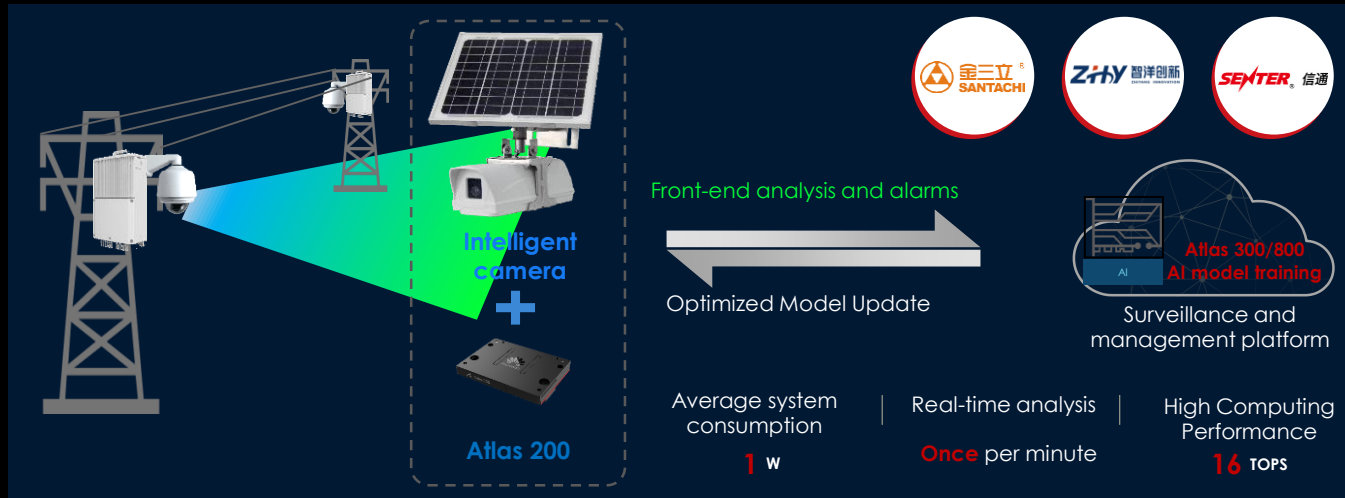
Solution

- 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

Intelligent camera + **Atlas 200**

Front-end analysis and alarms

Optimized Model Update

Atlas 300/800 AI model training

Surveillance and management platform

Average system consumption	Real-time analysis	High Computing Performance
1 W	**Once** per minute	**16** TOPS

Intelligent analysis at the edge with ultra-low consumption

- 3 W — Huawei
- 15 W — Others
- 16 TOPS — Huawei
- 2.x TOPS — Others

Power consumption | **Computing power**

Power consumption reduced by **80%**

Meeting edge computing requirements

中国南方电网
CHINA SOUTHERN POWER GRID

Manual inspection ← → AI inspection

Efficiency **5x+** up

System cost **30%** down

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14.6V -1.6A 84% 29℃

JueYuanZi

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Let me turn to Our Shenzhen Showroom for My Colleague for more details about our Intelligent Computing Products

Take-Aways

✓ Big Data Analytics, Infrastructure as a Service, AI, Intelligent Video Analysis and Autonomous Driving will be ubiquitous in new era. Telco must be ready to support these new workloads to keep competitive.

✓ In working with partners like Intel, VMware, SAP, Huawei has been offering a rich and innovative X86, AI & ARM64 Product Portfolio, and is ready to support your needs for 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 product covered cloud ,edge and device, can provide customer the E2E solution

HUAWEI

Thank you