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Building a Fully Connected,Intelligent World
构建万物互联的智能世界

How to reach Carbon Zero…

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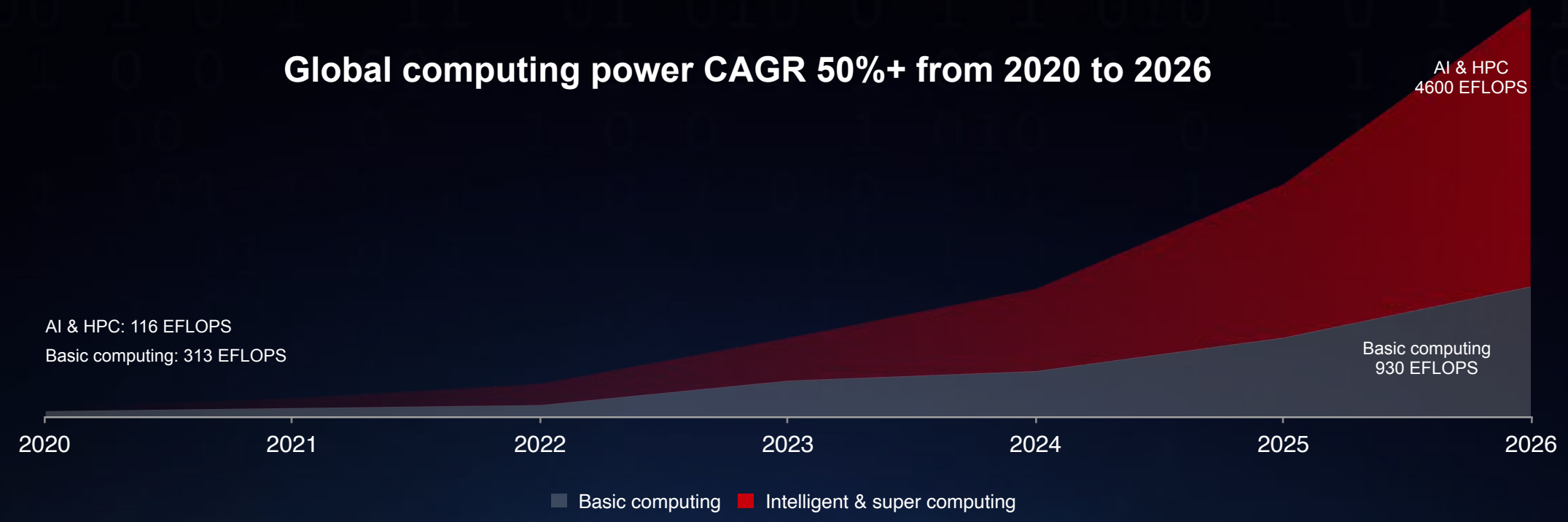
30h March , Oslo

Explosive Growth of Data and Computing Power in the Intelligent Era Drives the High-Density and Large-Scale Development of Data Centers



Smart manufacturing

AVIC (40P@2020) ->100P@2025)

Weather forecast

China Meteorological Administration (8.2P@2017->80P@2023)

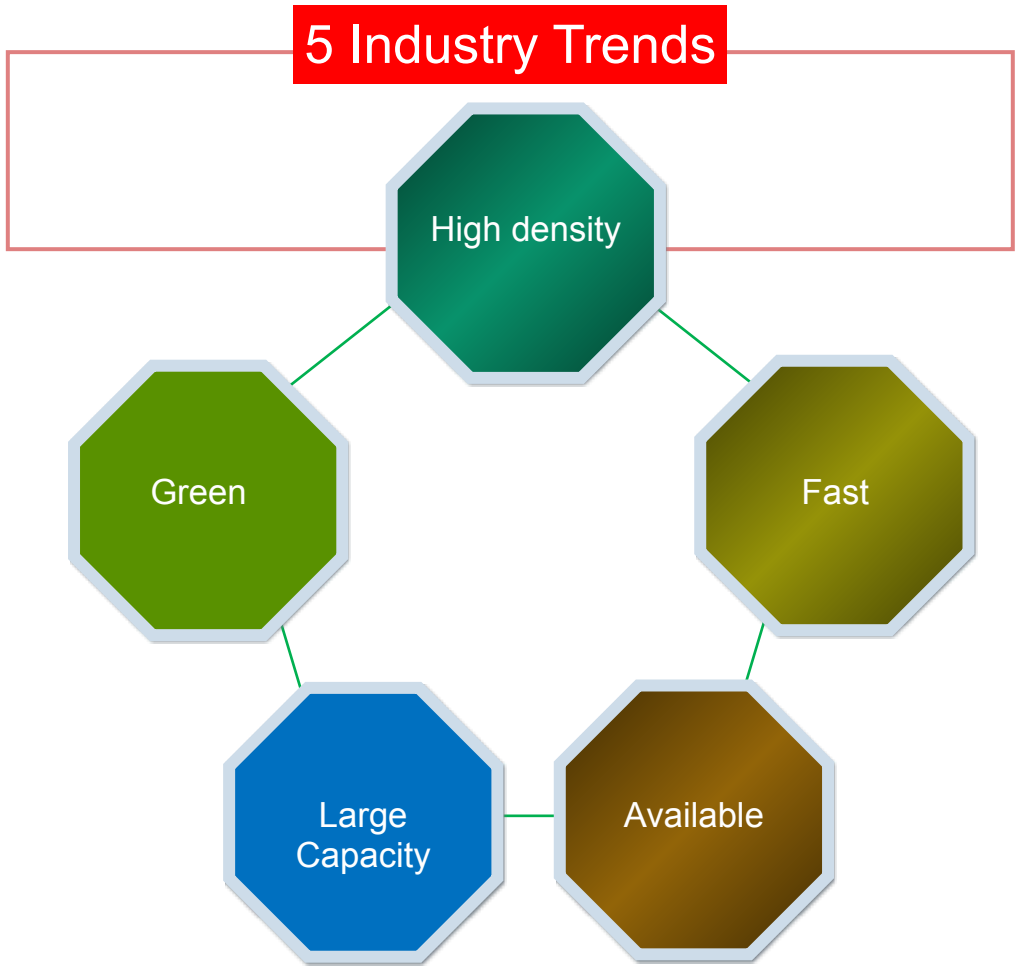
AR/VR

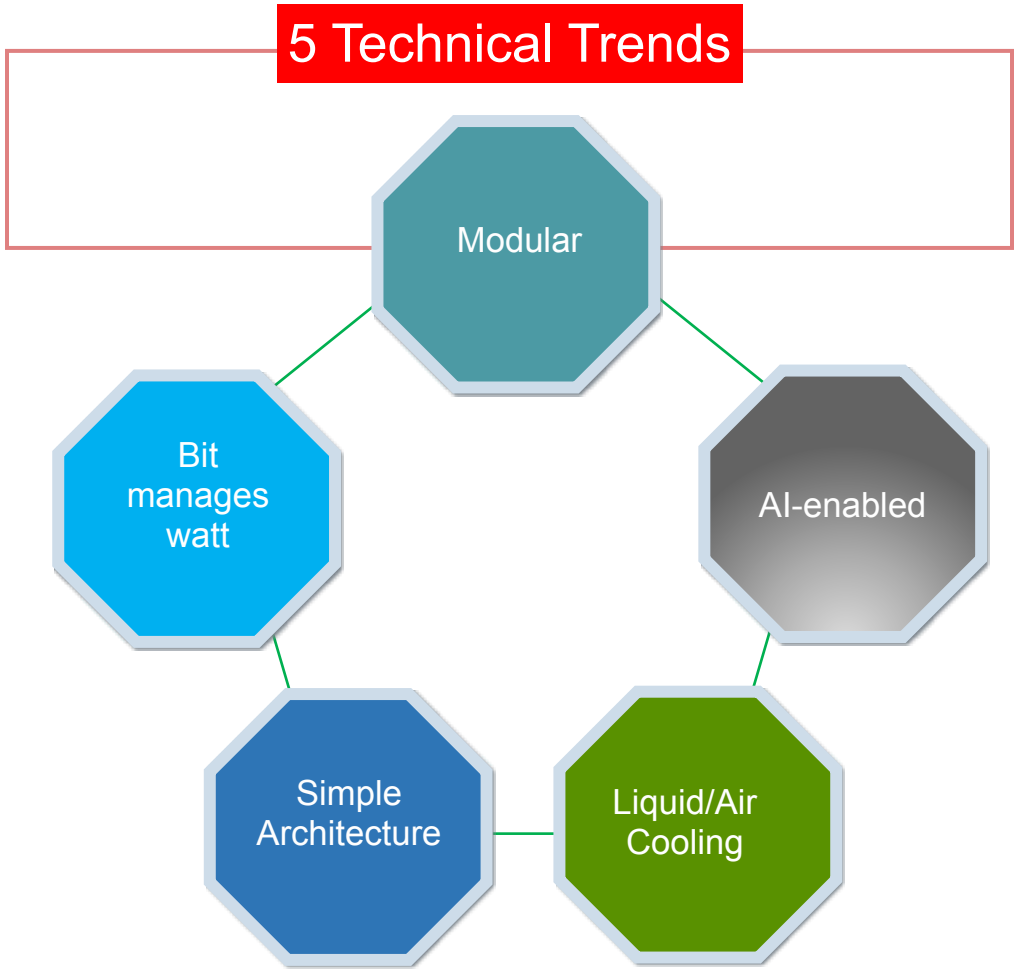
Optimal experience, 24K, 1.3 Gbit/s, 20 minutes < 190 GB

Autonomous driving

Level 4 autonomous cars 100 TB/day per car

Top Trends in Data Center Facilities





Data Centers in the Low-Carbon Era Should Prioritize Efficient Use and Recycling of Various Resources

Use

0.7 million kWh of electricity

890,000 tons of water

Rack utilization rate **50%**

42,000 tons of carbon emissions*

Recycling

8,000 tons of residual heat

Material recovery rate **15%**

Model: 12 MW data center, 1500 racks x 8 kW, 2N architecture, load rate 50%, PUE 1.3

** Carbon emissions in scope 2, excluding scopes 1 and 3*

Data Center System Construction Becomes Increasingly Complex

Power supply system

450 power distribution frames (PDFs), 225 power distribution boxes

3000 rPDUs, **150,000 m** cables

Cooling system

Six chillers, 390 flow meters, and 15 water pumps

150 m main pipe, **1650 m** branch pipe

Management system

200 measurement points per rack

300,000 measurement points for 1500 racks

Model: 12 MW data center, 1500 racks x 8 kW, 2N architecture, load rate 50%, PUE 1.3

What Kind of Data Centers Will be Needed?

Interaction of **energy**

Sustainable

All Green

All Efficient

All Recyclable

Composition of **matter**

Simplified

Simplified Architecture

Simplified Power supply

Simplified Cooling

Reliable

Proactive Security Secure Architecture

Usage of **information**

Autonomous driving

O&M **Automation**

Automatic Energy Efficiency Optimization

Operation **Autonomy**

Sustainable – All Green: Green Sources and Harmony with Nature

Electricity

Use green power on a large scale

Use renewables such as PV, wind power, and hydropower instead of thermal power.

Water

Use less clean water

Use reclaimed water or even no water.

Land

Use land in an intensive way

Enable each square meter of land to carry more computing power.

Climate

Use more free cooling

The free cooling duration can be extended if temperature and humidity are proper.

Sustainable – All Efficient: PUE → xUE, One Dimension → Multi-Dimensional System

Evaluation indicator: PUE → xUE

CUE

PUE

WUE

GUE

xUE: $_{\alpha}$CUE | $_{\beta}$PUE | $_{\gamma}$WUE | $_{\delta}$GUE | …

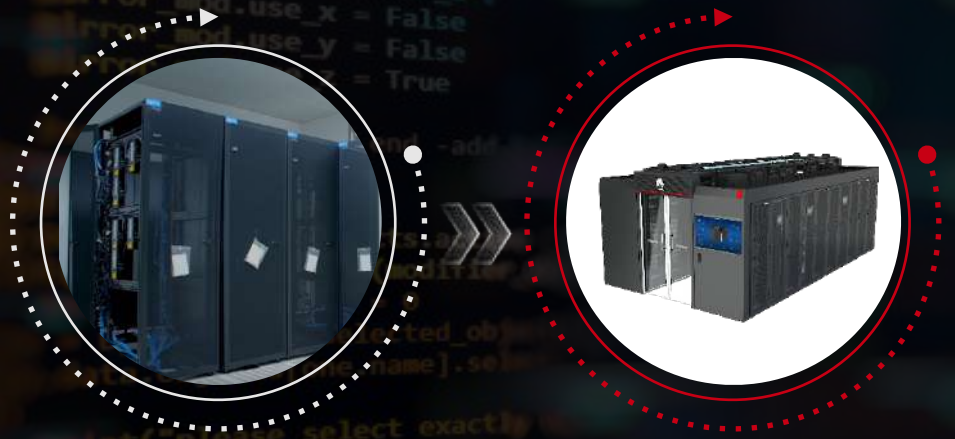
CUE : Carbon Usage Effectiveness
PUE: Power Usage Effectiveness
WUE: Water Usage Effectiveness
GUE: Grid Usage Effectiveness
α / β / γ / δ are used to balance the importance of each indicator. The values vary with regions/industries.

Simplified – Simplified Architecture: Innovative Buildings and Equipment Rooms

Prefabricated buildings

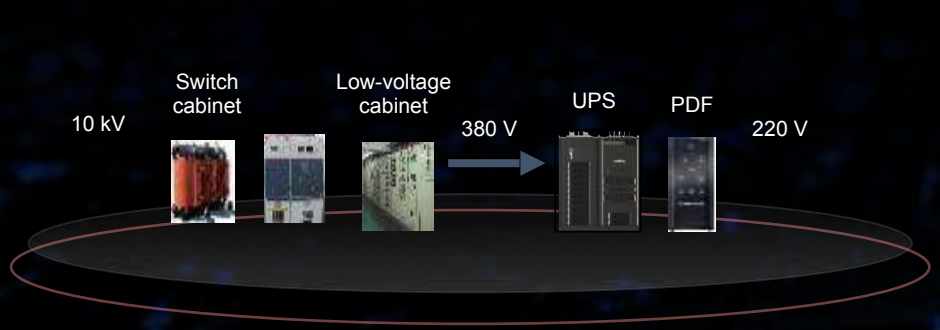
Breaking a whole into parts: parallel works thanks to product design of engineering

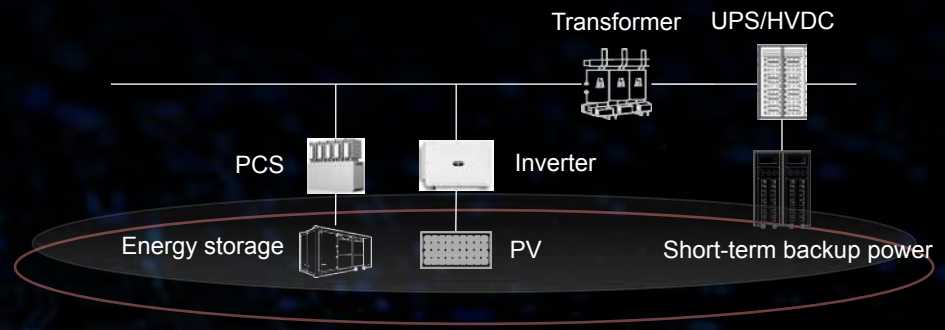
Modular equipment room



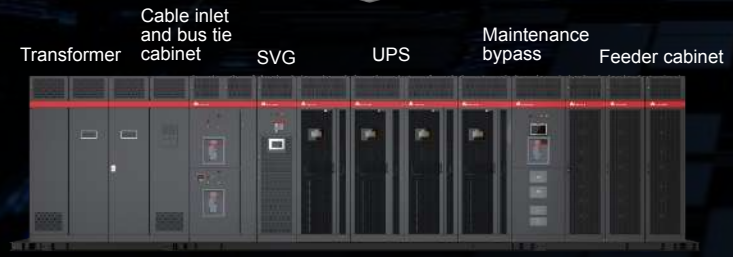
Integrating parts as a whole: all in one instead of combination

Simplified – Simplified Power Supply: Redefined Components and Links



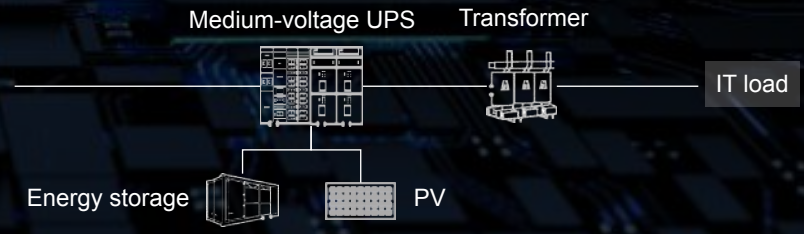


Component integration



Physical connections → Converged power supply

Link simplification



Complex → Simplified links

Autonomous Driving – O&M Automation: Keeps Personnel Away from Equipment Rooms

Manual inspection ↓ AI-based remote inspection

Smart sensing @IoT/voice recognition/image recognition

Digital and standardized O&M

Digital foundation for visualization/Expert experience sharing on cloud

Inspecting 2000 racks

2 hours → 5 minutes

Autonomous Driving – Operation Autonomy: Maximizes Resource Value

Resource optimization @AI

Intelligent matching between SPCN demand and supply

Energy scheduling @AI

On-demand scheduling of green power, energy storage, and backup power

Reliable – Proactive Security: Early Warning and Quick Fault Closure

AI predictive maintenance

Fault prediction

Remedy → Prevention

Automatic fault response

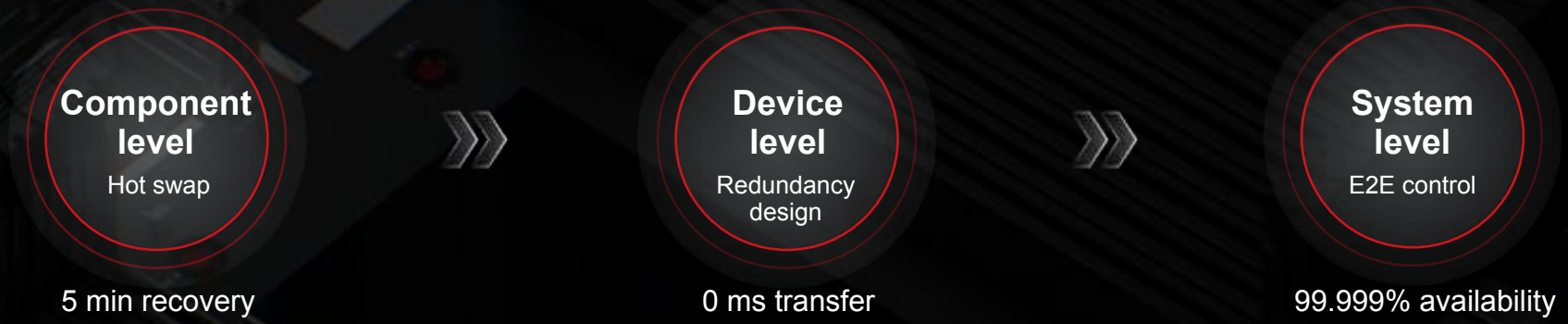
1 min discovery, 3 min analysis, 5 min service recovery

Manual response → Automatic response

Reliable – Secure Architecture: Safeguards All Ranging from Components to Data Centers

Enhanced resilience and defense

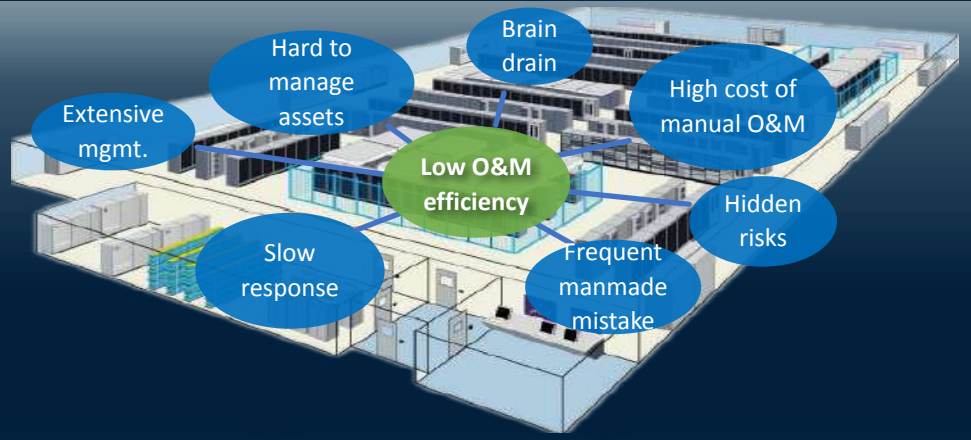
Modular design, lossless switchover, and always-on



Power electronics + ICT technologies

Digital Technology enabled Life-cycle Carbon Management

Challenges: Low Efficiency, High Cost, High Risk



- **61%** DC suffer shortage of skillful staff
- Labor cost account to **10%** of total cost of data center
- Downtime rate of data rata is rising , **80%** of which can be prevented

	L0: Manual O&M	L1: Assisted O&M	L2: Partial Autonomous DC	L3: Conditional Autonomous DC	L4: Highly Autonomous DC	L5: Fully Autonomous DC
						
Visuali-zation	Simple monitoring	3D visualization of systems	Centralized monitoring	BIM assisted digital twins	Digital twins	Cloud+SaaS
Energy Efficiency	No optimization	Visualized efficiency	Rule-based PUE optimization	AI enabled automatic optimization	AI enabled self- learning and healing	AI make rules
Mainten-ance	Manual record	E-maintenance	AI enabled inspection	AI enabled auto analysis and diagnosis	AI enabled fault prediction	Self-healing
Operation	No optimization	Resource visualization	Maximized utilization	Auto on-shelf	Decision-making reference	Unattended operation

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Thank you