5G, Wi-Fi 6, edge and AI: Enabling Technologies for Digital Transformation in Manufacturing

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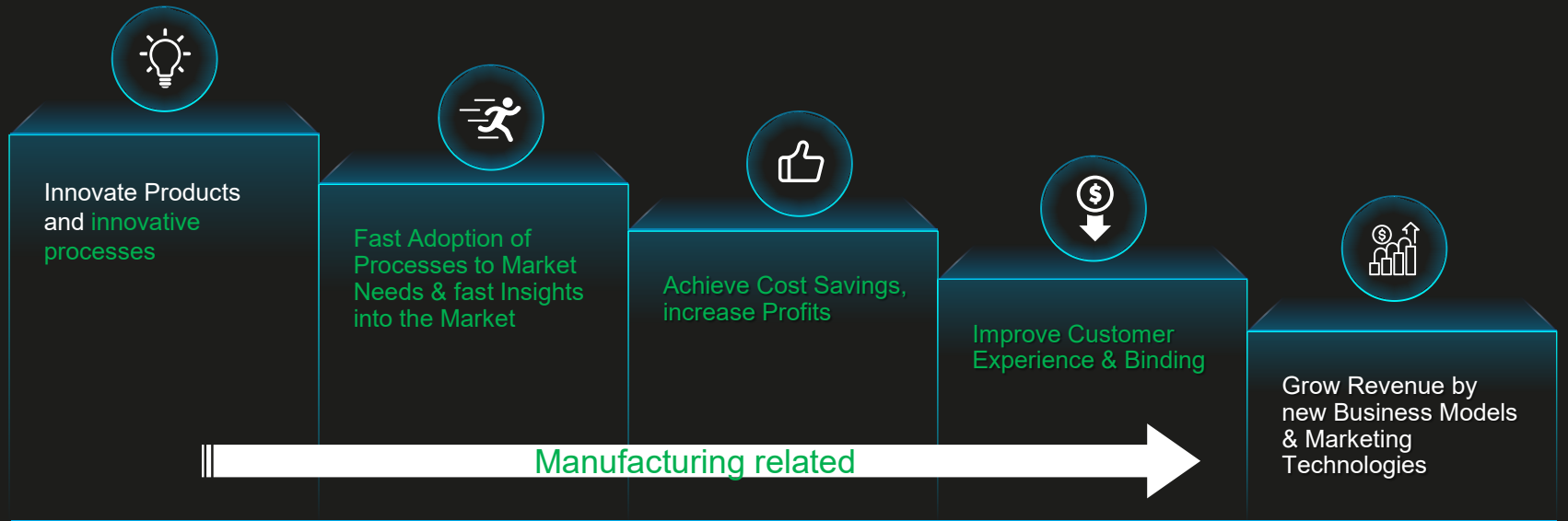
Why Digital Transformation and what Value to expect



Disruption becomes ubiquitous and the norm, not the exception!

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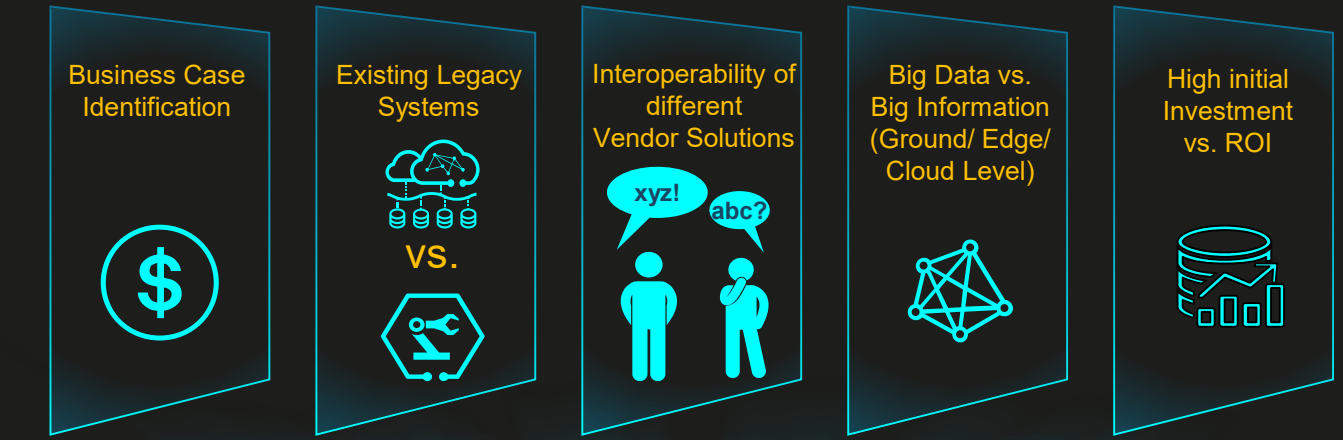
Industry challenges hindering rapid transformation



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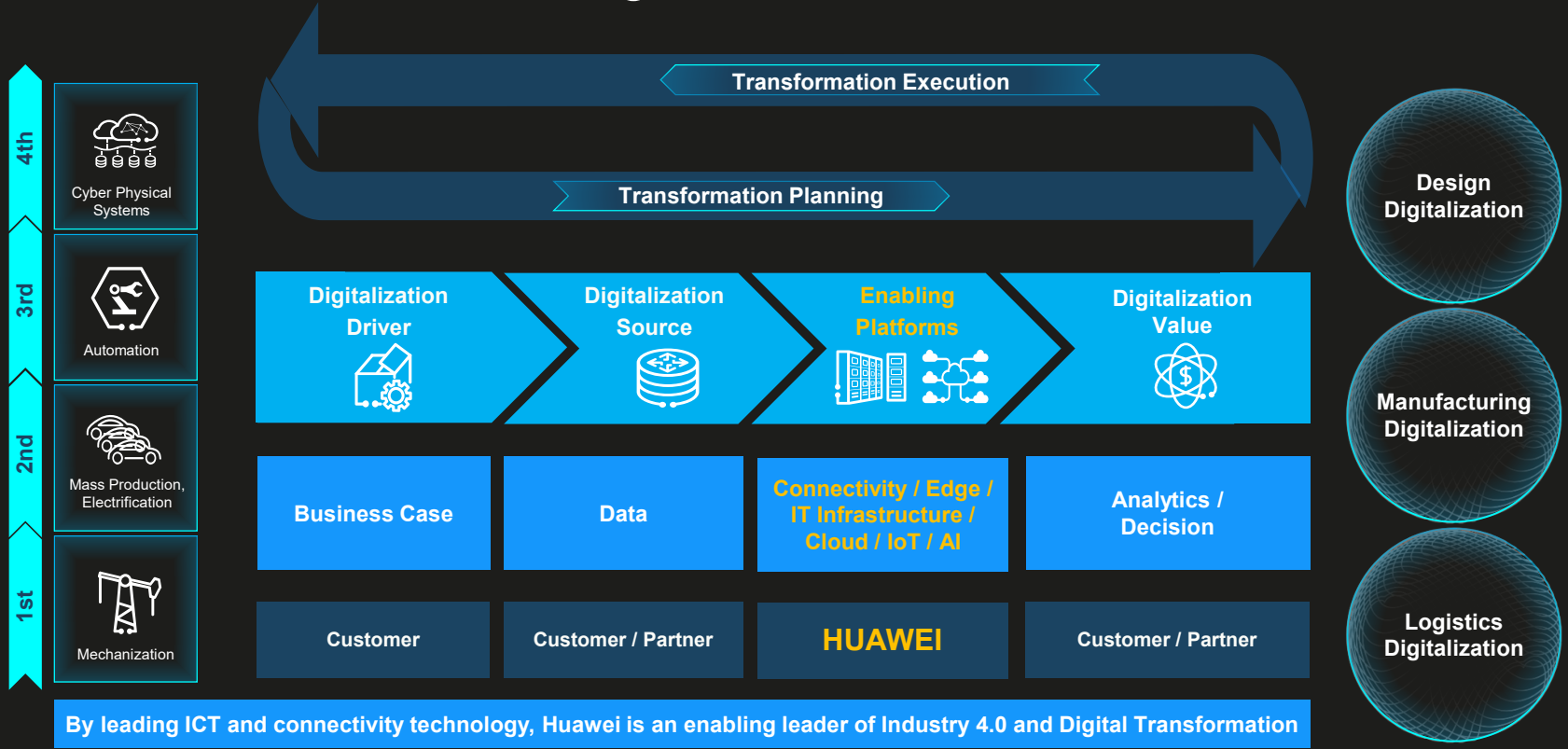
Huawei‘s Role within digital Transformation



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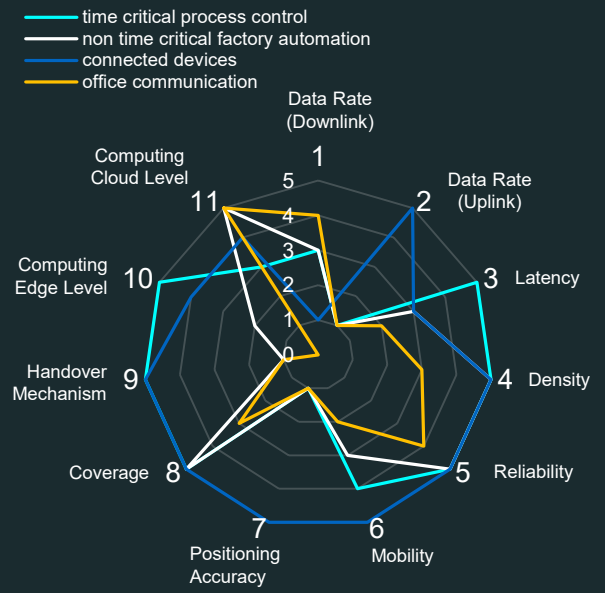
ICT Challenges & Requirements

Use Cases

Networks Requirements are depending on Use Cases

- Time critical Process Control
- Non-time critical Factory Automation
- Connected Goods / Devices
- Intra / Inter Enterprise Communication

Requirements



Costs

Low Cost Solution vs. Functionality Coverage vs. Volume

- Finding the right Balance between Functionality and Component Costs are the biggest Challenge

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4 Technology Directions are leading Digitalization

- Active in Definition of Global 5G Standards
- Board Member of the 5GPPP
- Founding Member of the 5GIC
- Key Member of the IMT-2020 (5G) in China
- Key Member of the 5GMF in Japan
- 300 top Scientists
- Joint 5G Test environments with 30+ leading Carriers

Wireless 5G / Wi-Fi 6

Edge Computing

- First mobile AI chip Kirin 970
- First AI embedded Edge (Atlas Serie)
- Basic Research
- Better Market Position
- Higher internal Efficiency & Quality

AI

Cloud / IoT

- Strategic Partnerships with Deutsche Telekom, Orange, Telefónica and China Telecom
- 3 Basic Principles:
  - We don't monetize data
  - We don't develop applications
  - We don't make equity investment
- Connected Vehicles, Connected Lifts, Connected Machines
- 450+ IoT Partners
- 30+ Industry Applications

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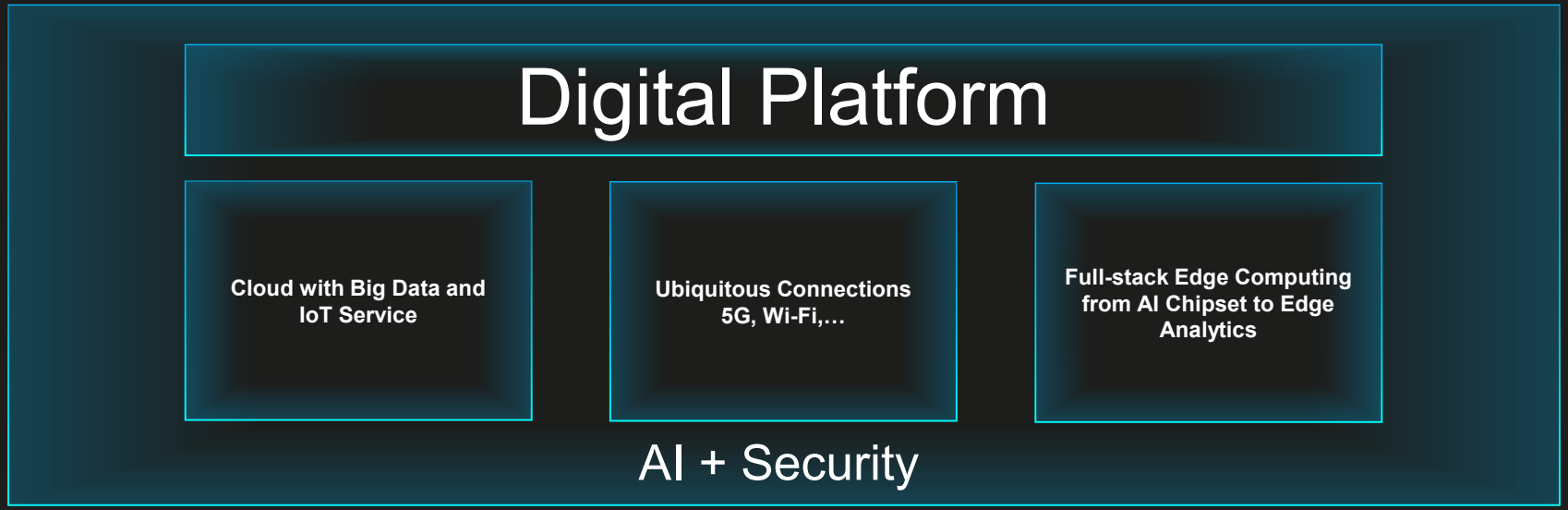
Huawei‘s Digital Transformation Vision and Strategy
DIGITAL PLATFORM



Being best Partner of Digital Transformation for the Manufacturing & Automotive Industry

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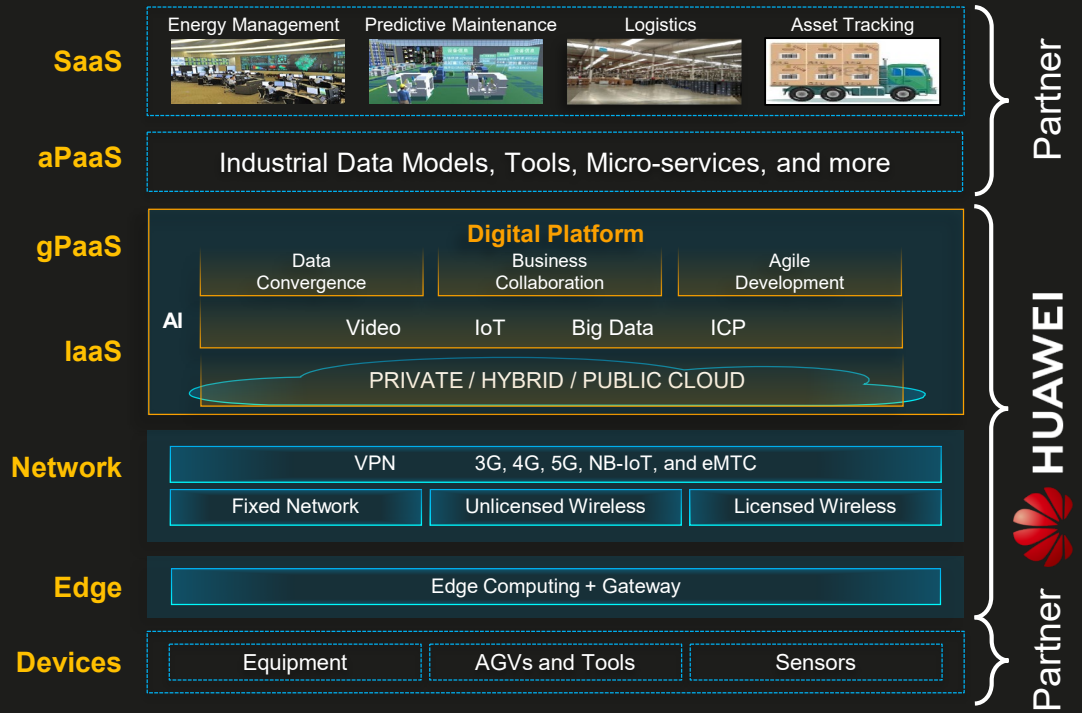
Enable Digital Transformation for Enterprises and explore the Value of Industrial Data

1 Digital Platform



- Full-stack Platform and Connection Capabilities enable Digital Transformation in multiple Value Chains
- Pre-integrated and Collaborative Intelligence Solutions
- Open Architecture for Ecosystem Integration

What we do

- Connectivity (3/4/5G, Wi-Fi, NB/IoT, …)
- Edge Computing
- Trusted IaaS, Industrial PaaS
- Eco-System to provide SaaS

What we NOT do

- Industrial Applications
- Industrial Equipment
- Industrial Data

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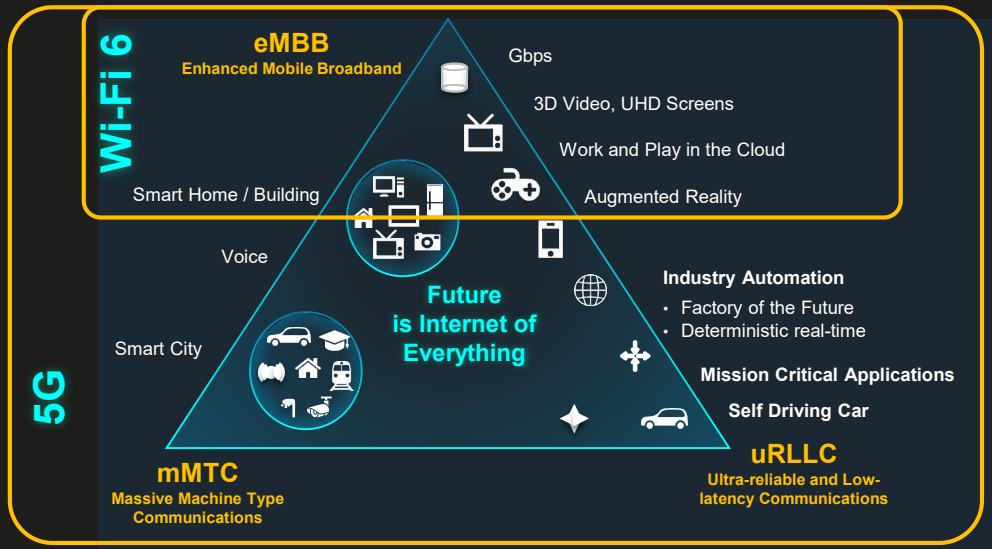
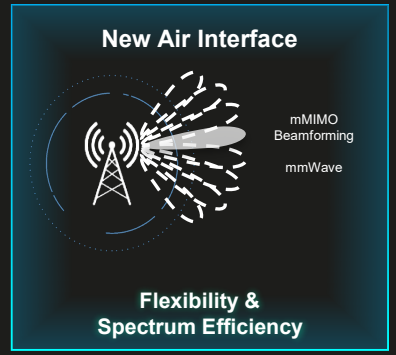
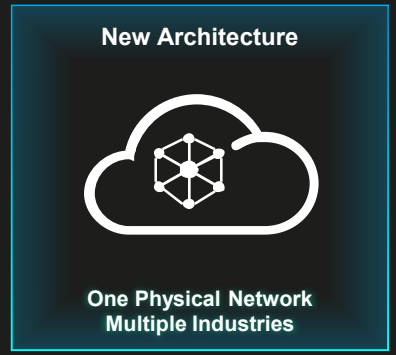
Wireless Connectivity in the Manufacturing Industry



Factory of the Future



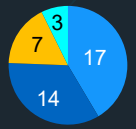


100 billion
Connections until 2025

1 ms
Latency

10 Gbit/s
Peak Speed

5G-ACIA Member Structure



OT-Industry
ICT-Industry
Academia
Others

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Importance of Edge Computing in the Manufacturing Industry

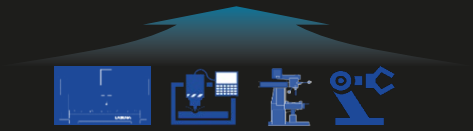
Average Plant	Digitalization Source	Solution
Number of Machines	**Data / Day**	
• 500 Robots • 100 CNC Machines • 50 Conveyers • 30 Torque Tools • …	• 500 Gbyte • 150 Gbyte • 100 Mbyte • 600 Gbyte	More than 1 Tbyte / Day to Cloud ?

AI/
Machine Learning

Real-time Analytics / Smart Filtering on Edge

EC-IoT / AI

Real-time Status Data Collection



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Cloud, Big Data and IoT in the Manufacturing Industry

What we do

- Network Connection
- Edge Computing
- Trusted IaaS
- Industrial PaaS
- Gathering Partners to provide SaaS

What we not do

- Industrial Applications
- Industrial Equipment
- Industrial Data

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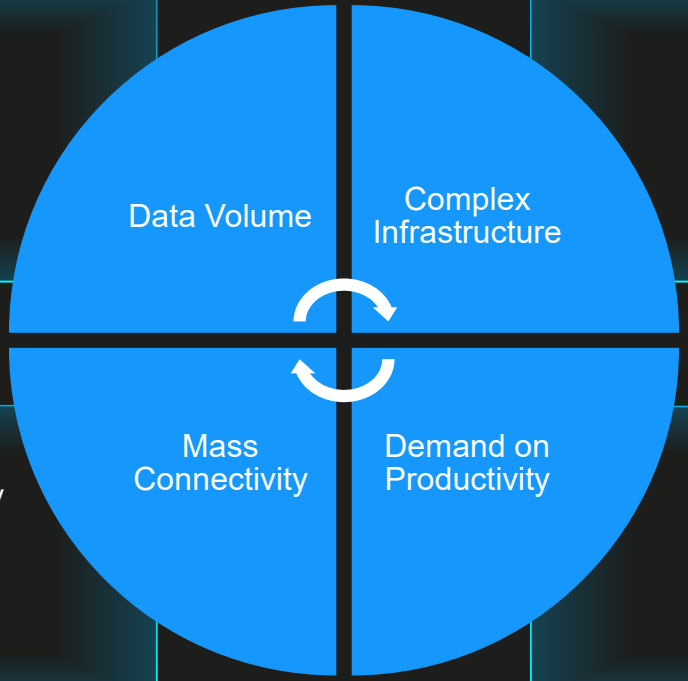
AI in the Manufacturing Industry

5 AI

- AI supports to Break Protocol and Architecture Borders and leads to accelerate Storage and simplifies it



- Complexity on different Layers in Infrastructure
- AI embedded in the Network to support secure and self healing Infrastructure

- First mobile AI chip Kirin 970
- AI as an enabling Technology
- Basic Research
- Better Market Position
- Higher internal Efficiency & Quality

- Optimization OEE
- Optimization productivity
- Optimization Supply Chain

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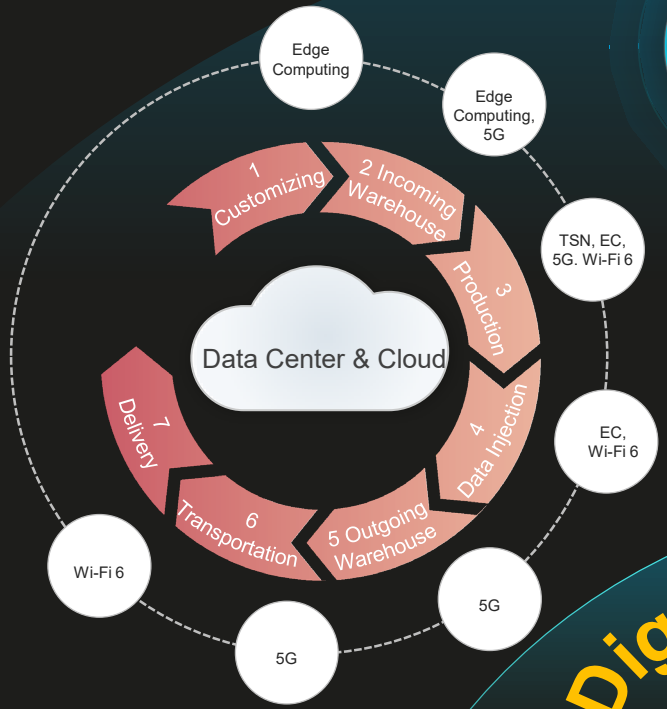
We Provide Solutions where its needed



Global R&D Collaboration on the Cloud

- Collaborative Tools
- Collaborative Simulations
- Fault Detection
- Data Exchange / Delivery Optimization

Global Manufacturing Operations and Command Centers

- Defect Detection & Prevention
- Industrial Internet / IoT
- Predictive Maintenance
- Personalization
- Virtual Trainings / Augmented Reality
- Operation Optimization

Smart Campus

- Individualized Access
- Security / Safety Optimization

Smart Logistics and Digital Warehousing

- Defect Detection & Prevention
- Localization & Tracking
- Predictive Scheduling
- Carrier Monitoring
- Supply Chain Optimization

Digital Transformation

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Solutions Portfolio fitting Customers Pain Points

Process Steps	Creation & Customizing of Order	Incoming Warehouse	Production	Data Injection	Outgoing Warehouse	Transpor-tation	Delivery
Process Actions	➢ Order Creation ➢ Order Customizing ➢ Order Release	➢ Select correct parts ➢ Quality check of the direction ➢ Send parts to production	➢ Swap into right direction ➢ Produce (labeling)	➢ Rotate USB ➢ Download data to USB	➢ Buffering product ➢ Handout to mobile robot	➢ Pick up USB's ➢ Transport product to final warehouse	➢ Handout right product to end user
Main Issues	➢ Cross-department, Cross-regional and cross-functional working model in big enterprises	➢ Flexibility ➢ Latency ➢ Concurrent connections	➢ Production Down Time ➢ Real-Time ➢ Flexibility ➢ Latency ➢ Sensor data collection	➢ Flexibility ➢ Downloa d rate ➢ Reliability	➢ Flexibility ➢ Latency ➢ Concurrent connections	➢ Handover problems Wifi5 ➢ Reliability ➢ Concurrent Connections ➢ Latency	➢ Flexibility
Techno-logy & Solution	Edge Computing ➢ Edge DC, Preprosessing of Data, Analysis on edge	Edge Computing ➢ Decentralized smart warehousing based on Edge computer and Wifi6	Edge Computing TSN 5G ➢ Predict. maintenance based on edge ➢ Data collection via TSN network at shopfloor ➢ 5G network at shopfloor	Wifi 6 ➢ Wifi6 at final assembly line for ECU flashing	5G ➢ Decentralize d smart warehousing based on Edge computer and Wifi6	5G ➢ 5G network for AGV's, mobile robots	Wifi 6 ➢ Wifi6 network at delivery stations

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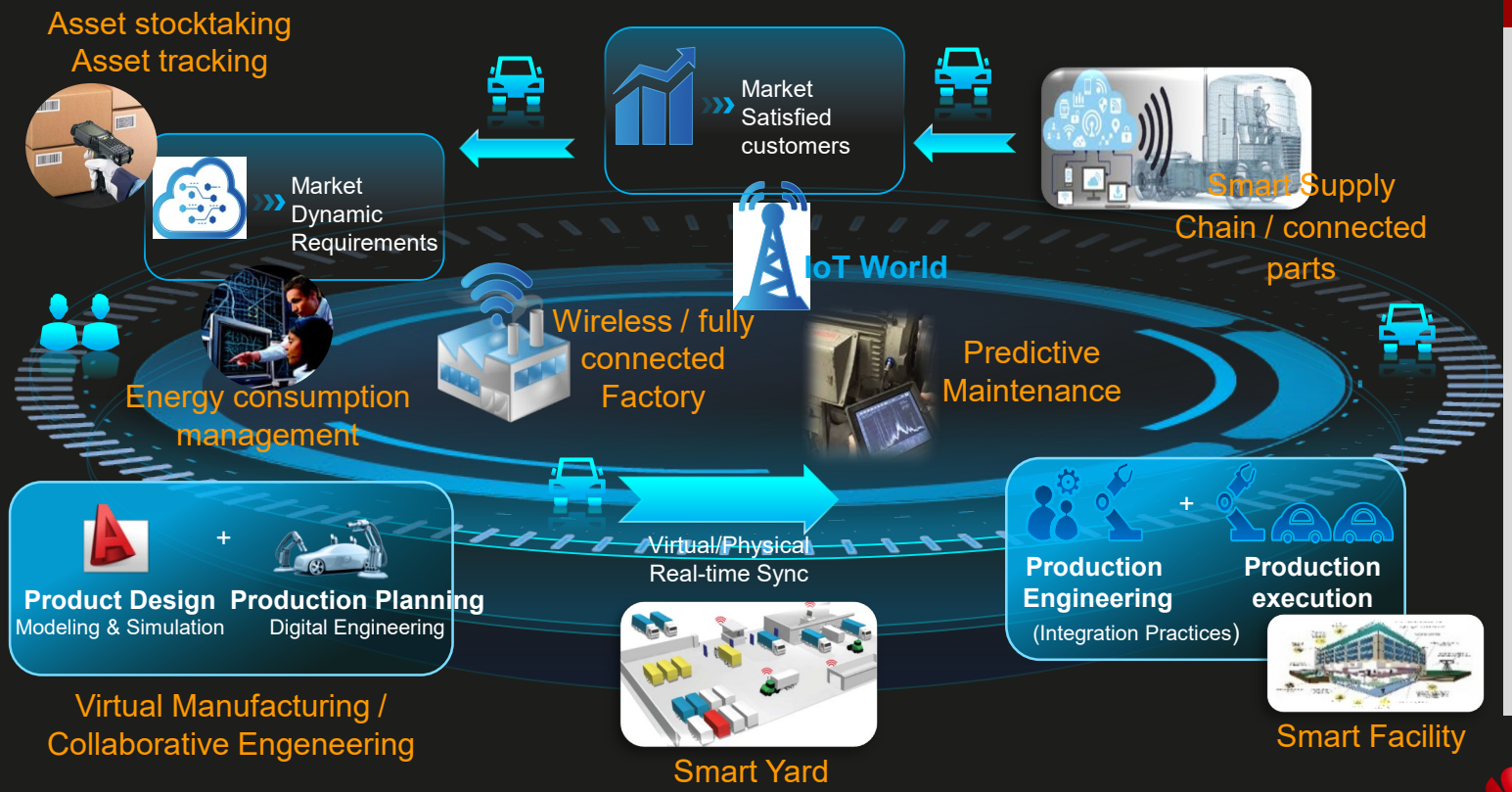
Huawei Smart Manufacturing Solution Offers



Key Highlights

- **End-to-End Solutions**
  - Together with a strong Eco System, Huawei provides end-to-end Solutions with Partners
- **Connectivity**
  - Due to strong background in the mobile technology Huawei provides prove connectivity solutions, like 5G, Wifi6
- **Full Integrated**
  - Due to huge portfolio manage entire infrastructure with one management dashboard

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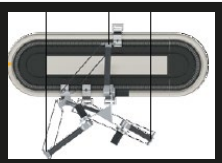
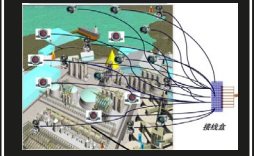
5G-ACIA smart manufacturing requirement scenario

	Motion control	Inter-machine control	Mobile panel (with security control)	Mobile robot	Large-scale connection	Industrial AR and monitoring
Factory automation		✓	✓	✓	✓	
Process automation				✓	✓	
HMI and IT system			✓			✓
Logistics and warehousing		✓	✓	✓		
Monitoring and Maintenance					✓	
Outside Yard Management				✓	✓	
							
USE CASE Feature	Reduce component wear and reduce deployment costs and maintenance costs.	• Seamless collaboration. • High efficiency. • Zero downtime. • Low latency • High stability and reliability.	• Reducing deployment cost for devices requiring mobility.	• AGV • Remote monitoring • Mobility, low latency, high reliability, and deterministic transmission	• Cloud-based application requires high density connectivity. • Long distance, harsh propagation environment, and industrial safety	• Ever-increasing applications of industrial wearable devices require wide area, large bandwidth, and low latency.
Requirements for Wireless	URLLC	URLLC	URLLC	URLLC	mMTC	eMBB

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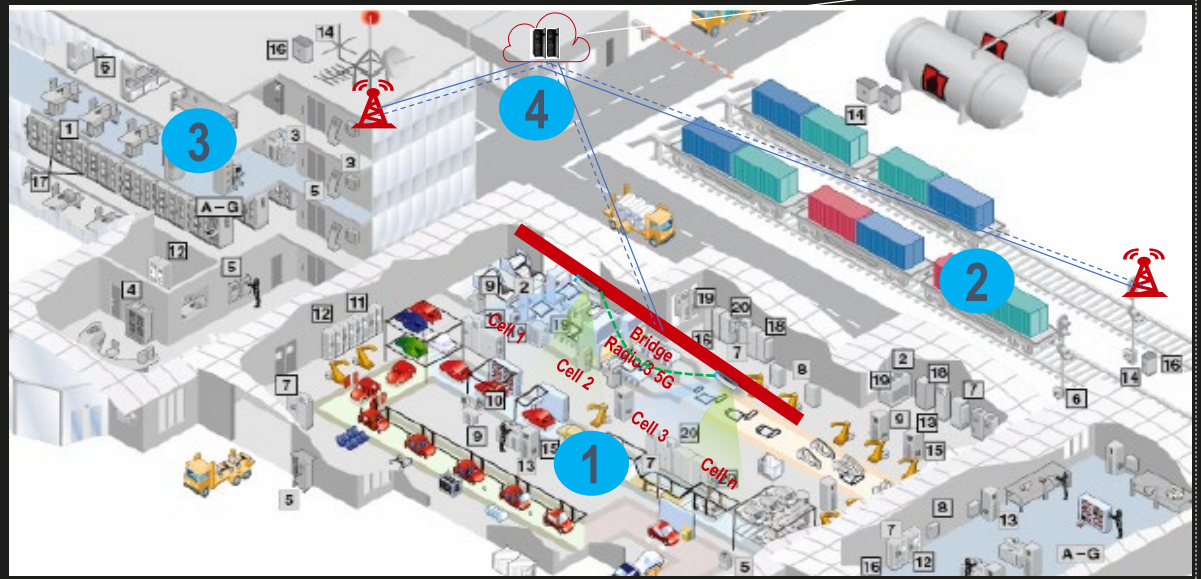
Huawei understanding of a 5G factory campus

Public 4G/5G Network

Private 4G/5G Network



5 FMC Core

1 Production Network

2 Warehousing Network

3 Office & IT Network

4 On-premise Edge Computing

5 Public Mobile Network

Key Highlights

- **5 Categorized network zones**
- SLA needed for security, reliability and flexibility
- 5G introduction with 3 steps (coverage -> performance -> automation)
- Potential Business Models - either a dedicated production 5G network or sliced 5G network

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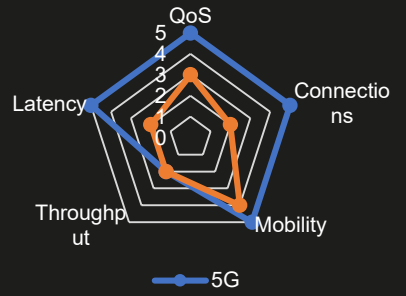
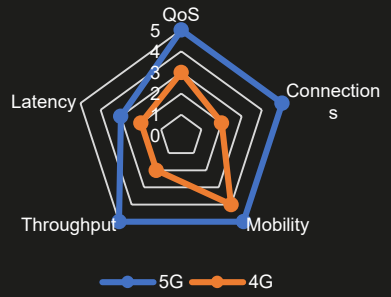
Huawei 5G Solution

Huawei 5G, Leading Industry Transformation

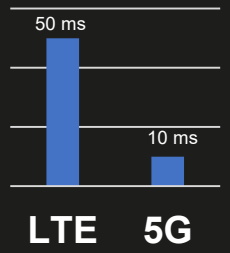
URLLC



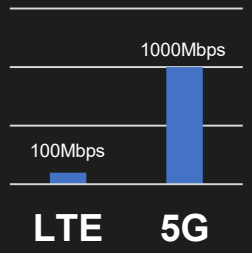
Massive MIMO



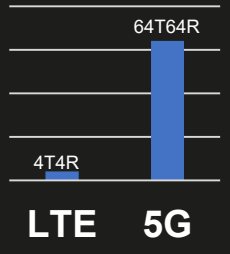
The delay is 1/5 of the LTE network.



The throughput is 10 times that of LTE.

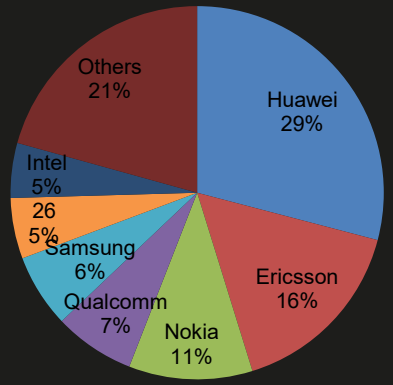


64T64R multi-antenna Improve the coverage capability.

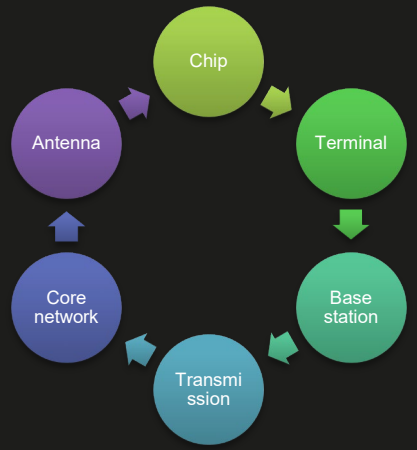


Huawei 5G, the best 5G

5G Technical Contribution



Complete E2E industry chain



- Leading: 5G industry leader, ranking No. 1 in standard technical contribution
- Most successful: Global 50+ commercial/pre-commercial network, delivered 25,000 5G base stations
- Most abundant: Chip, terminal, base station, transmission, core network, antenna, and end-to-end solution

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Huawei Wi-Fi 6 Solution

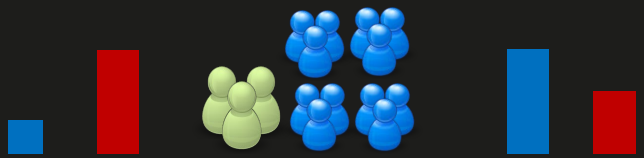
Huawei Wi-Fi 6, Ultimate Customer Experience

Quality office

High-density stadium

Intelligent warehousing

High bandwidth, high density, and low latency



Industry	4x vs Wi-Fi 5 Rate 9.6G	4x vs Wi-Fi 5 1024 Access Count	Decrease by 50% vs Wi-Fi 5 Average delay 20 ms
Huawei	Real environment Maximum throughput	The number of concurrent users is 50% higher than that in the industry.	The latency of key applications is low to 10 ms.

Huawei Leading Wi-Fi 6

- **Phased array antenna: The signal is moving with the human, and the signal of any position in the complex space is the best. 1024 antenna array, which has the strongest anti-interference capability in a complex electromagnetic environment**
- **Lossless roaming: Link establishment and link disconnection, low delay, no packet loss, and no roaming awareness**
- **Dynamic RF: Exclusive three-RF + dual-5G, dynamic frequency selection, dynamic channel allocation, and dynamic bandwidth selection. Adaptive burst access peak, ensuring the available bandwidth for each connection, increasing the number of concurrent single-A-P users by 50%**
- **Intelligent application acceleration: Channel resource scheduling based on application identification. The delay of high-priority applications is less than 10 ms.**

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Some 5G facts in Germany

- By end of 2018, BNETZA published 5G spectrum for public network and for private network
- 3.4-3.7GHz is used by TELEKOM, Vodafone, Telefoninca/O2, and 1&1 Drillisch
- 3.7-3.8GHz is used as private spectrum by industry company
- In July 2019, the regulation of private spectrum usage were published.
- In 2019H2, the renting cost of private spectrum will be published.
- 70+ companies have already applied for pilot spectrum until now, most of them are manufacturing companies.

Thank you.

Bring digital to every person, home and organization for a fully connected, intelligent world.