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5G+Smart Factory Solution

China Mobile International

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Contents

Introduction and Characteristics of Discrete Industrial Industries

Characteristics of discrete industries

- Discrete industries mainly include machining, machine tools, and other processing and assembly industries. Typical products include automobiles, computers, daily appliances, etc. The production and sales units of discrete industries are unified

1

Technological Process

The layout of production equipment is not based on products but on processes, and it is necessary to schedule the processed materials. Therefore, for discrete manufacturing industries facing large-scale inventory production, production equipment needs to be arranged according to the process

2

Material Storage

The raw materials of discrete industrial enterprises are mainly solid, and the products are also in solid shape, so the storage is mostly indoor warehouses or outdoor open-air warehouses

3

Automation Level

Due to the discrete processing nature of discrete manufacturing enterprises, the quality and productivity of products largely depend on the technical level of workers, and automation is mainly at the unit level. Therefore, discrete manufacturing is also a labor-intensive industry with relatively low automation levels

4

Production Plan Management

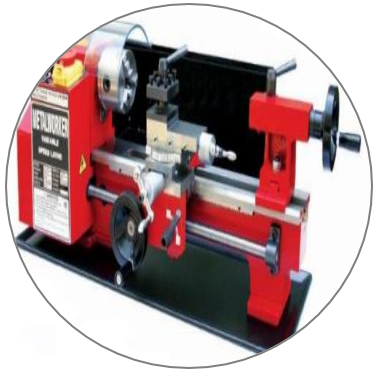
Discrete industries organize production according to orders, and the production process of products often changes. Therefore, the planning of procurement and production workshops requires high requirements for the production planning system, and computers are particularly needed to participate in the planning system work. The efficiency of planning is quite high in discrete industries

Pain Points and Demand Analysis of Industrial Enterprises

Discrete industrial enterprises have a strong demand for intelligent manufacturing in all production factors

- In the process of equipment manufacturing, the core issue of transformation and upgrading is how to start from various elements of the production process, such as **human**, **machine**, **material**, **method**, **environment**, and **measurement**, to achieve **Quality Improvement, Efficiency Increase, Cost Reduction**, and **Consumption Reduction** in the production process, and to enhance the core competitiveness of the enterprise.



Human

- Difficulty in real-time monitoring and early warning of human safety status
- Difficulty in monitoring the level of operational standards among human

Machine

- There are still "dummy equipment" in the workshop, making it difficult to obtain real-time start status
- Old instruments cannot automatically obtain data

Material

- Many components require refined management
- The assembly process is complex and prone to errors

Processing Technology

- Some quality inspections are still manually completed with average accuracy
- The quality of key processes such as welding requires effective testing

Production Environment

- The environment of the processing monitoring may affect the effectiveness of certain precision machining processes

Test

- The experimental testing process may require real-time video and data monitoring, as well as intelligent assistance method

Five Stages of Internetization of Industrial Enterprises

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Connect & Monitor

- Connecting devices for remote control
- Aggregating data to the platform for monitoring and processing
- Reduce downtime, ensure efficient operation and customer experience

Analyze & Predict

- Aggregating data from multiple enterprise level IT systems for analysis and processing
- Using big data analysis tools to gain insight into data
- Optimize processes and improve efficiency based on new insights
- Constructing a Multidimensional Machine Learning Model for Predictive Warning
- Develop standardized solutions for process solidification, cost reduction, and efficiency improvement

Digitalize & Transform

- Realize interconnection and interoperability across systems, devices, applications, and operational services
- Building a diverse and multidimensional deep learning model
- The creation of new lifecycle products, services, and applications

Values

Assets can be controlled/processes can be monitored

Assets Networking Control

Process Monitoring

Assets Performance Management (APM)

Predictable Faults

Fault warning

Fault prediction

Maintenance Specifications

Energy consumption can be evaluated

Use Transparency

Energy Consumption Optimization

Digital Twins

Product Digital

Production Digital

Performance Digital

Virtual Design

Virtual Production

Physical production

Decision Intelligence

EDI interface standardization

Integrated Database

Deep learning

Decision-making model

Artificial Intelligence

Cloud/Edge

Intelligent Manufacturing

Self optimizing system

Artificial intelligence

Accurate control

Production parameter transfer

Business model transformation

NC Machine | Flexible Manufacturing System | Industrial Robots | Supply Chain Network Collaboration | Industrial Internet Platform | IOT

Industrial Ethernet | PLC Communication Protocol | Cloud computing/edge computing | OPC independent architecture protocol/remote control | TSN (Time-Delay Sensitive Network) | 5G

CAD/CAM | ERP/MES | CRM/SCM/SRM | Big Data | Artificial Intelligence | AR/VR

Introduction to 5G+Industrial Segmentation Industry

◆ Focusing on key sub industries such as **electrical equipment, aviation manufacturing, automotive and spare parts, general and specialized equipment manufacturing, electronic information, clothing and textile industries**, we have standardized solutions for sub industries and promote and implement them in the form of products and projects across the entire network.

Solutions

- Customized solutions
- Battle building collaboration and customer demand analysis;
- Pre-sales technical support … …

Project Delivery

- Integration before and during sales
- Deep cultivation of key projects
- Products, R&D into projects … …

5G Industrial Private Network Advantages

5G Has Stronger Anti-interference Ability

- The frequency band used by WiFi is the public frequency band
- The frequency band used by 5G networks is dedicated by operators

Poor anti-interference ability of WiFi network
5G has higher security and reliability

5G Meets High Concurrency Data Carrying Demands

- Lack of WiFi channels and limited resources
- 5G has high bandwidth characteristics

WIFI network suffers from severe interference in multi-user situations
5G can carry high concurrency and large data volume services

5G Ensure Ultra-low Latency and Wider Coverage

- WIFI latency is unstable, and the increase in users leads to increased latency
- 5G networks can reduce latency and increase coverage through industry customization

5G networks have stronger customization capabilities
Meet diverse business needs

5G Can Achieve Fast Switching

- Fast moving objects cannot be switched under WiFi connection
- 5G network can achieve data switching in fast mobile scenarios

5G network can achieve reliable data transmission

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Introduction to 5G+Smart Fully Connected Factory Business Scenarios

5G fully connected factories can empower and improve the five business processes of enterprise production and manufacturing, office management, logistics supply, sales services, and smart parks.

Manufacturing

Target: Quality and efficiency improvement, agile manufacturing

Systems: ERP, MES, SCADA, PLC, CNC machine tools, industrial robots

Scenario: 5G+edge computing and future uRLLC support machine vision and industrial control applications; 5G+Cloud to Realize Cloudization of Production and Manufacturing Systems

Office Management

Target: Improve the efficiency of internal operational management within the enterprise

Systems: OA, financial management, HRM, collaborative communication, video conferencing, etc

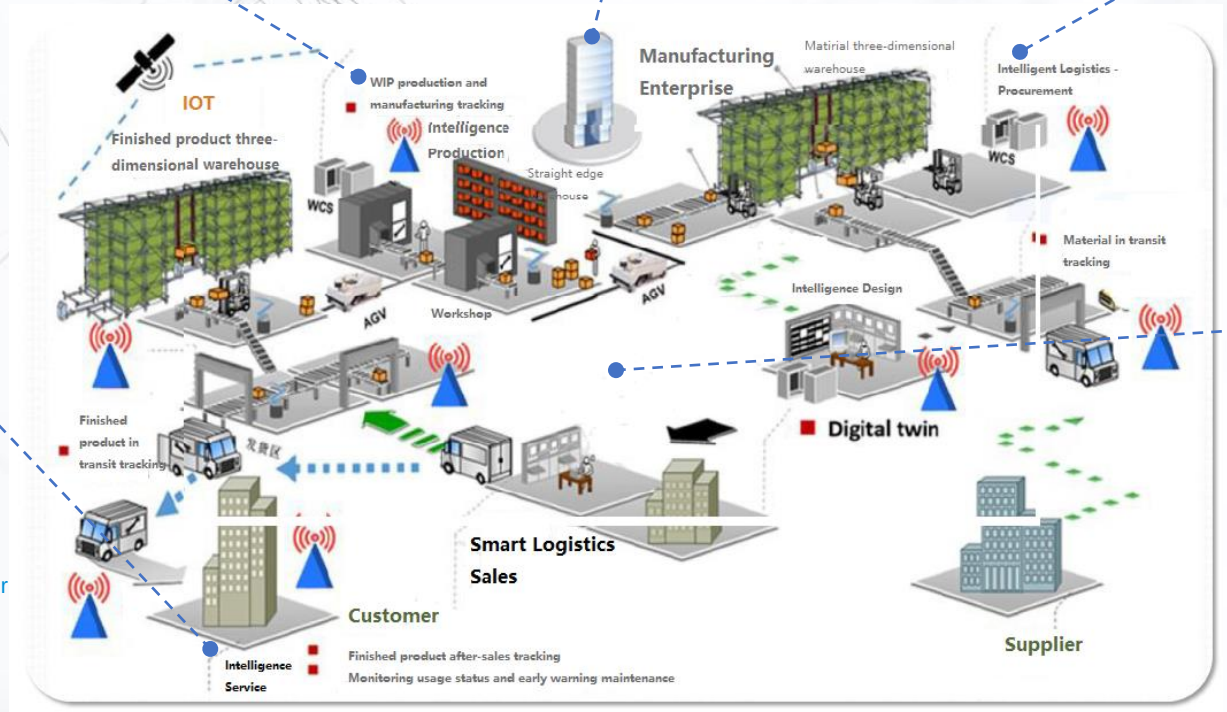
Scenario: Mobile applications such as 5G based cloud phones and high-definition video conferencing to improve office efficiency

Logistics Supply

Goal: Connect upstream and downstream, improve delivery efficiency, and reduce inventory

System: SCM, WMS, Library, AGV

Scenario: High bandwidth and mobility services such as factory logistics and park video surveillance, based on cloud deployment+5G bearer, as well as mobile control such as AGV



Sales Services

Goal: To ensure and improve customer satisfaction

System: enterprise website, e-commerce platform, CRM, call center, predictive maintenance, etc

Scenario: Based on cloud services and 5G capabilities, provide customers with new applications such as VR/AR (such as product experience) to better support model innovation

Smart Park

Smart park presented separately

Goal: Safe, efficient, and intelligent park supporting facilities

System: security monitoring, access control, attendance

Scenario: 5G serves as a backhaul for high traffic and connectivity scenarios in the factory area, such as video surveillance

Industrial Internet applications with 5G as the core run through the main business processes of industrial enterprises, with production & manufacturing scenarios as the core

5G+ Smart Factory Integrated Solution Architecture

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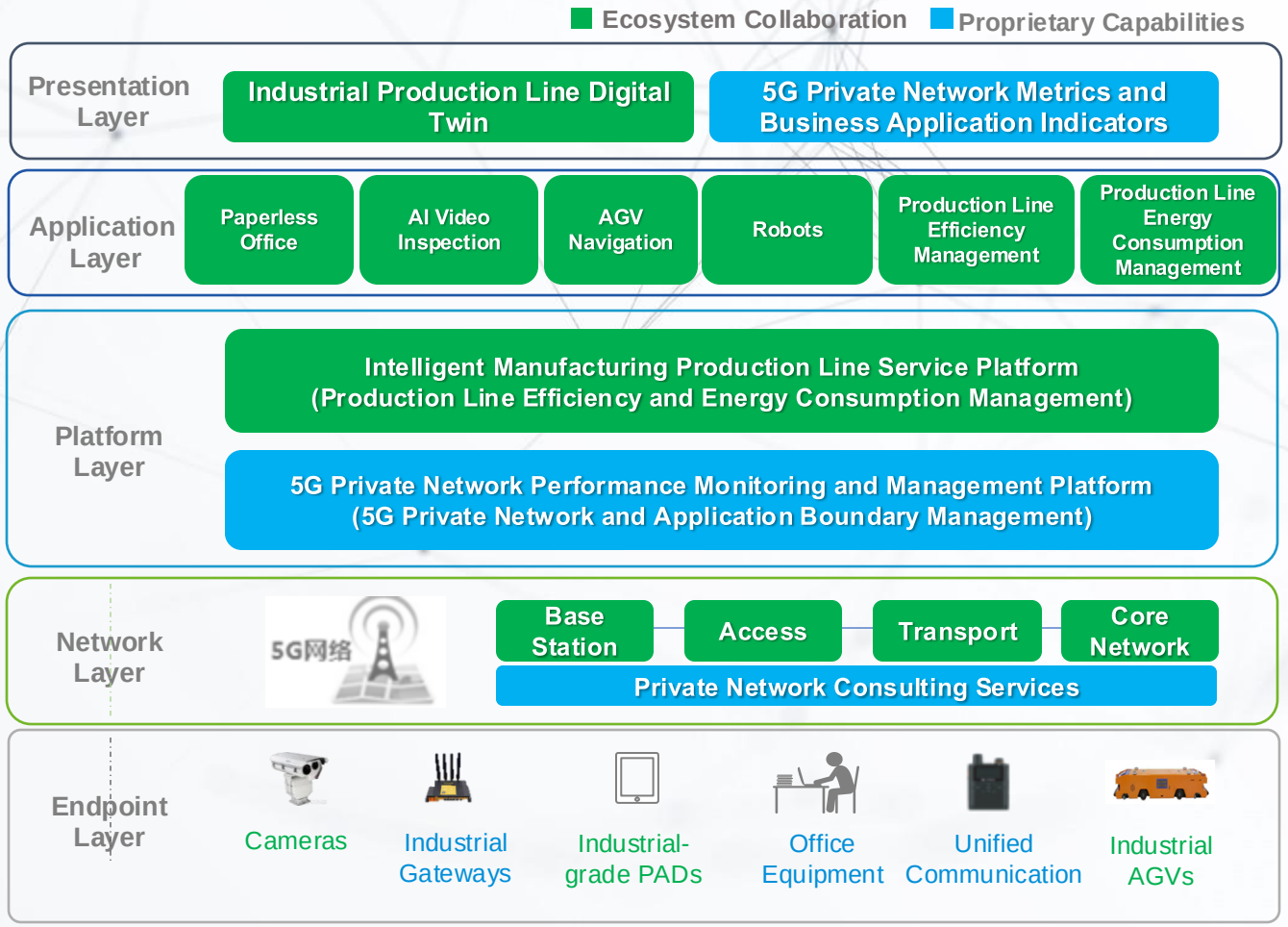
China Mobile provides comprehensive solutions for the industrial sector through 1 industry-specific private network + 2 service platforms + N application scenarios, collaborating with industry partners to offer customers integrated digital transformation services for smart factories.



➢ 6 Major Application Scenarios

①Paperless Office ②5G High-Definition AI Video Inspection ③5G Robots ④5G AGV Navigation⑤Industrial Production Line Efficiency Management⑥Industrial Production Line Energy Consumption Management. These six application scenarios meet the requirements for intelligent factory construction.

➢ Two Service Platforms (5G Private Network and Industrial Applications)

Intelligent Manufacturing Production Line Service Platform: This platform is based on industrial big data for production line equipment data collection and intelligent operation and maintenance management. It enables intelligent operation and maintenance analysis for complex automated production lines, including applications in discrete manufacturing industries such as automotive manufacturing, new energy batteries, and mechanical processing.

5G Private Network Performance Monitoring and Management Platform: This platform utilizes network probe deployment and data collection at the core network's N3/N4/N6 interfaces to gather network and business metrics. It enables the rapid identification of issues on the network or business side.

➢ One Industry-Specific Private Network

New Infrastructure: A 5G private network is established for the construction of smart factories, meeting the requirements of low-latency and high-bandwidth scenarios such as AI quality inspection on production lines, industrial robots, and AGVs (Automated Guided Vehicles). This solution avoids issues like AGV interruptions caused by network switching in WiFi environments, enhancing factory efficiency and improving data security.

5G+ Smart Factory：5G New Industrial Gateway Product

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Model	Minimalist Industrial Gateway DC2000	5G Computing Gateway EA1000
CPU	Cortex-A53 4 Core	Cortex-A72 2 Core + Cortex-A53 4 Core
Memory	2GB	4GB
Storage	16GB	64GB
GPU	Not Support	Mali-T860MP4 GPU Support H264/H264 4K video processing Supports OpenGL ES1.1/2.0/3.0/3.1, OpenVG1.1, OpenCL, DX11
OS	Ubuntu	Debian
Wireless Interface	5G(NSA/SA)	5G(NSA/SA)、WIFI6
Interface	2*GE、1*USB3.0、1*Micro USB	2*GE、1*Console、2*USB3.0、1*HDMI、1*RS232、1*RS485、1*CAN
Industrial Protocol	40+ Mainstream industrial protocols including Modbus, Siemens series, Mitsubishi series, Delta series, etc.	40+ Mainstream industrial protocols including Modbus, Siemens series, Mitsubishi series, Delta series, etc.
Software	VPN (GRE/IPSEC/L2TP/L2TP over IPsec), 5G side quality probes, bridges, routers, VLANs, DDOS protection, ACL, QoS, remote operations and maintenance, etc.	VPN (GRE/IPSEC/L2TP/L2TP over IPsec), 5G edge quality probe, lightweight AI, bridge, routing, VLAN, DDOS protection, ACL, QoS, remote operation and maintenance, etc.
Virtualization Support	Support	Support
Power	DC 9-36V Wide Voltage	DC 9-36V Wide Voltage

Function:
Industrial data collection

5G+ Smart Factory：1 5G Factory Safety Network (To ensure Data Keep in Factory)

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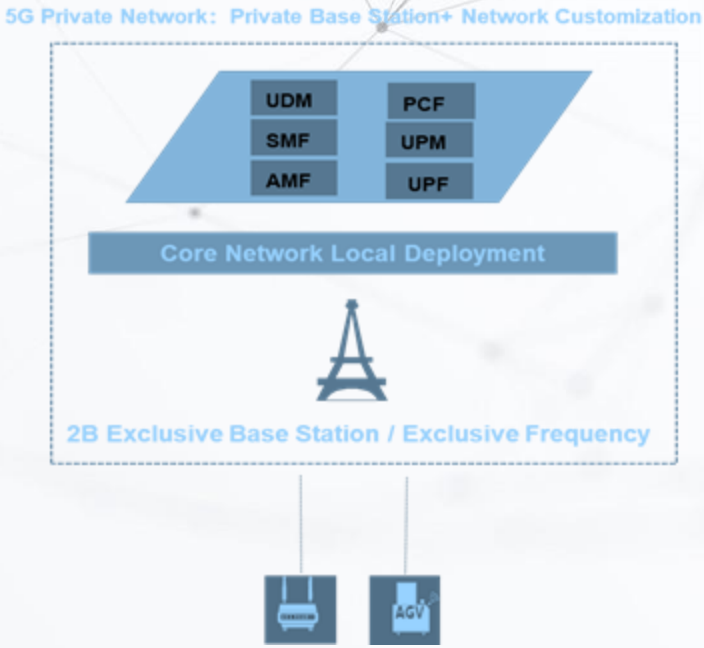
As the "backbone" supporting the industrial internet system, industrial networks **provide important infrastructure capabilities for the implementation of smart factories. We can collaborate with local operators to provide 5G industrial private network services for factory users, achieving full production process and no dead-end network coverage, and have the characteristics of flexible deployment and low operation and maintenance costs.**

- Based on the degree of network specialization and the characteristics of industrial enterprises' demand for wireless transmission networks, two network mode services, exclusive and exclusive, can be selected according to customer needs, providing collaborative spectrum, customized networking differentiated services, universal terminals, intelligent operation and diversified capabilities

To Build 5G Private Network

- By leasing spectrum from local operators or jointly building 5G independent private networks with local operators, the application needs of various factory scenarios can be met through dedicated base stations, frequencies, network resources, etc., providing high security and high isolation services.



5G Private Network Consultancy Service

- Relying on China Mobile's rich experience in private network construction, we assist overseas local operators in building independent 5G private networks, effectively ensuring the scenario application use of customers in the smart factory industry.

Contents	Deliverables
Analysis of Wireless Network Construction Demand	✓ Distribution of business hotspots ✓ Business Forecast Report ✓ Value Area Analysis Report ✓ Network structure analysis report
Wireless network coverage planning	✓ Wireless network coverage planning indicators ✓ Scenario based wireless network coverage scheme ✓ Radio network coverage prediction report
Wireless network capacity planning	✓ Cell level capacity prediction analysis report ✓ Scenario based capacity expansion solution ✓ Capacity expansion indicators and suggestions for capacity expansion methods
High precision simulation (Corresponding precision digital map is required)	✓ Localized 4/5G wireless propagation model correction (if necessary) ✓ Wireless network simulation report ✓ High precision three-dimensional simulation report (local key areas can be provided if necessary)
Scenario engineering scheme consultation	✓ Scenario based equipment selection scheme ✓ Suggestions on BTS parameter configuration ✓ Project investment estimation ✓ Scenarios Days ✓ Feeder Project Scheme ✓ Wireless network construction scheme

5G+ Smart Factory： 1 5G Private Network Performance Monitoring Platform

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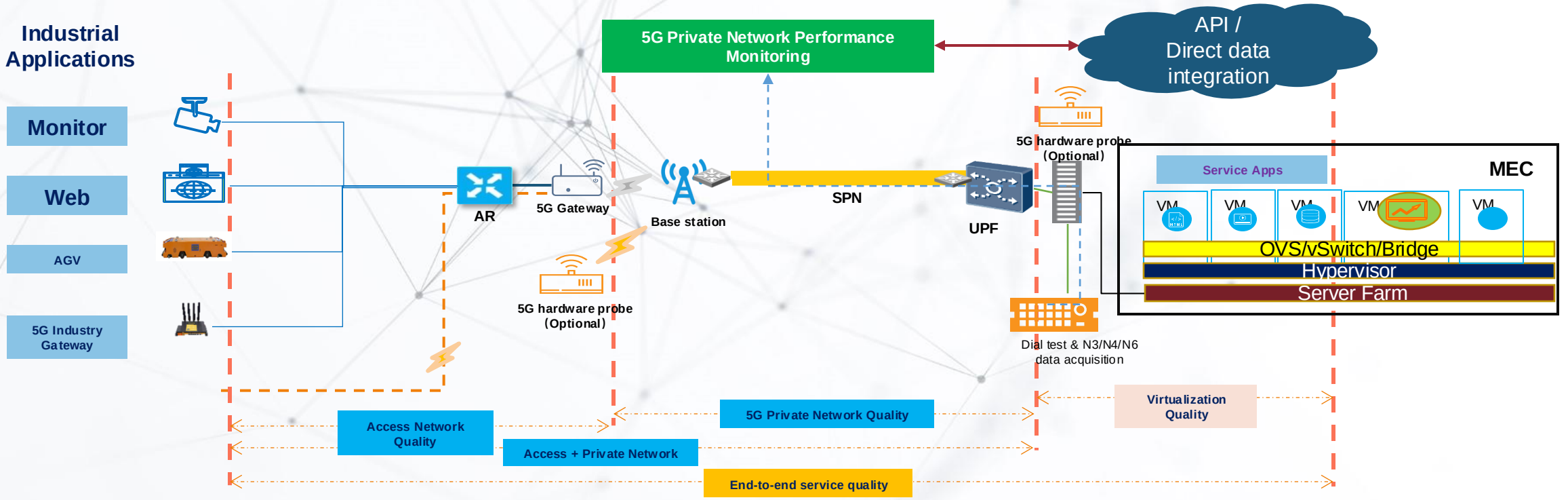
- Based on the ability of active dial test and traffic collection and analysis, collect and analyze the status performance data of end-side equipment and the status data of heterogeneous network equipment, so as to provide dynamic visual monitoring of smart factory network and service quality, and realize the functions of network and service quality monitoring, patrol inspection, statistical analysis, quality warning, fault diagnosis and demarcation, etc.



If adding 5G hardware probes:

1. Network quality analysis can be conducted in segments (**highlighted in blue text**), such as network quality analysis from terminal devices to 5G gateway devices, 5G gateway devices to the core network, and from the core network to business apps;
2. Network indicators and transmission quality indicators that can be analyzed include: latency, packet loss, jitter, bandwidth rate, TCP connection delay, TCP connection success rate, client delay, and server delay

The soft probe and N3/N4/N6 interface data collection can analyze the end-to-end business quality from the terminal side to the business apps side (**highlighted in yellow box content**), mainly including the analysis of the following business indicators:

1. Browsing and downloading services, including TCP link building delay, HTTP service response delay, HTTP request success rate, etc.
2. Video services, including bit rate, encoding, rate, latency, packet loss, lagging/flickering, success rate, anomaly monitoring, etc3. The specific N3/N4/N6 indicators can be found on the next page.

5G+ Smart Factory： 1 Intelligent Manufacturing Production Line Service Platform

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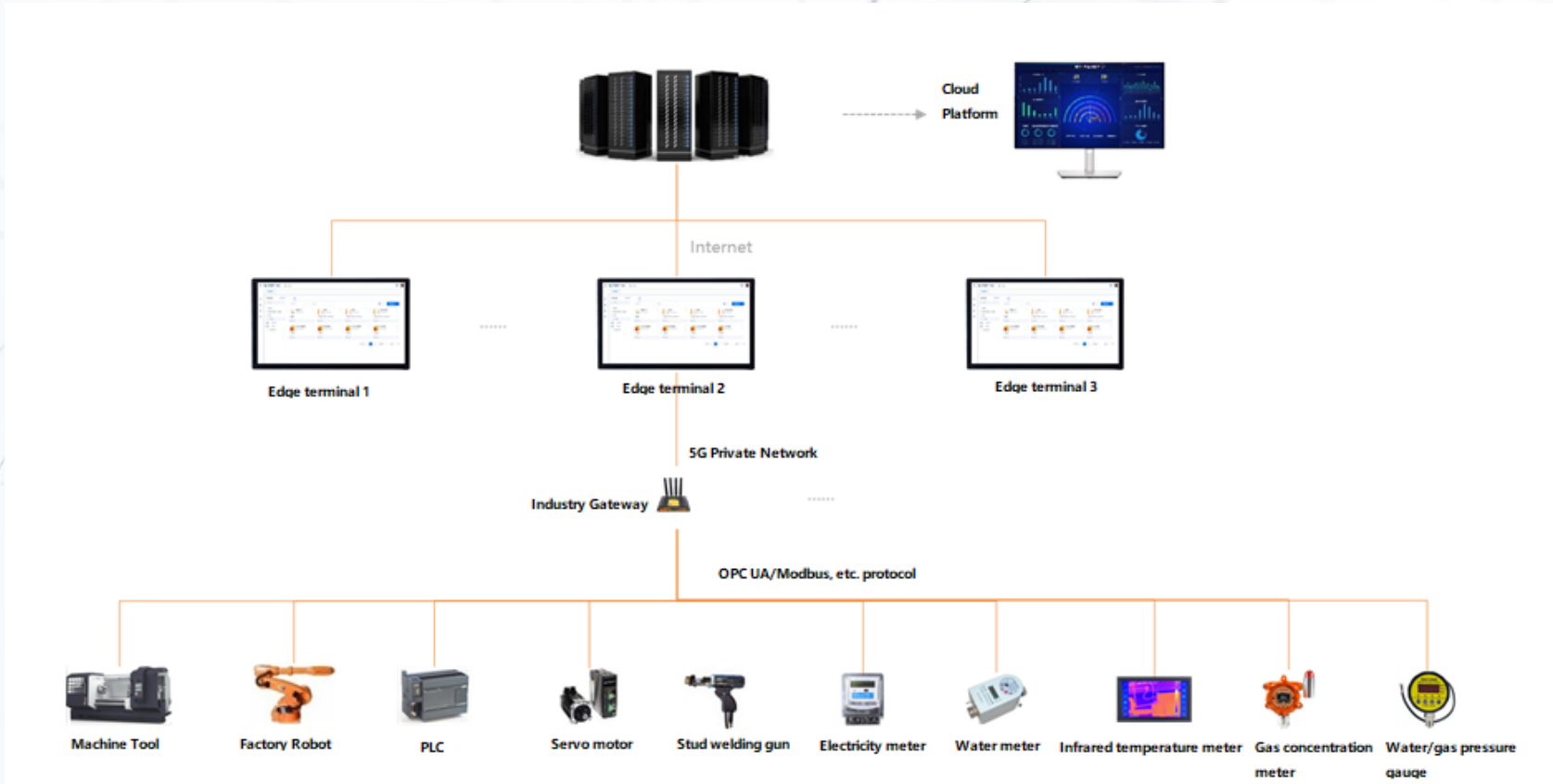

Production and manufacturing application scenarios

5G+ Smart Factory： N Smart Application Scenarios

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Overall Factory

Digital Twin Centralized Control Command Center

- Real time scheduling of production plans, logistics, quality, equipment and other abnormal issues
- Dynamic monitoring of key elements such as production progress, employee performance, and production line balance

Warehousing Distribution

Material Positioning Navigation

- Assist in the positioning and navigation of large outdoor materials, assets, or equipment

5G+AGV Collaborative Work

- Improve material transportation efficiency and enhance factory automation

Intelligent Logistics in Factory Area

- Improve the logistics management level of enterprise parks, reduce transportation costs, and improve transportation efficiency

Product Development

5G+AR collaborative R&D design

- Realize remote R&D personnel to share models through AR, discuss based on models, and reduce travel and time costs

Quality Control

Visual Quality Inspection

Using machine vision instead of manual quality inspection to improve the accuracy and efficiency

Vision Measurement

Utilizing lightning vision technology to achieve U-shaped arm, bending detection, suspension arm deformation measurement, etc., improving measurement accuracy

Material Traceability

Utilize RFID and other technologies for material traceability

Technological Design

Electronic SOP

- Using AR glasses to retrieve homework instructions saves time and costs, improves homework efficiency, and reduces trial and error costs

AR measurement markers

- Replacing the original manual measurement and manually marking the position operation workflow, improving work efficiency and accuracy

Assets Management

Equipment Fault Diagnosis

Realize early warning of critical operating parameters of equipment and abnormal system data, and automatically generate repair work orders

Equipment Fault Prediction

Implement monitoring and prediction of potential malfunctions in robot systems

Production Operation

5G Device interconnection

- Utilizing 5G to replace traditional wired and achieve flexible deployment of devices

Fault Diagnosis

- Establishing a knowledge graph through big data for accurate fault identification and prediction

After-Sales Service

5G+AR Remote Expert Diagnosis

- Utilizing 5G+AR technology, real-time display of on-site conditions allows experts to diagnose faults remotely

5G+ High Precision Positioning

- Utilize 5G+high-precision positioning technology to achieve real-time control of equipment position

5G+ Smart Factory：5G Paperless Office（Data Safety）

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Paperless Office

- Utilize technologies such as 5G PDA and SOP electronic operation manual to achieve remote control of equipment and assist on-site workers in their operations. At the same time, the detection results are recorded and managed by the backend, and statistical analysis reports are displayed.

Requirements

Remote Control of Equipment

- By using devices such as 5G and PDA, remote control of on-site equipment can be achieved. By issuing control commands, remote operation and control of production on-site equipment can be carried out 。

Document Circulation

- Transfer electronic files through PDA and issue electronic operation manuals for on-site operators to review.

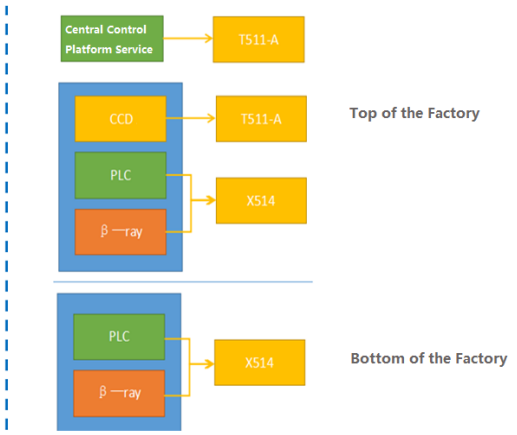
Reporting of Test Results

- The on-site staff will fill in the test results through PDA and transmit them to the backend through 5G network.

Solutions

- Connect the front-end PLC β- The information data such as ray and PIN pin adjustment are transmitted to the edge central control server, and the intelligent PDA controlled remotely is also connected to the edge central control server through a 5G network;
- Authorized management personnel have achieved real-time optimization of front-end equipment production parameters at any location within the factory area through remote intelligent PDA, saving more than 50% of technical personnel labor costs 。

Device Type	Interface	Data Direction	Bandwidth
CCD	RJ45	Uplink	40mbps
PLC	RJ45	Both	10mbps
B-ray	RJ45	Uplink	10mbps
Central Control System	RJ45	Downlink	500mbps



Cases

Germany XXX Company

Measures:

- Utilize 5G PDA for file circulation and reporting of detection results to achieve remote equipment control.

Effect:

- Improve production efficiency and reduce error rates;
- Implement remote operation of equipment and issue control instructions to on-site staff;
- Form a history of operations for easy retrieval.

5G+ Smart Factory：5G Machine Vision Quality Inspection

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5G Machine Vision Quality Inspection

- 5G machine vision quality inspection is aimed at the inspection process of factories. By combining 5G technology with machine vision technology, high-definition images of products are transmitted in real-time to the cloud data processing system. After image recognition, judgments and control commands are issued to achieve automatic product quality detection and alarm. This can improve the efficiency of raw material and finished product quality inspection in various stages of the production line and reduce quality inspection costs.

Requirements

Poor Detection Accuracy

- Artificial vision quality inspection and traditional machine vision quality inspection have low efficiency and low accuracy

Poor Production Environment

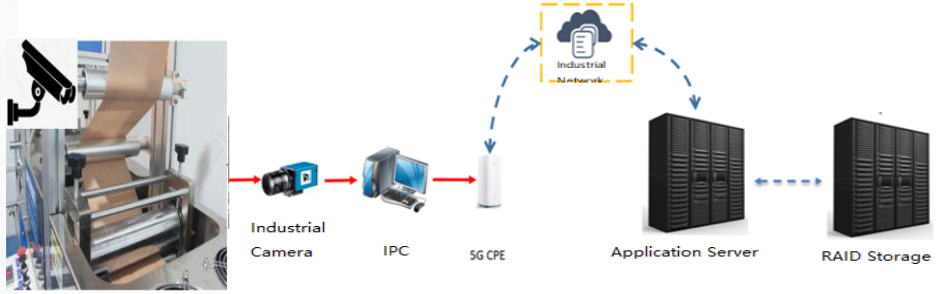
- There are dangerous work situations that are not suitable for manual work or situations where the human eye cannot meet the requirements, leading to issues such as missed inspections, false detections, and low efficiency 。

Intermediate Products can't be Detected

- In some actual production line processes, it is not possible to conduct quality testing on products in the intermediate process

Solutions

- Utilizing 5G machine vision quality inspection equipment, it is used to solve the problems of high skill requirements for personnel in production scenarios such as coating, relying solely on personnel for quality control, difficult equipment management, and overlapping work with multiple personnel.
- Based on the high-definition image transmission requirements of multiple 8K line scanning cameras (10-20M for a single photo) attached to a single 5G terminal in machine vision scenarios, 4.9Ghz PRRU is deployed pointwise on the factory line for network reinforcement, achieving a peak transmission rate of 400Mbps upstream and 700Mbps downstream.
- Connect the CCD upper computer on the coating and other factory lines through a 5G network β Ray upper computer and coated PLC terminal data are connected to the central control console to achieve centralized monitoring of the entire workshop data.



Cases

XXX Company Battery Cell Quality Inspection

Measure:

Through machine vision quality inspection technology, intelligently inspect the battery electrode and ear.

Implementation effect:

- Effectively solve the problems of substandard safety production, manual inspection omissions and errors, and low efficiency,
- Reduce labor costs by 30%

XXX Electric Appliances Company:

Measures:

achieve defect detection of the air conditioning chassis, detect whether the air conditioning chassis welding parts are present, and provide real-time alarms for abnormalities.

Implementation effect:

- The defect detection rate reaches 99.99%
- Reduce production costs by 10%

5G+ Smart Factory： 5G Machine Vision Interpretation Code

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Visual Code Reading and Decoding

- 5G machine vision OCR decoding is designed for scenarios such as product packaging code reading, product surface OCR, and classification. It can transmit high-definition images of product surface inkjet codes in real-time to AI platforms. After image correction, inkjet recognition is carried out through deep learning, achieving remote transmission and analysis of decoded data, solving the pain points in manual copying and statistics, saving labor costs, and improving recognition accuracy.

Requirements

High Labor Cost

- Some digital dials do not have external data transmission interfaces and require manual copying of dial data;

Misjudgment and Omission

- There are errors and omissions in manual testing, as well as poor consistency. There are also errors and omissions in manual testing, and the consistency of testing results among different quality inspectors is poor;

Low Detection Rate

- In high-speed assembly line detection scenarios, manual detection cannot be complete;

Solutions

- Based on 5G technology, implement a 5G+intelligent inspection application scenario solution, which achieves OCR automatic meter reading, environmental automatic monitoring, and remote collaboration through inspection robots, smart helmets, and AR glasses.

Instruments Equipment

Industrial Camera

5G CPE

5G Access Network

Industrial AI Cloud Platform

MEC

Cases

XXX Steel Company

Measures:

Automatically detect steel plate spray codes through machine vision to avoid missed and erroneous inspections, and reduce labor costs

Implementation Effect:

- ➢ Effectively solve the problems of substandard safety production, manual inspection omissions and errors, and low efficiency,
- ➢ Reduce labor costs by 30%

China Airlines XXX Company

Measures:

By using terminal AR Glasses+Pad+Large screen, it can achieve image and text transmission, OCR recognition, workflow prompts, spatial annotation, and other capabilities.

Implementation Effect:

- ✓ Effectively alleviate the difficulties of limited expert personnel and remote equipment maintenance;

5G+ Smart Factory：5G AR Remote Collaboration

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AR Remote Collaboration

- 5G AR remote collaboration combines 5G technology with AR technology, and is a high-definition audio and video communication tool based on AR technology. This means that on-site personnel wear AR glasses, initiate high-definition audio and video calls to technical experts, and collect and share the first view of the scene in real-time; Technical experts use platform tools to assist on-site personnel in completing corresponding tasks, in order to improve remote collaboration efficiency and save on-site support costs.

Requirements

Immediate Repair

- The composition of industrial equipment systems is complex and there are numerous components, which require timely maintenance in case of malfunctions.

Remote Guidance

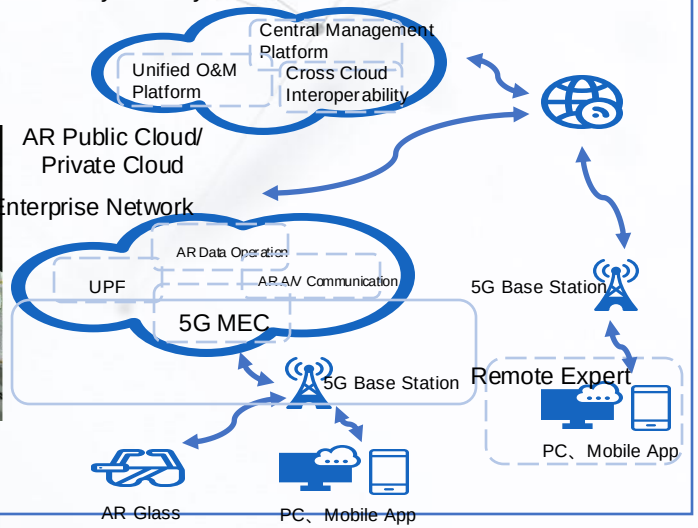
- The flow of frontline maintenance personnel is large and the level of personnel is limited, making it difficult to solve complex equipment failures. We need to wait for the equipment's original factory experts to go to the site for troubleshooting and maintenance, which will affect the normal production of the production line.

Collaborative Work

- Present the on-site situation from the first perspective, assist on-site and remote experts in collaborative operations.

Solutions

- Multi terminal access: Support access to AR hardware of different brands and models, freeing up the hands of on-site personnel;
- High-definition audio and video communication: 5G transmission can achieve first view high-definition video and high-fidelity voice, avoiding lag and delay phenomena;
- Freeze screen annotation and real-time annotation: Background technical experts can pause the communication screen with one click, or directly perform real-time annotation on the screen, and synchronously provide feedback to on-site maintenance personnel.
- Multi party collaboration: Supporting application scenarios for multi party collaboration such as one-to-one, one-to-many, and many to many.



Cases

XXX Commercial Development Project:

Measures:

- Implement functions such as realistic rendering, spatial perception, image and text transmission, image recognition, workflow prompts, and spatial annotation

Effect:

- Improve research and development efficiency by 10%;
- Increase production efficiency by 20%;
- 2% reduction in labor costs

XXX Steal Company:

Measures:

- Utilize 5G and AR technology to solve the problem of foreign engineers unable to guide equipment assembly on site during the epidemic period.

Effect:

- Greatly reduces labor costs, improves efficiency, and increases overall efficiency by 20%.

5G+ Smart Factory：5G AR/VR Training Operation

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AR/VR Training

The 5G AR/VR operation training scenario combines 5G technology with AR and VR technology for operation training, helping manufacturing enterprise experts deposit operation guidelines for complex mechanical equipment in the AR effect editor tool. Operators use AR glasses to visualize the parts manual and operation manual of industrial equipment, reducing the cognitive cost of complex machinery for enterprise employees and reducing the training cost of the enterprise.

Requirements

Timeliness of Operation

- The composition of industrial equipment systems is complex and there are numerous components, which require timely maintenance in case of malfunctions

E-TRAINING

- New employees often find it difficult to perform such maintenance operations without receiving training and guidance.
- Experienced teacher Fu needs a lot of practice in the enterprise, making it difficult to cultivate a large number in the short term.

Improve Training Efficiency

- How to efficiently share the experience of skilled workers with new employees and reduce their skill acquisition cycle

Solutions

- AR business visualization: Based on machine vision capabilities, achieve recognition of two-dimensional images and complete AR business visualization;
- AR Material Management: Provides a tool for AR/VR operation training, which can create, edit, and publish AR effects on different types of multimedia materials (such as text, images, videos, models, etc.);
- AR remote collaboration integration and control: Based on OnePower Industrial AR Effect Editing Tool, integrating AR remote collaboration business capabilities, achieving linkage and control of industrial AR business capabilities AR visualization, job guidance, and remote collaboration.

Cases

XXX Industrial Strength Institute

Company：

Measures:

Upload the aircraft model file to the AR cloud platform, and the intelligent glasses will call up the aircraft model with adhesive tape and strain gauge position and size data one-on-one with the on-site testing machine, guiding employees to operate.

Effect:

- Reduced the time cycle for classroom teaching and offline teacher training;
- No need for lecturers and experts to teach for a long time, and can learn repeatedly and independently;
- Improve the work efficiency of beginners and newcomers, quickly get started, and reduce mistakes;
- Improve production safety and product quality;
- Improve production efficiency and reduce error rates.

5G+ Smart Factory：5G Cloud AGV

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Cloud AGV

- The 5G cloud based AGV scenario is mainly aimed at the logistics scheduling process within the factory. The AGV car integrates positioning through various technologies such as vision, radar, and wireless. It uploads position and motion information in real-time through a low latency and high reliability 5G network, enabling the AGV to perform on-site logistics transportation operations after receiving tasks or remote control, improving the automation level of the production line.

Requirements

Improve Logistics Efficiency

- Relying on manual handling results in low efficiency and a serious increase in occupational safety risks.Mainly stacked on flat ground, with low storage utilization rate and serious waste of storage space.

Reduce Cost

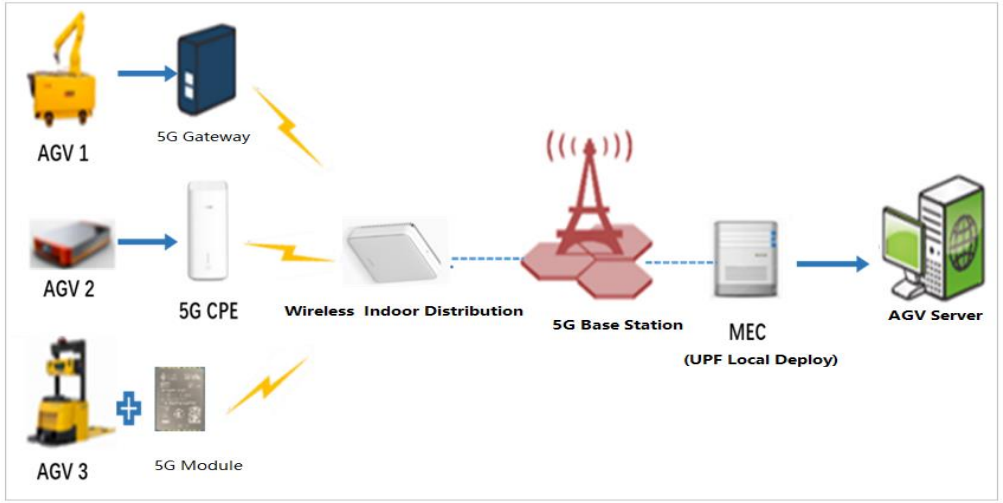
- High labor costs, high personnel turnover, and the impact of mood, fatigue, etc. are not conducive to the continuous and stable operation of enterprise logistics, increasing the operating costs of the enterprise.

Improve Aesthetics

- Utilize a central dispatch system to uniformly dispatch vehicles, plan routes, and control the distribution of vehicles in a seamless manner to enhance the aesthetics of the workshop.

Solutions

- The mode of laser radar+cloud SLAM is used for area detection and route planning. The cloud server and 5G edge computing nodes are deployed near the plant line. The 5G network features low latency and wide connectivity for real-time data update.
- Used in transportation scenarios such as automatic cell launch, module automatic transfer, and line side material circulation distribution, it improves delivery accuracy and inventory turnover while saving labor costs.



Cases

XXX Machinery Company

Measures:

- Utilize 5G network communication technology, deploy workshop AGVs, achieve automation of material flow between various workstations, and achieve unmanned transfer of vehicles through positioning and scheduling control.

Effect:

- The efficiency of factory logistics has been improved, saving over 70% of labor, improving inventory capacity and material flow capacity.
- 5G support, stable operation, supporting 99.95% stable operation time

5G+ Smart Factory： 5G Production Safety Behavior Analysis

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5G Production Safety Behavior Analysis

- 5G production safety behavior analysis is aimed at the video surveillance security control requirements of smart factory workshops, factory areas, etc. It combines 5G technology with AI video structured analysis technology to achieve terminal and cloud system integration. Utilizing the large bandwidth and high reliability characteristics of 5G network, the video stream is real-time transmitted back to the monitoring platform system, and after AI detection and recognition, violation records are generated to improve the safety management level of smart factories.

Requirements

High Labor Cost

- The number of internal management personnel in the park is insufficient, making it difficult to comprehensively supervise and control numerous violations, and the dependence on personnel is too strong.

Misjudgment and Omission

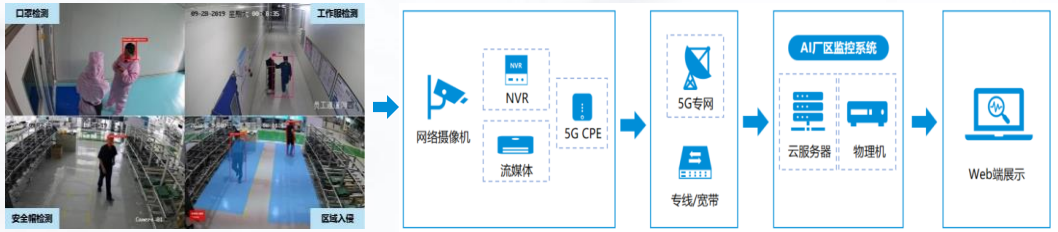
- There are errors and omissions in manual testing, as well as poor consistency. There are also errors and omissions in manual testing, and the consistency of testing results among different quality inspectors is poor;

Low Detection Rate

- In high-speed assembly line detection scenarios, manual detection cannot be complete;

Solutions

To address the production safety issues of employees in the XXX factory, we provide identification of employee safety attire regulations, monitoring of hazardous behaviors in the work area, production safety monitoring and hazard source detection, and detect whether employees' attire meets safety protection standards. This includes intelligent detection of safety attire such as helmets, work clothes, masks, safety shoes, and protective glasses; Intelligent detection for dangerous behaviors such as smoking, using mobile phones, and falling; Simultaneously detecting dangerous area intrusion, wall crossing detection, off duty detection, open flame detection, etc; Reduce safety hazards in factories and create intelligent supervision workshops.



Cases

XXX Electric Appliances Company：

Build a 5G private Network+AI visual electronic fence security system application solution, and establish an AI factory monitoring application system on the basis of the 5G private network.

Implementation Effect:

- Avoiding the problem of missed inspections in traditional security operations
- Reduce manual inspection costs by 60%

XXX Rubber Company:

Measures:

Through 5G network and camera, personnel fall detection, safety helmet detection, and tooling detection are achieved, and alarm information is uploaded to the security platform.

Implementation Effect:

- Reduce labor costs for security control by 50%

5G+ Smart Factory: 5G Production Line Efficiency Diagnosis

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5G Production Line Efficiency Diagnosis

- 5G Smart Factory production line efficiency is primarily achieved through 5G technology to enhance production efficiency, reduce costs, increase flexibility, promote environmental protection, enable real-time data collection and monitoring, connect and automate equipment, improve network performance and reliability, and facilitate on-site adjustments and maintenance. These factors work together to drive the digital transformation and intelligent upgrade of the manufacturing industry.

Requirements

Production Line Monitoring

Overall production line monitoring issues include:

- Lack of real-time production monitoring
- Information transfer relies on on-site personnel

Production Line Statistics

- Lack of equipment-level data statistics on the production line
- Insufficient report dimensions, lack of conclusions, making the reports difficult to use

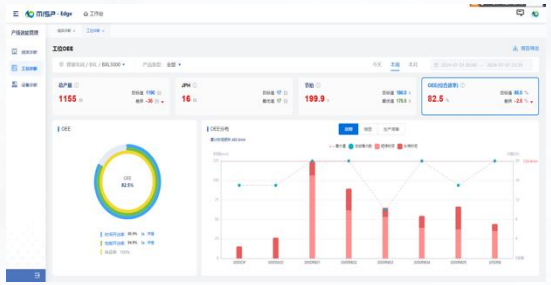
Production Line Analysis

- Takt time analysis relies on experience or hardware, leading to high costs
- Takt time analysis cycle is long

Solution

Solution: Through the Intelligent Manufacturing Production Line Service Platform's Efficiency Management Module, create an "**Efficiency Diagnosis Hospital**" for automated production lines.

Features	Indicator Name	Industry Solution	MINO Solution
Full Dimensions	Statistical Dimensions	3	5
Real-time Monitoring	Data Collection Period	Minute-level	Second-level
Lightweight Delivery	Delivery Cycle	Monthly	Weekly
	Project Cost	Hundred Thousand/Million-level	Thousand-level/Ten Thousand-level
Openness	System Openness	Closed	Open API
High Value	Production Increase Services	None	Yes



Values

Full Dimensions: The industry production management system focuses on the **workshop**, **area**, and **production line** levels. The MINO system supports the **workshop**, **area**, **production line**, **workstation**, and **equipment** levels.

Real-time Monitoring: Real-time monitoring of on-site production at the **second level**, with **remote control** of production dynamics and immediate abnormal alerts.

Lightweight Delivery:
Short project cycles, typically weekly or monthly, with low investment costs, estimated to be in the range of thousands to tens of thousands.

Openness: The platform supports **self-developed data collection** or **third-party data integration**, and allows for platform **expansion** of applications or interaction with **third-party applications**.

High Value: Provides turnkey, **worry-free production services**, offering customers a **full chain solution** that includes health checks, diagnostics, and optimization.

Product Reliability:
The MINO data collection solution will add PLC MISP data blocks, typically with memory size **<100k**, memory impact **<0.5%**, and scanning cycle impact **<1ms.**

5G+ Smart Factory: 5G CNC Machine Efficiency Optimization

5G CNC Machine Efficiency Optimization

- 5G CNC Machine Efficiency Optimization primarily involves the use of 5G technology to intelligently upgrade CNC machines, enhancing their production efficiency and performance. 5G technology significantly boosts machine tool productivity by optimizing production processes and reducing downtime. It helps lower production costs, enables quick response to market changes, and adapts to different production requirements, thus increasing production flexibility. This plays a crucial role in driving the digital transformation of the manufacturing industry.

On-site Requirements

Low business flow efficiency

- The program USB drive is prone to damage, increasing replacement costs.
- There is no version tracking for programs and process routes.
- The MES system's production tasks cannot be linked to machine tool equipment.
- Task execution status is not summarized, leading to inaccurate manual reporting.

Production processing

- Low efficiency in single-machine processing
- Significant variation in rough machining blank allowances, leading to excessive cutting allowances
- Difficulty in analyzing areas for improvement in the machining process
- Auxiliary process time: Wasted idle tool movement
- Effective process time: Wasted cutting movement

Cost analysis

- Rapid tool wear
- Unclear tool usage management
- No tool life or tool usage statistics management

Solution

Product: A lightweight and efficient optimization tool designed for small-batch, multi-variety discrete machining industries.

Features	Indicator Name	Industry Solution	CMI Solution	DIFFs
High Efficiency	Auxiliary Process Optimization Ratio (Idle Tool)	2%	2~5%	↑ 2~5%
	Full Process Optimization Ratio (Idle Tool + Cutting)	5%	5~15%	↑ 5~15%
	Equipment Utilization Rate	77.5%	82.6%	↑ 5.1%
High Return	Business Process Digitization	80%	100%	↑ 20%
	Tool Life (pieces)	400	433	↑ 8.2%

Product Value

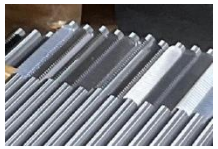
High Efficiency:
By leveraging intelligent algorithm modules and mainstream data collection technologies, the optimization of auxiliary processes and effective process time can reach up to **15%**.

High Return:
The entire business process, from blueprint to program management, is digitally enhanced to **100%.** Additionally, tool life management becomes visualized and more refined.

Application:
The machine tool efficiency product empowers machining production lines, with a payback period of approximately 5 months for annual revenue calculation.

Client: **Hubei Factory
Equipment: Grinding Machine
Product: Rack
Parameter Settings:

- Auxiliary Process Optimization (Idle Tool)
- Maximum Feed Rate: 120%



The single-piece processing saves **536.89 seconds**, resulting in a **2.2% increase** in production efficiency.

5G+ Smart Factory: Enterprise Cloud

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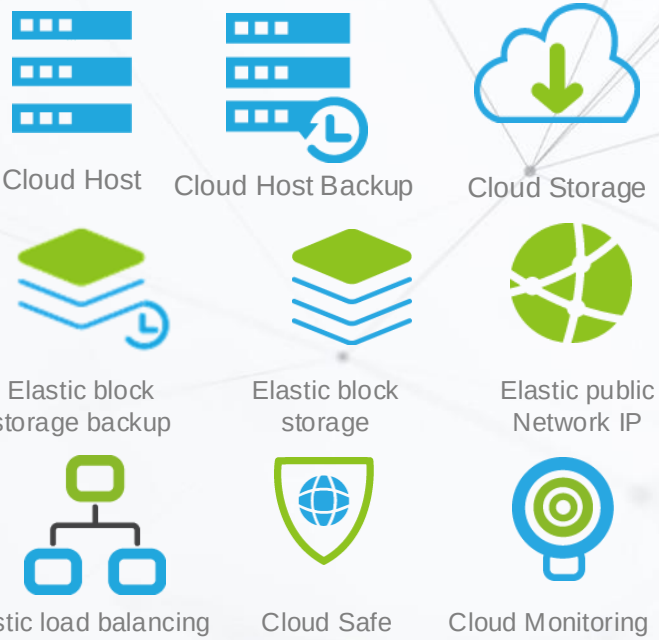
Application Scenario Overview

- In combination with local conditions, on the basis of strengthening cloud computing platform services and operation capabilities, with accelerating the promotion of enterprises in key industries to the cloud as the focus, and with improving supporting services as the guarantee, we will promote cloud platform service providers and industry enterprises to strengthen the connection between supply and demand, promote enterprises to accelerate the transformation of digitalization, networking and intelligence by using cloud computing, and promote the deep integration of the Internet, big data, artificial intelligence and the real economy.

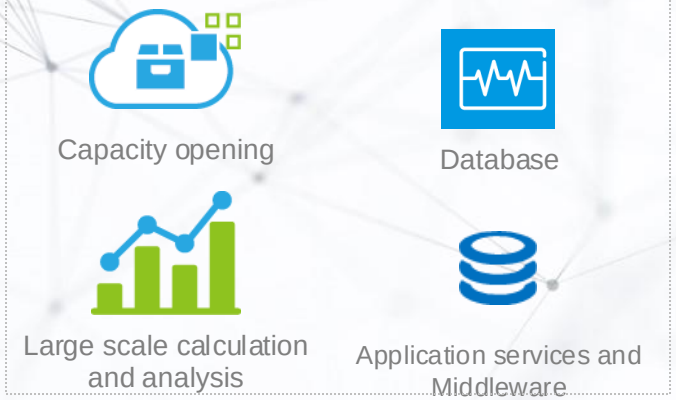
Application System Composition

Infrastructure Cloud Services



- Provide IAAs layer computing resource service, storage resource service, network resource service and security protection service

Platform System Cloud Services



- Provide multiple service capabilities of PaaS layer, including:
- Database services
- Big data analysis service
- Middleware platform services
- IOT platform services
- Software development platform services

Service Application Cloud Services

- Provide variety of SaaS layer service capabilities, including collaborative office service, operation management application service, operation management service, R&D and design service, production control service, and artificial intelligence platform service

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Contents

Case 1： German XXX 5G Smart Factory Case

Project overview:

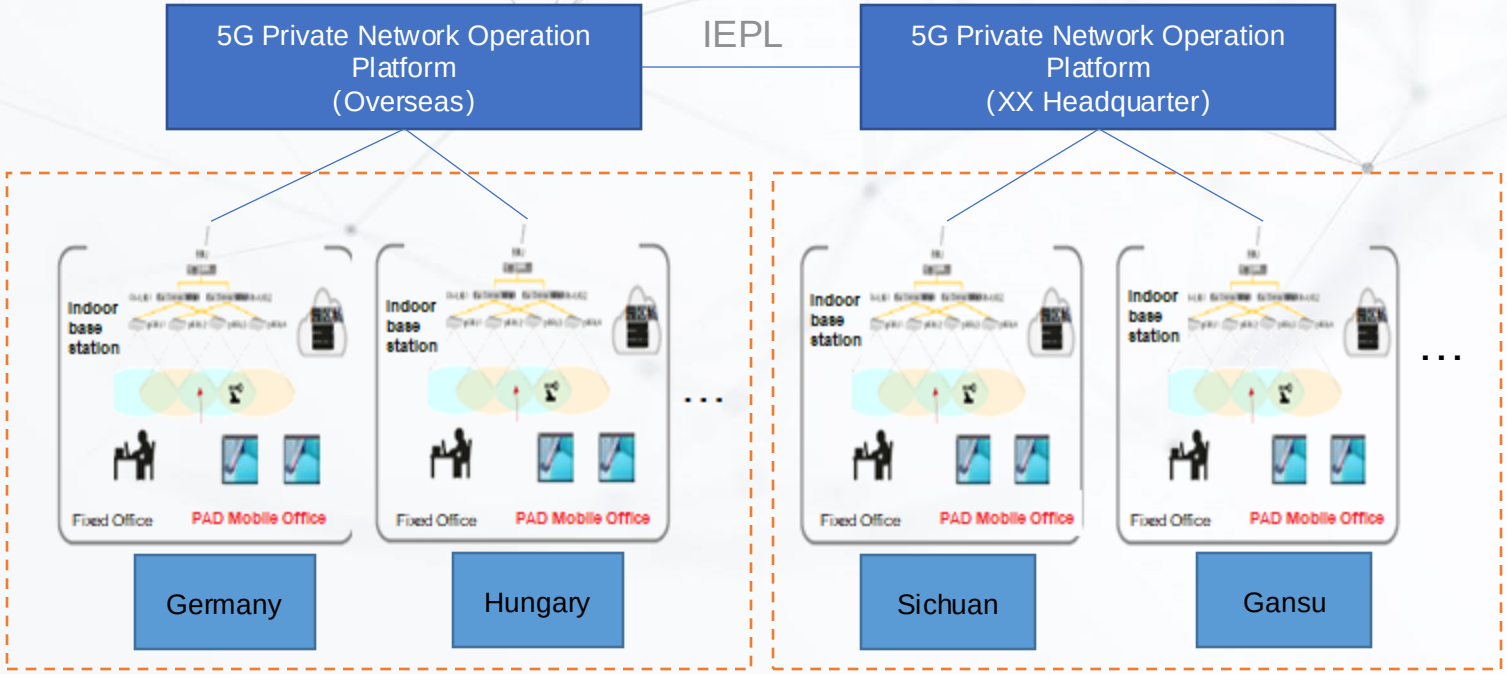
The customer is a globally leading lithium-ion battery R&D and manufacturing company, specializing in the research and development, production, and sales of new energy vehicle power battery systems and energy storage systems. In the global power battery enterprise ranking, it has ranked first in the world for five consecutive years. We use the Industry 4.0 frequency band to build a 5G private network, helping customers achieve the overall architecture of a global 5G network, comprehensively improving production efficiency and network security levels

Customer Needs

The customer needs to achieve basic coverage of a secure and reliable 5G private network in the factory area to meet the high bandwidth and low latency requirements of 5G applications.

Solution

Assist customer building local 5G private networks, further improving work efficiency and security levels in production and office scenarios through cross-border links of CMI's global backbone network and local 5G private networks, and helping customer achieve paperless office scenarios and machine video quality inspection capabilities.



Implementation Effect

- ✓ Through the 5G private network, we help customers replace traditional office manuals with intelligent office terminals to meet application needs such as SOP file circulation and quality inspection result reporting in the production process.
- ✓ Relying on the backbone network of CMI, we help customers achieve cross-border networking, realize global network visualization management, and unify dispatch and command

Case 2： Mexico XXX 5G Smart Factory Case

Project overview:

China Mobile's provision of 5G industrial gateway for XXX customer's 5G smart factory in Mexico has significant value in multiple aspects. It not only helps the customer's own digital transformation and competitiveness improvement, but also provides a successful example for the development of Mexico's manufacturing industry, promoting the local manufacturing industry to move towards intelligence and efficiency.

Customer Needs

The XXX Mexico factory covers an area of 2000m² and has a building area of 2800m². There is already one SMT line, and by the end of 2023, three SMT lines will be equipped.
To provide closer, faster, and better services to North American customers, it is necessary to further improve the production efficiency and accuracy of the production line.

The “Lingshi” series 5G computing gateway EA1000

Cortex-A72 2 Core + Cortex-A53 4 Core 4+64G

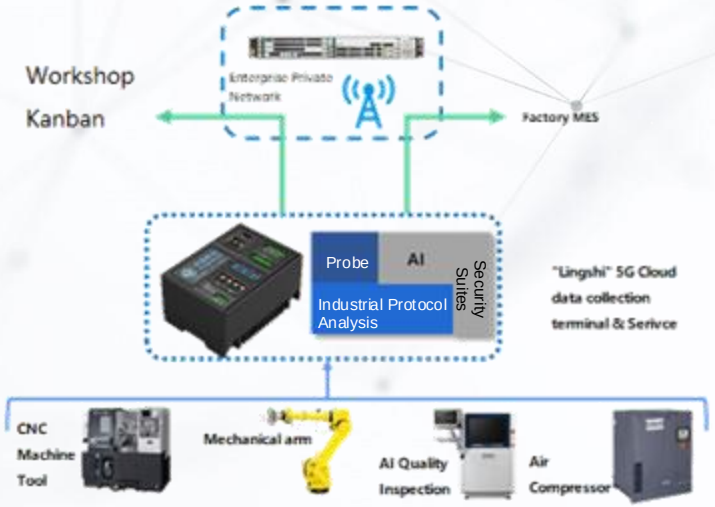
Wireless interface supports 5G (NSA/SA) and WIFI6

Support GPU

Supports over 40 mainstream industrial protocols

Solution

Provide 5G edge computing gateway equipment to customers, and help customers build data foundation and facilitate intelligent and digital transformation through international 5G data acquisition and debugging services.



Implementation Effect

- ✓ Improving data transmission efficiency and performance, realizing data mining and utilization, thereby enhancing the digital capabilities of enterprises, reducing costs, and bringing more value to enterprises.
- ✓ Realize the overseas sales of 5G edge computing gateway for the first time, and promote China Mobile 5G products overseas in the "small and beautiful" mode.

Case 3：Shandong Qingdao XX Group 5G Smart Factory Project

Project overview:

In conjunction with Shandong XX, 5G+MEC enterprise private network was built, and AR assistance and machine vision were selected as upper layer applications to achieve cloud control, algorithm self optimization, and the security of enterprise data not leaving the park. At the same time, cloud deployment made product testing, maintenance, and expansion more convenient, and the deployment time was significantly shortened;

Solution

Equipment Operation & Maintenance	• Scenario: The new production scenario of XX in the smart factory requires operation and maintenance • Composition: Terminal AR glasses, network 5G, cloud edge computing cloud • Functions: image and text transmission, image recognition, workflow prompt, spatial annotation ✓ AR spot check and training
Machine Vision	• Scenario: XXX manual quality inspection is inefficient and costly. HD industrial camera quality inspection requires high network bandwidth and extremely low network delay, and wired deployment is not flexible enough • Remote multi axis robot control + HD industrial camera • AI+ machine vision inspection • Product defect detection ✓ Machine vision quality inspection

Implementation Effect

- Security: Deploy 5G+MEC to ensure all enterprise data store in the local park
- Saving: The cloud-based algorithm greatly saves the terminal investment cost and reduces the overall maintenance cost by 65%.
- High Efficiency: The network with high speed and low delay makes the original manual quality inspection into machine quality inspection, with more flexible detection methods and more obvious improvement of operation efficiency
- Convenience: Cloud deployment makes debugging, maintenance and expansion more convenient, and greatly shortens the deployment time.

Case 4： Shanghai Minhang District XXXX 5G Smart Factory Project

Project Overview

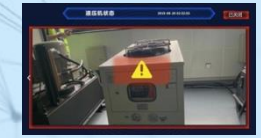
In cooperation with XXXX Customer, 5G+MEC enterprise private network has been built to realize machine vision inspection, AR assisted assembly, remote multi axis robot control \ high-definition video return and other capabilities, help China Aviation launch to realize material test and intelligent assembly of large components, monitor the whole process of commissioning, and improve the quality and efficiency of large engine assembly and commissioning;

Solution

Inspection High Speed Coordination

- Remote laboratory on-site monitoring + remote presentation of working computer screen data
- Machine vision OCR recognition
- Intelligent alarm
- Dynamic presentation of experimental process data

✓ Machine Vision



AR Visual Remote Guidance

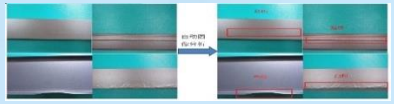
- AR Application
- Composition: terminal AR Glasses +PAD+ Large Screen, Network 5G, Cloud Edge computing cloud
- Functions: reality rendering, spatial awareness, image and text transmission, image recognition, workflow prompt, spatial annotation

✓ AR Spot Check and Training

Remote Real-time Monitoring

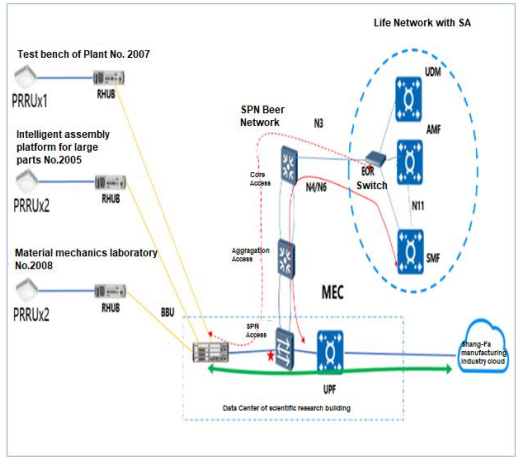
- Remote multi axis robot control + HD video return
- AI+ machine vision inspection
- Oil leakage detection and defect detection

✓ Machine Vision Quality Inspection



Implementation Effect

- **Data Keep in Factory:** Deploy 5G+MEC to realize local data Diversion Management
- **People No Touch Data:** avoid personnel leakage through 5G+ machine vision
- **High Efficiency R&D:** complete remote monitoring of engine test in real time to avoid possible personal injury during test run; Reduce field wiring
- **High Quality Production:** Aero-Engine AR assembly training;



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Thank You!