IoT Development History and Overview

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Foreword

- Internet of Things (IoT) is an important part of the new generation of information technologies and an important development phase in the information era.
- IoT is widely used in network convergence using communications and sensing technologies, such as intelligent sensing, identification, and pervasive computing. Therefore, IoT is called the third wave of global information industry development after computers and the Internet.

Objectives

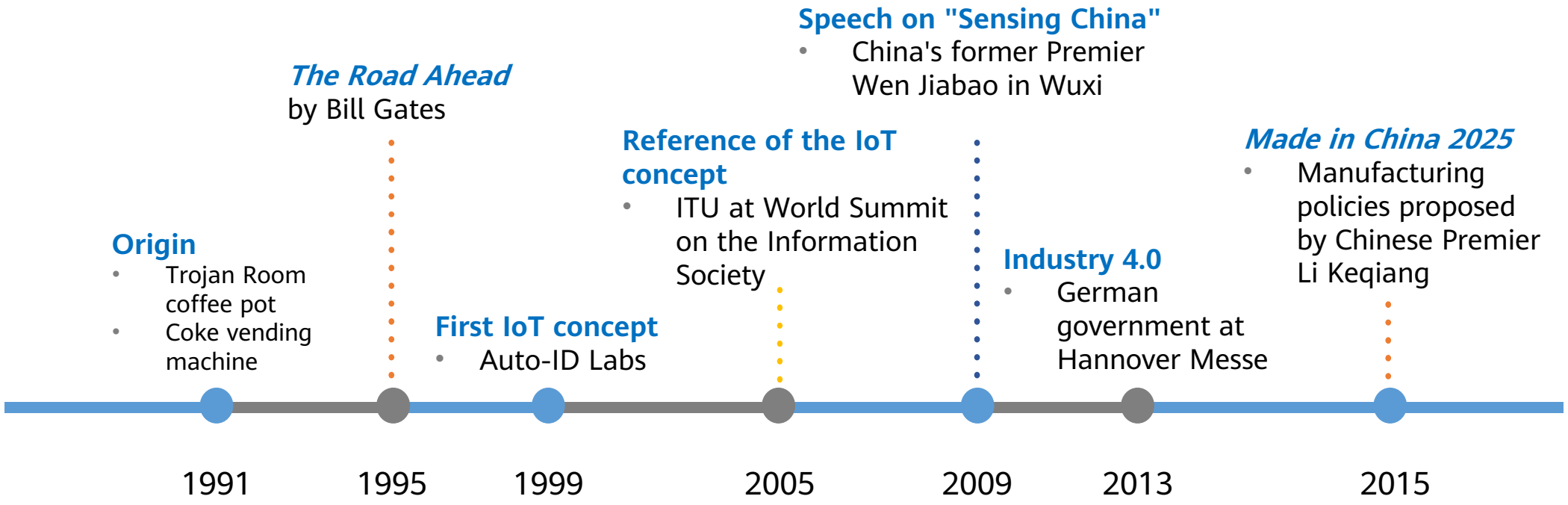
- On completion of this course, you will have an understanding of:
  - IoT development history
  - Basic IoT concepts
  - Layers of the IoT architecture

Contents

Origin of the IoT

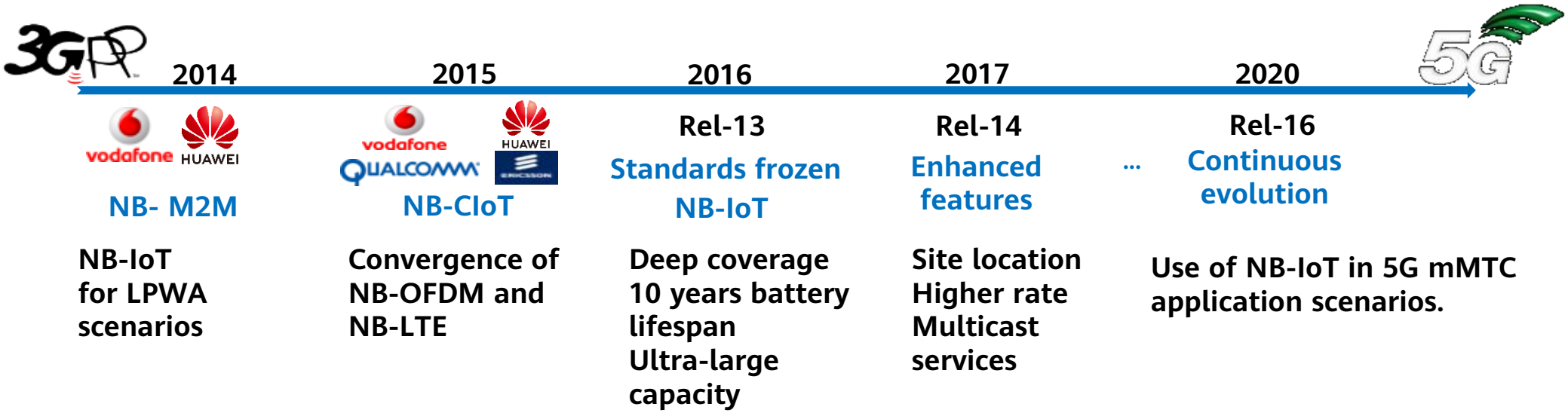
- Trojan Room coffee pot in 1991: At the Trojan Room of the Computer Laboratory in Cambridge University, scientists went downstairs to see if the coffee was cooked, but often returned empty-handed.
- To solve this problem, they wrote a set of programs and installed a portable camera next to the coffee pot. The camera was aimed at the coffee pot. Computer image capture technology was used to check at any time whether the coffee was cooked, eliminating the need to go up and down the stairs.

Development of the IoT



IoT Key Events: Evolution of NB-IoT Standards

- The standards of the narrowband cellular IoT (NB-IoT) communications technology NB-IoT were officially initiated in September 2015, and the core standards were frozen in June 2016.



After two convergences, NB-M2M evolved to NB-IoT.

IoT Key Events: Commercial Use of 5G

- On October 31, 2019, China Telecom, China Mobile, and China Unicom jointly announced the launch of 5G commercial services and released corresponding packages at the opening ceremony of the China International Information Communication Technology Exhibition. 5G will bring diversified and comprehensive benefits to IoT, and will also promote new solutions and industry chains.

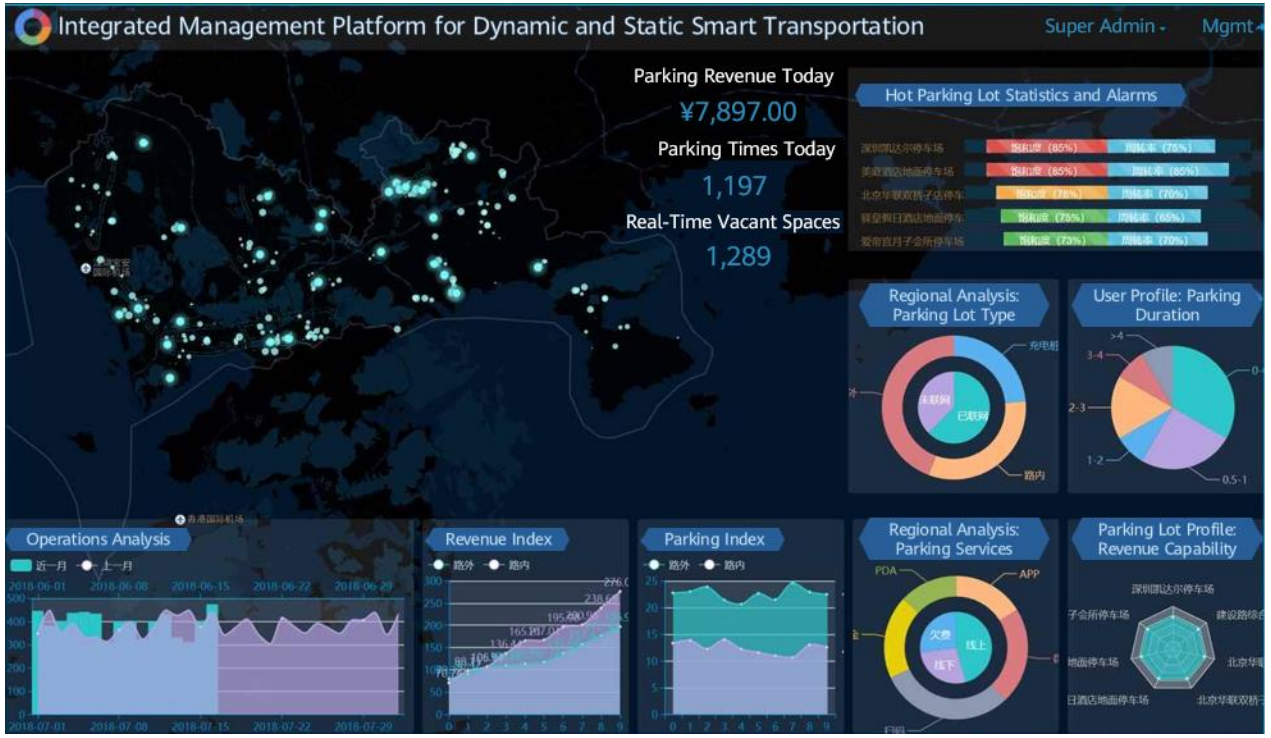
IoT Key Events: SoftBank's Acquisition of Arm

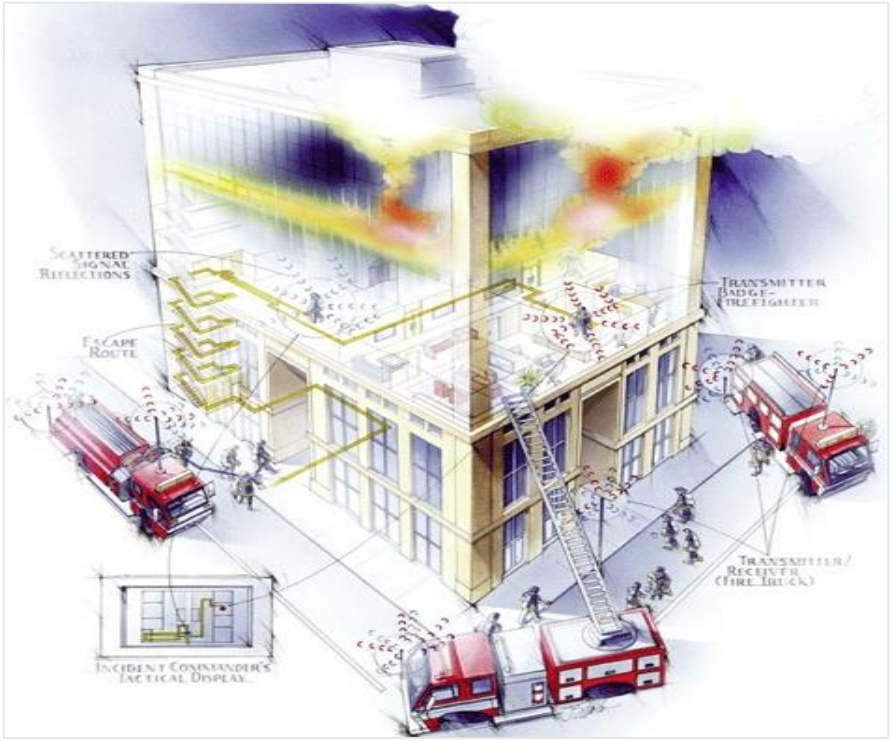
- On July 18, 2016, Japan’s SoftBank and the UK’s Arm announced that they had reached an agreement. SoftBank acquired Arm at GBP 24.3 billion (CNY 202.8 billion, JPY 3.3 trillion).

Development Status of the IoT Industry: Consumption-Driven

- Consumer IoT is directly applied to consumers' IoT products and services. Consumer-related IoT products and services include smart bands, VR and AR glasses, body fat scales, smart locks, smart speakers, shared bicycles and trams, and automated driving vehicles. According to a report released by MarketsandMarkets, the global consumer IoT market scale in 2018 was **$46.8 billion USD**. It is expected to reach **$104.4 billion USD** by 2023 with a compound annual growth rate of 17.39% from 2018 to 2023.

Development Status of the IoT Industry: Policy-Driven





- Policy-driven applications mainly cover city management scenarios, such as firefighting, security, system integration, public utilities, lighting, and parking.

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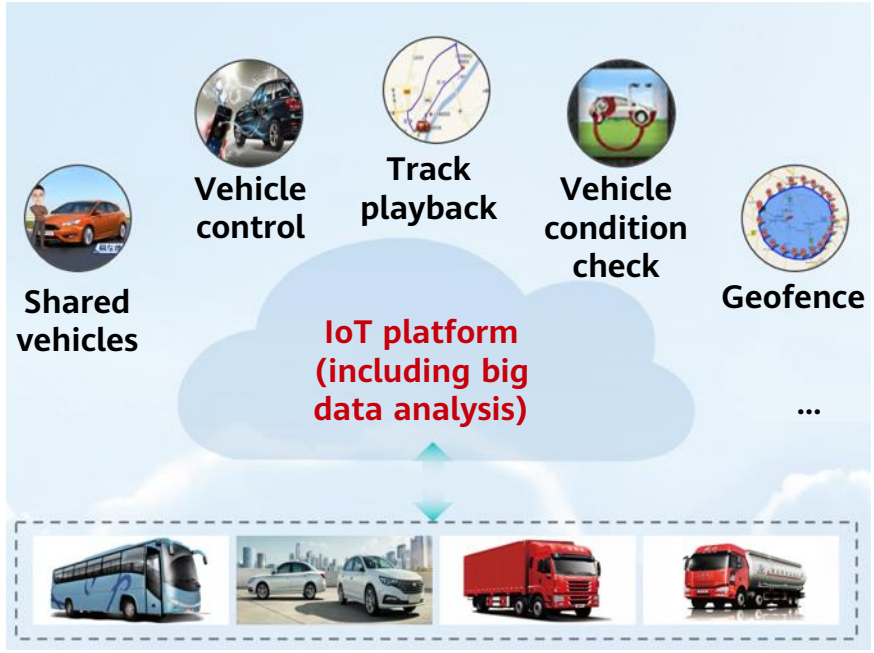
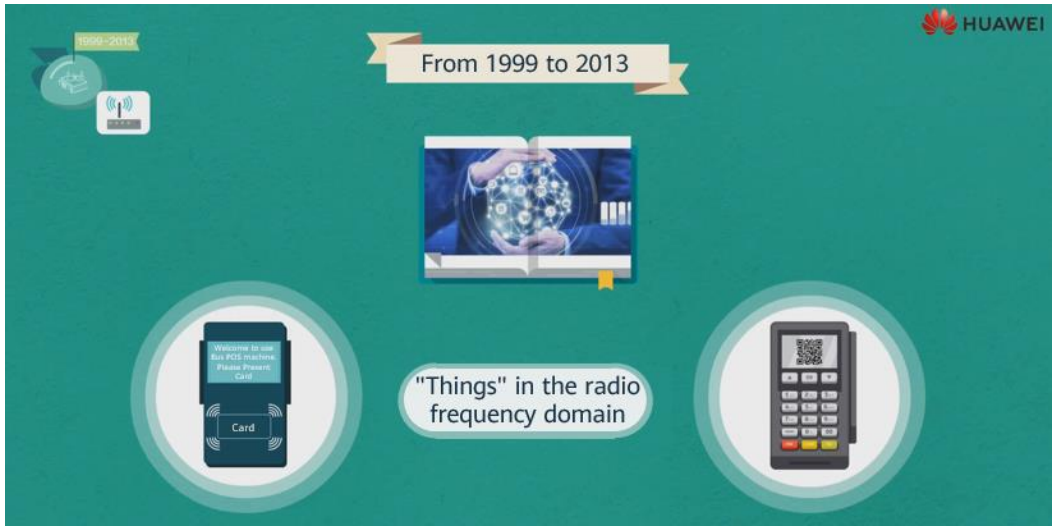
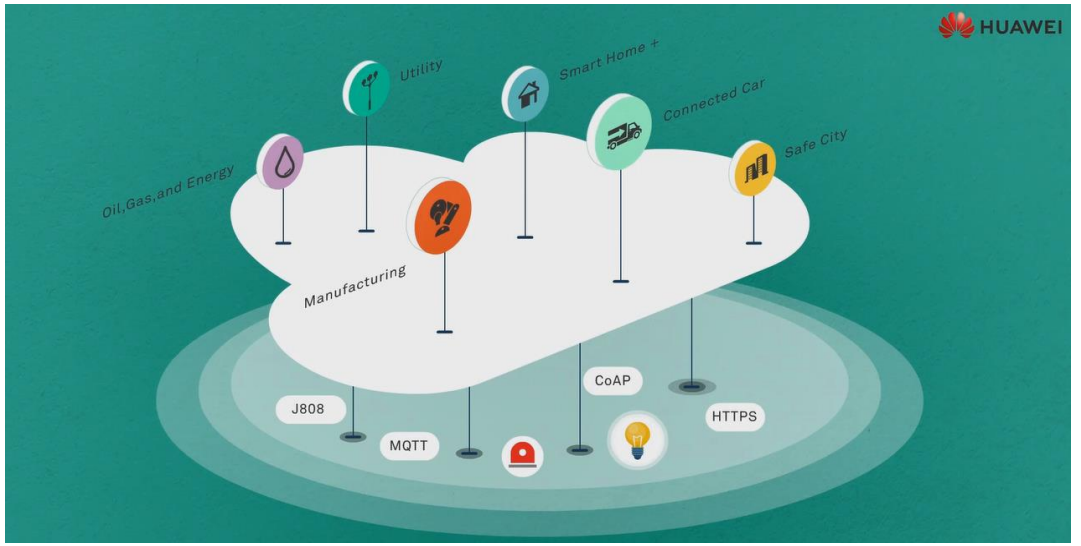
Development Status of the IoT Industry: Industry-Driven



- Industry-driven applications are mainly oriented to business customers. Relevant industries include smart industry, Internet of Vehicles (IoV), smart logistics, and smart agriculture.

Penetration and Development of IoT in Industries





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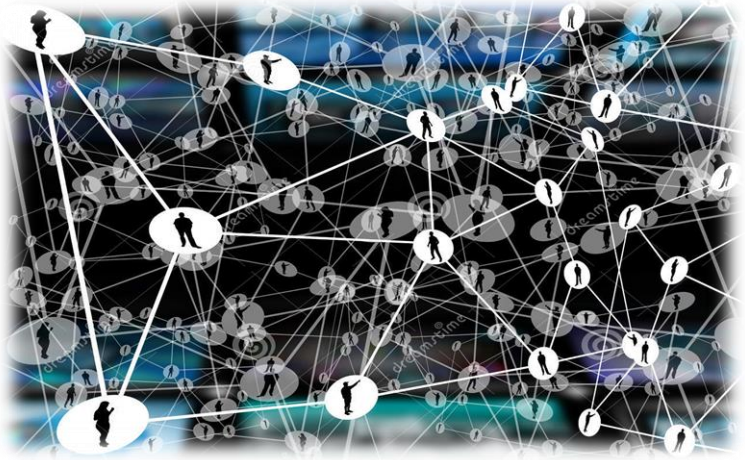
IoT Overview

- The concept of IoT was first proposed by MIT in 1999. The early IoT was a network based on RFID technology and devices. It combined objects with the Internet using the agreed communication protocols to implement intelligent identification and management of objects and realize interconnection and information sharing.
- IoT serves as a network that enables information sensing devices, such as QR code scanners, RFID, infrared sensors, global positioning systems, and laser scanners, to **connect any item with the Internet** for information exchange and communications based on agreed protocols. As such, IoT can facilitate intelligent identification, location, tracking, monitoring, and management (ITU).
- IoT is an Internet **where all things are interconnected**. This sentence has two meanings. First, the core and foundation of the IoT is still the Internet. IoT is an extended network based on the Internet. Second, the IoT connects any thing at the user end for information exchange and communication (Baidu Baike).

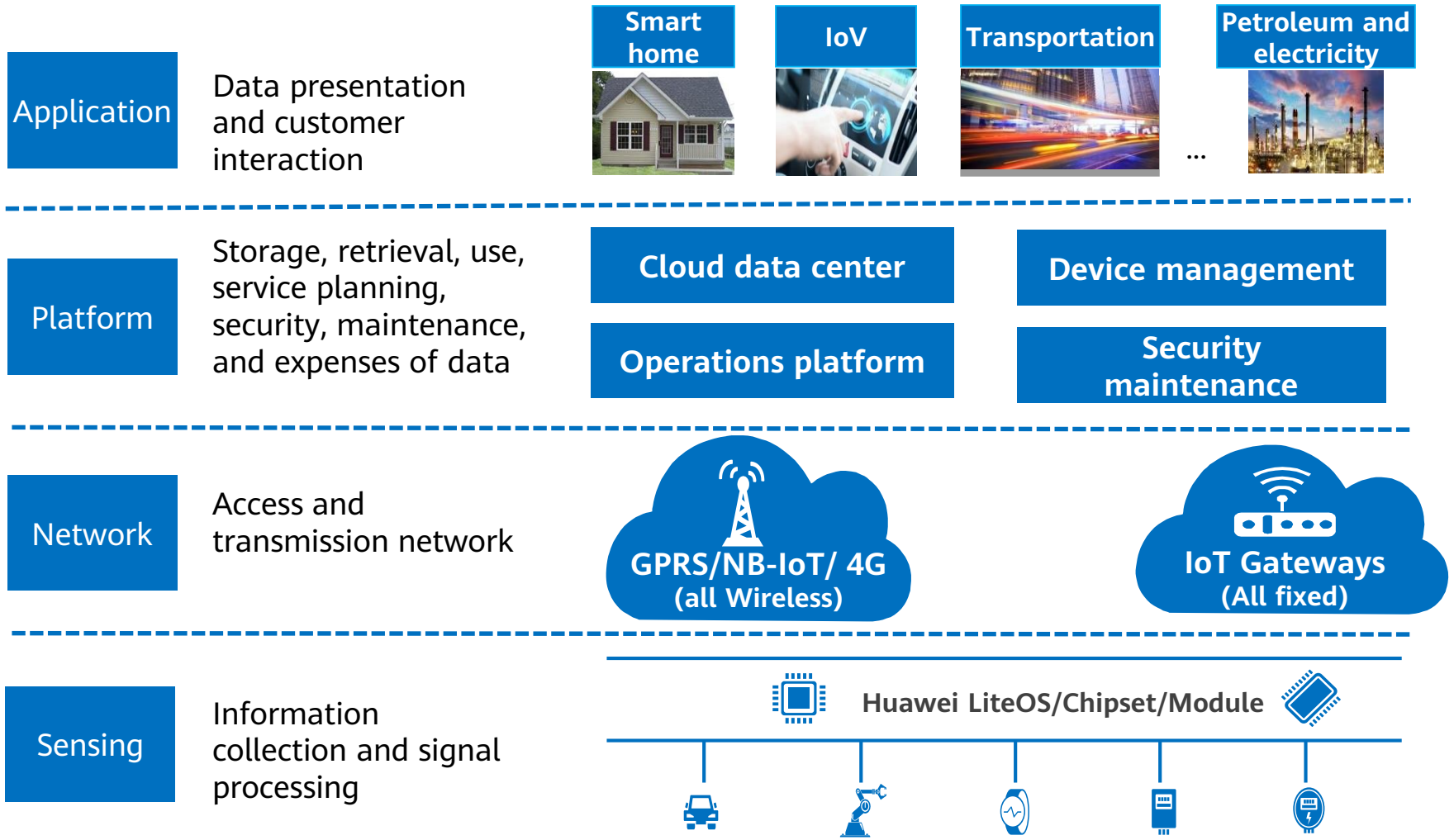
IoT: From Internet of People to Internet of Things

Internet of People



Internet of Things

Layers of the IoT



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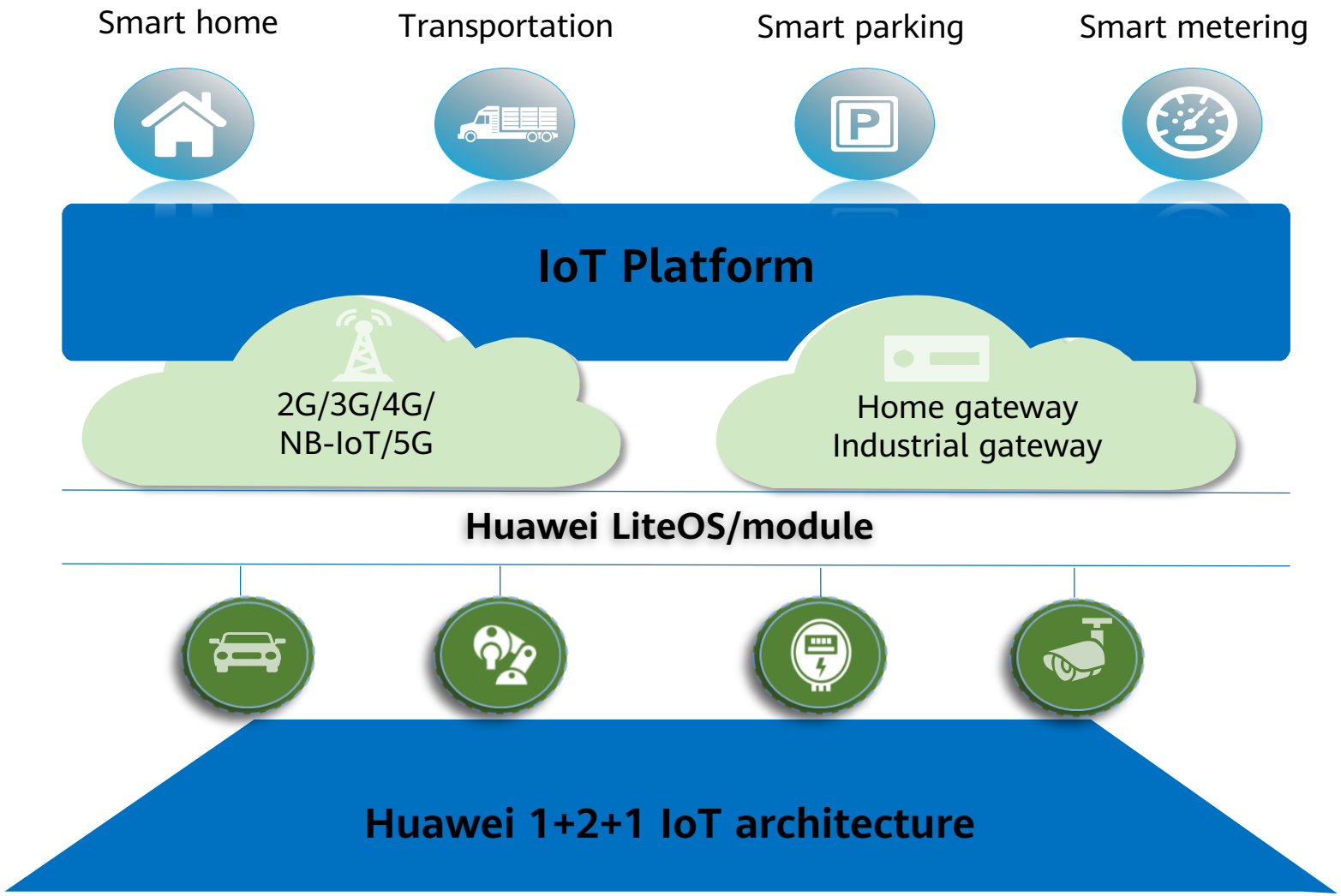
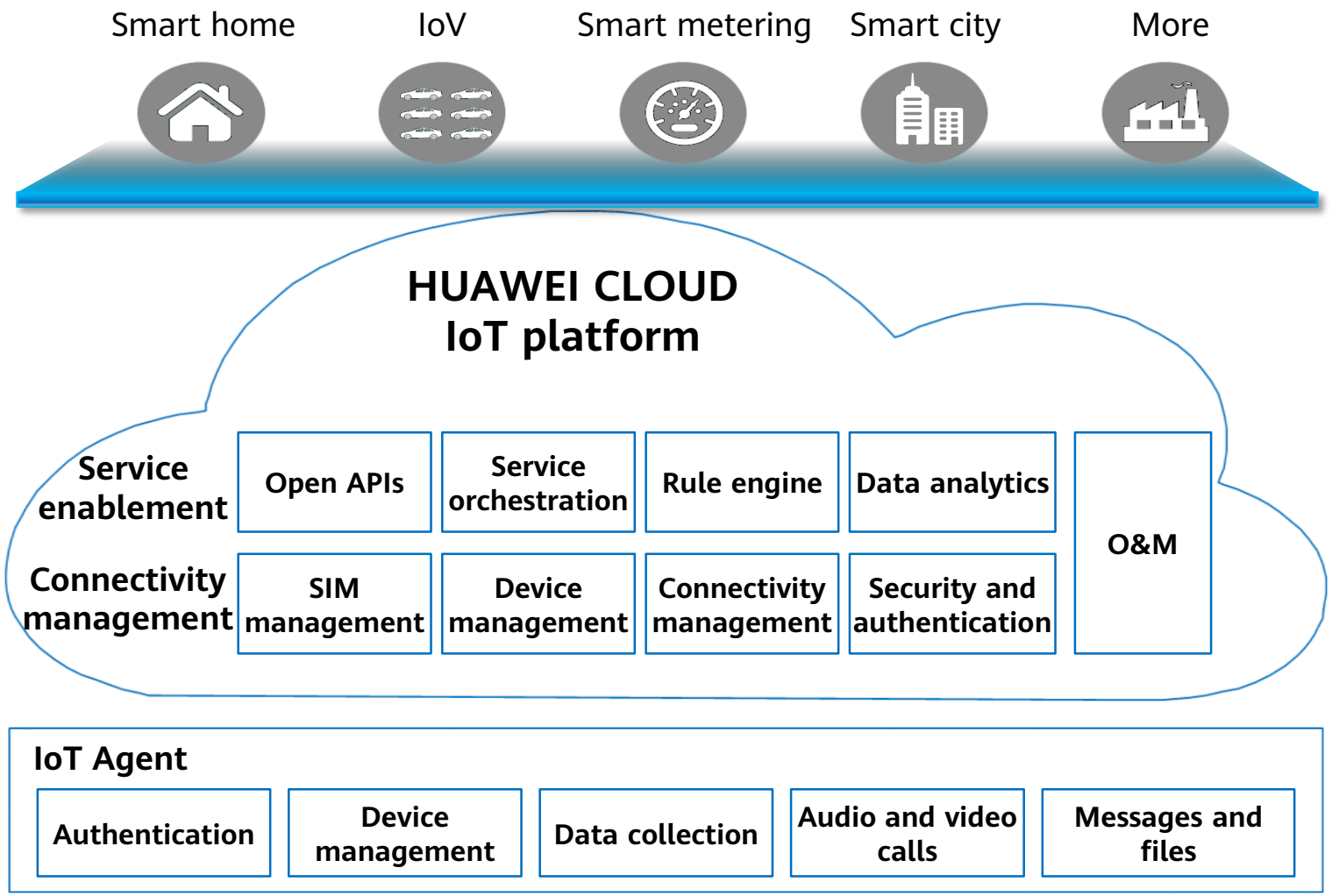
Huawei 1+2+1 IoT Solution Architecture



Overall Architecture of HUAWEI CLOUD IoT Platform



Open

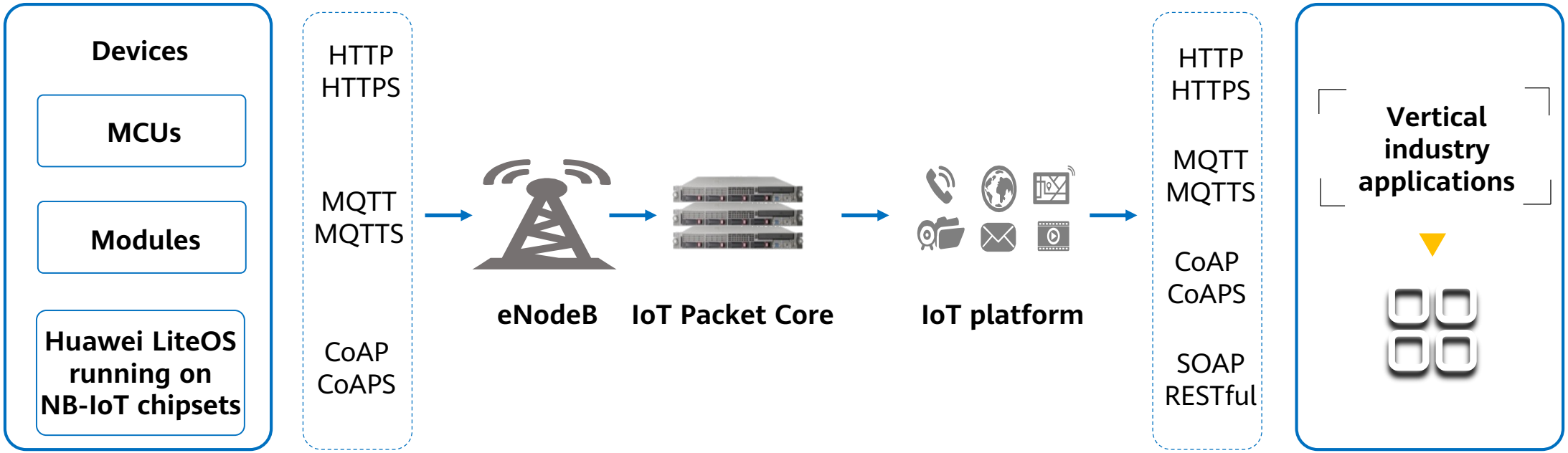
Pre-integrated

Cloud-based and service-oriented

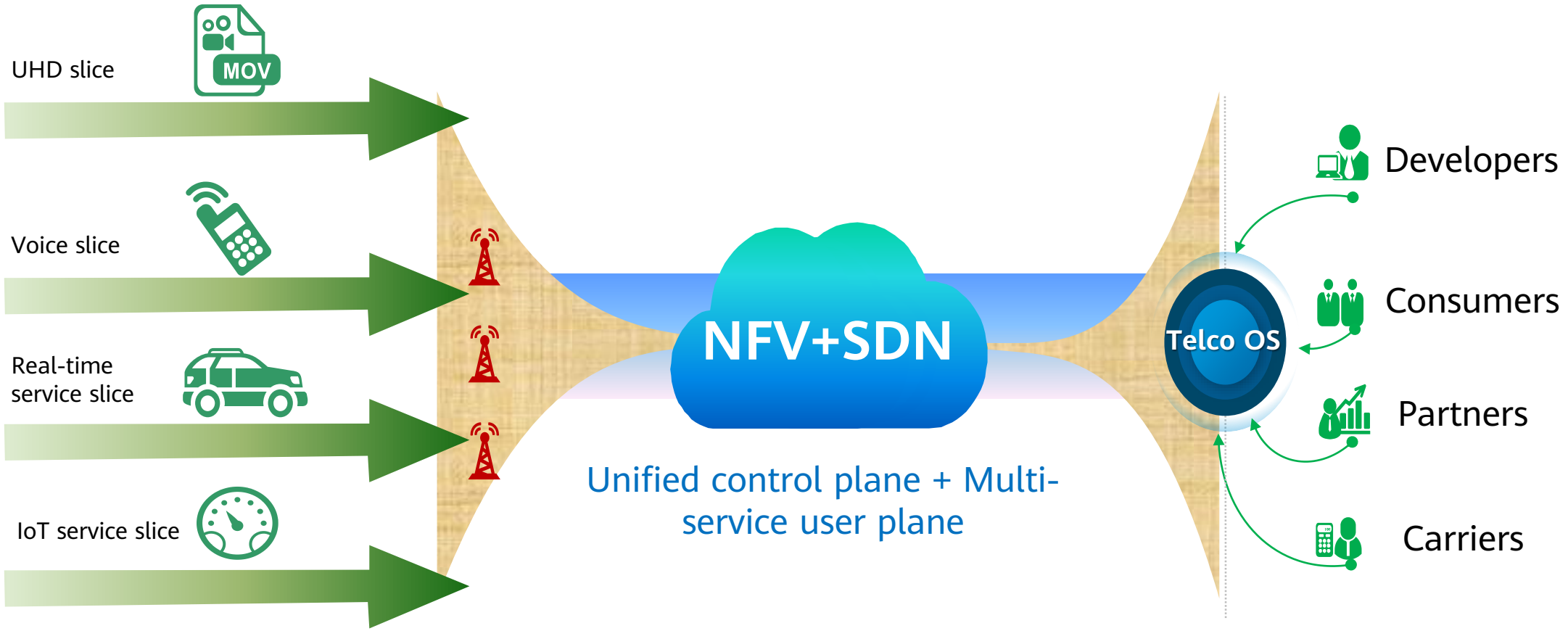
Access-independent

NB-IoT: Connecting Device Fleets Using Cellular Networks

- NB-IoT end-to-end solution



5G Architecture: One Network Supporting Hundreds of Industries



Industrial IoT Gateway

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Agile AR

Industrial switching/Industrial routing/Built-in computing

Industrial-grade design

Shockproof/Waterproof/Dust proof/Anti-electromagnetic

+

Various interface support

ZigBee/RF/Bluetooth/ RS-485/RS-232/DI/DO/more

+

Complex protocol adaptation

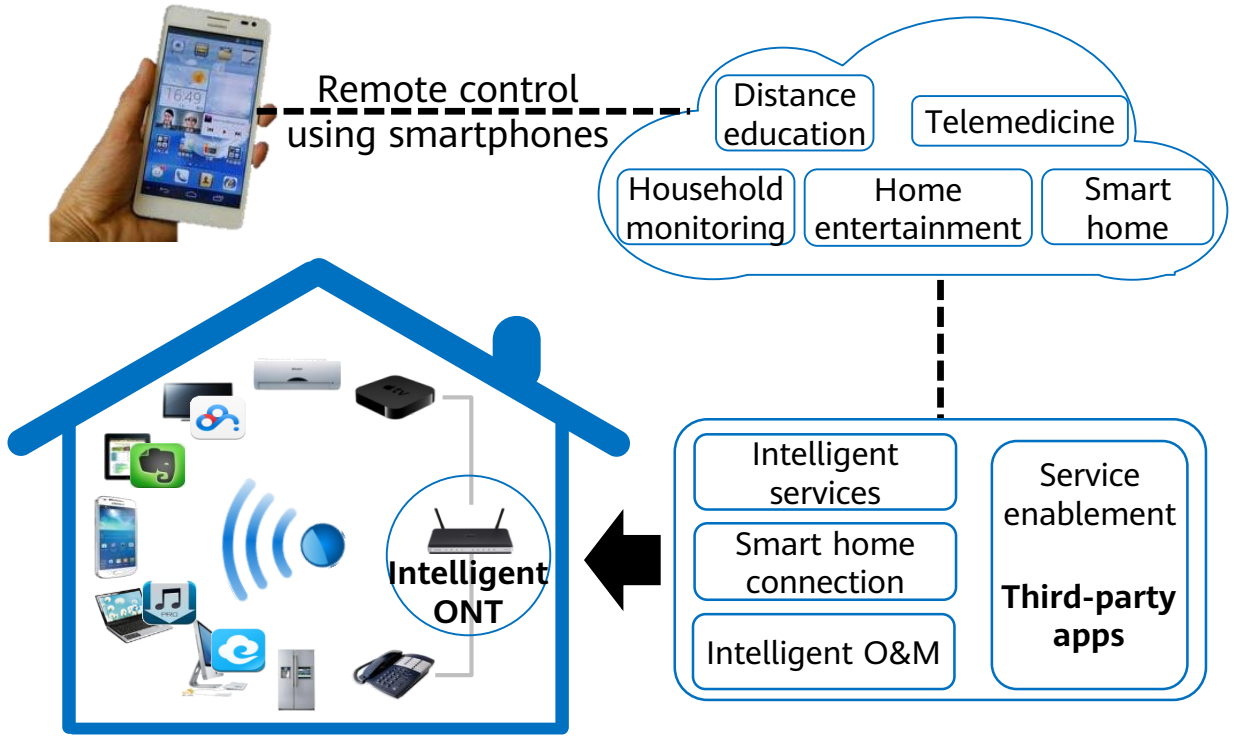
CAN/Modbus/ IEC 62056/IEC 104 /more

+

Local intelligence

Local computing and storage

Fully Open Smart ONT



- **Mass market:** Wi-Fi coverage, security, energy management, and digital home
- **Entry control point:** The ONT, as the entry point to homes, becomes a value control point.
- **Digital home is coming:** AT&T and PCCW launched smart home security services.

Intelligent services

FBB, MBB, and digital home services in one bill

Smart connectivity

1 Gbit/s full Wi-Fi coverage home solution

Intelligent O&M

Self-service troubleshooting and remote test and diagnosis

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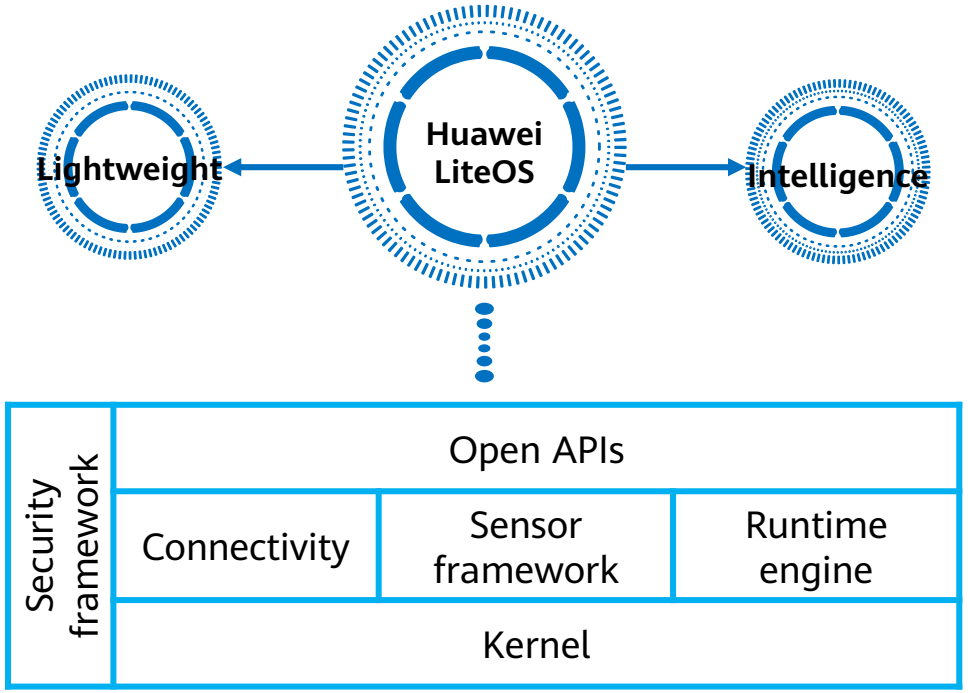
Lightweight, Intelligent Huawei LiteOS

[KB-level kernel]

[Milliwatt-level power consumption]

[Microsecond-level response]



Shorter time-to-market for devices

- Support for connection and device management by industrial protocol stacks
- Support for Huawei and third-party platforms
- Supports HiSilicon and third-party chipsets

[Intelligent sensing]

- Delay reduction
- Accuracy improvement

[Intelligent connection]

- Support for short-distance and long-distance protocols
- Automatic networking

[Intelligent application]

- Chip-level application virtual machine

Quiz

1. (T or F) IoT is an Internet where all things are interconnected. This sentence has three meanings.
2. (Multiple-choice) Which of the following belong to the hierarchical architecture of IoT?
   A. Sensing Layer
   B. Network Layer
   C. Platform Layer
   D. Application Layer

Summary

- In this course, you learned about the origin and history of IoT development and the four-layer architecture of IoT.
- You also learned about Huawei's solutions in the IoT industry based on the four-layer architecture.

Thank you.

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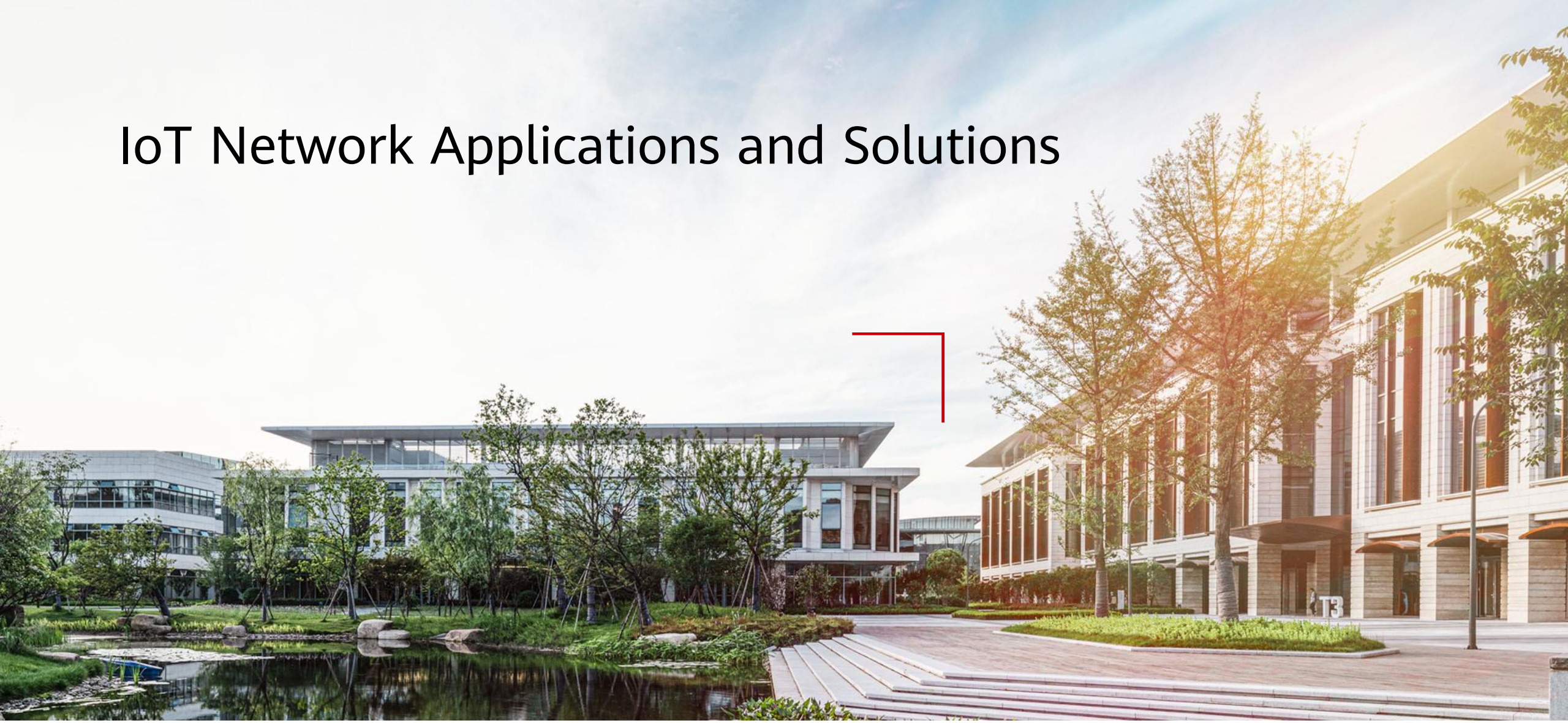
IoT Network Applications and Solutions



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Foreword

- With the development of Internet of Things (IoT) technology, its impact has penetrated into every aspect of society. IoT technology is applied everywhere, from smart home to smart city.
- This slide analyzes existing problems in five IoT industry scenarios: smart city, smart campus, AMI, IoV & DRIS, and industrial Internet. It also describes solutions provided by IoT technologies and success stories. Finally, it introduces the development trends of intelligent connection of everything based on other emerging technologies.

Objectives

- After completing this course, you will be able to understand:
  - Common problems in smart cities and corresponding solution
  - Pain points of smart campus management and corresponding solutions
  - Requirements for reducing the power consumption of the smart grid and corresponding solutions
  - Driving forces of IoV development and the corresponding solutions
  - Requirements and challenges of industrial IoT and the corresponding solution
  - Technologies such as 5IABCDE and the development trends of intelligent connection of everything

Contents

Overview and Objectives

- The following three conditions must be met for IoT to reach the next stage: high population density, strong industrial base, and an integrated national market. Only China meets these three conditions. In November 2008, IBM put forward the concept of Smarter Planet. Later in August 2009, they released the Smarter Planet Wins in China plan, officially unveiling their Smarter Planet strategies in China.
- Smart City is a pilot project inspired by Smarter Planet. It covers a large number of application scenarios and faces many difficulties and challenges. This section describes the challenges encountered by Smart City in different domains and their corresponding solutions.

Common Problems - Traffic Management

Frequent traffic congestion and accidents

Congestion is a pressing issue. Accidents occur frequently due to drivers disregarding traffic laws.

Increased travel time

Heavy traffic significantly increases travel time and lowers commute satisfaction.

Increased pollution

Low driving speeds caused by congestion result in low energy use efficiency, which results in more pollution.

Common Problems - Parking Management

Parking management

Imbalance

- Lack of resource integration and sharing
- Severe tidal effects

Inconvenient charging

- Low labor efficiency and high costs
- Frequent payment evasion

Difficult inspection

- Low efficiency
- Difficulty confirming paid fees

Increasing congestion

- Time wasted locating parking spaces
- Lack of guidance and reservation services

Parking experience

Difficulty finding parking spaces

- Difficulty locating empty parking spaces
- Lack of parking guidance facilities

Difficulty finding vehicles

- Difficulty locating parked vehicles
- Difficulty navigating complex environments

Difficulty entering and leaving parking lots

- Inconvenient parking, card collection and payment
- Congestion at parking lot entrances and exits during peak hours

Outdated payment systems

- Congestion due to manual charging
- Lack of charging modes

Common Problems - Street Lamp Management

Reliable lighting

Provides reliable lighting for urban roads, which is the core responsibility of the Street Lamp Administration.

Emergency lighting

Starts the emergency lighting in bad weather or special weather during daytime.

Simplified O&M

Promptly detects and repairs faulty street lamps. Considers the employment impact when applying advanced technologies.

Asset management

Protects street lamps from being damaged or stolen.

Energy conservation

Turns off lights on time after daybreak. Reduces illumination in the middle of the night. Lowers brightness when there are no pedestrians or vehicles.

Revenue growth

Rents lamp poles to advertisement companies and tower companies for profit. (It is difficult to obtain commercial benefits with current systems.)

Common Problems - Firefighting Management

- Nine small public areas are vulnerable in urban fire safety.
  - Fire risks: chaotic environment, group rentals, random stacking of flammable things, and electricity piracy
  - Weak firefighting facilities: no firefighting facilities or outdated firefighting equipment
  - Delayed fire warning: delayed fire detection and insufficient fire information due to the time-consuming manual inspection

Firefighting facility issues

Flammable material stacking

Old cables

Common Problems - Manhole Cover Management

- Manhole covers are embedded in city streets like screws on giant machines. The manhole covers belong to administrative departments for water, communications, gas, heat, power, and traffic management. Problems of manhole cover management are as follows:
  - Difficult management due to large quantity
  - Disordered identity management due to complex ownership
  - Theft, loss, and shifting
  - Secondary injuries due to security risks




Common Problems - Environmental Sanitation Management

Outdated

Outdated facilities, high O&M costs, low work efficiency, and poor work quality

Low

Outdated management models, limited management methods, lack of basis for decision-making, and serious resource waste

Chaotic

Inconsistent operating standards, random operating status, serious interference caused by human factors, and difficult command and dispatch

Slow

Lack of innovation, slow overall development, slow application of new modes, new devices, and new concepts, low informatization levels, and high management cost

Summary of City Management Issues

Unclear background information

The informatization rate of manhole covers, street lamps, garbage cans, garbage stations, trees, pipelines, dangerous sources, and bridges is low. Manual inspection is heavily relied on.

Untimely issue identification

Issues such as road occupation, facility damage, and garbage overflow cannot be detected on time. As a result, there is little interaction between citizens, and public satisfaction is low.

Difficult collaboration across departments

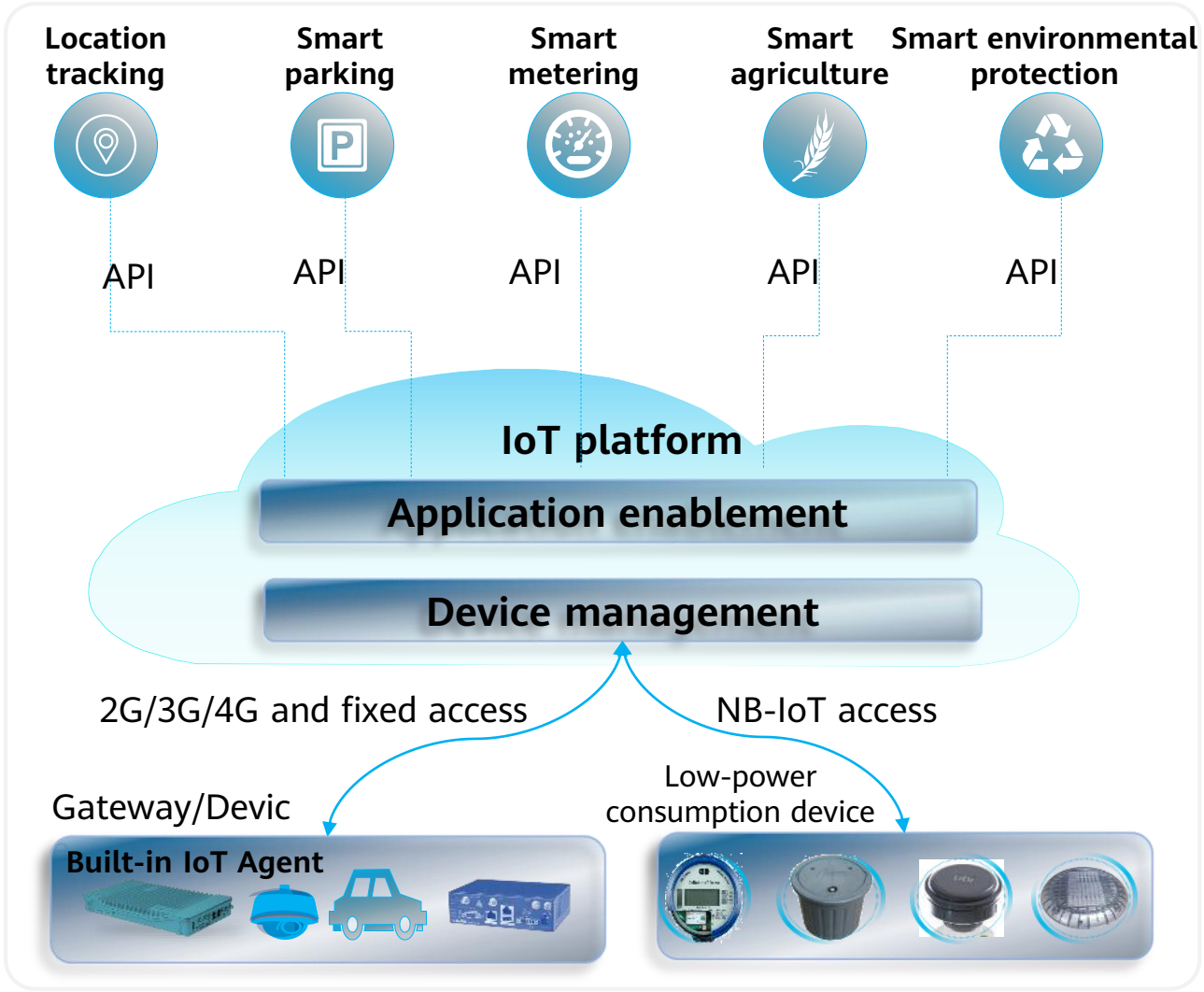
Incidents such as random unloading of slag trucks and water pipe bursts involve multiple departments, such those for sanitation, law enforcement, gardening, city appearance, housing and construction, environmental protection, public security, transportation, and civil affairs. These departments are difficult to coordinate.

Difficult decision-making across isolated systems

Issues include repeated platform construction, isolated systems, difficult data aggregation, lack of a unified data analysis and decision-making systems, and lack of bases for scientific decision-making

How do we use innovative technologies to achieve smart city management?

Smart City Solution



Simplifies development of IoT applications.
Incubates and enables an urban IoT ecosystem.

Aggregates real-time urban IoT data to provide real-time decision-making support for the comprehensive city management system.

Provides unified access standards for IoT applications and devices to prevent fragmented IoT application access.

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