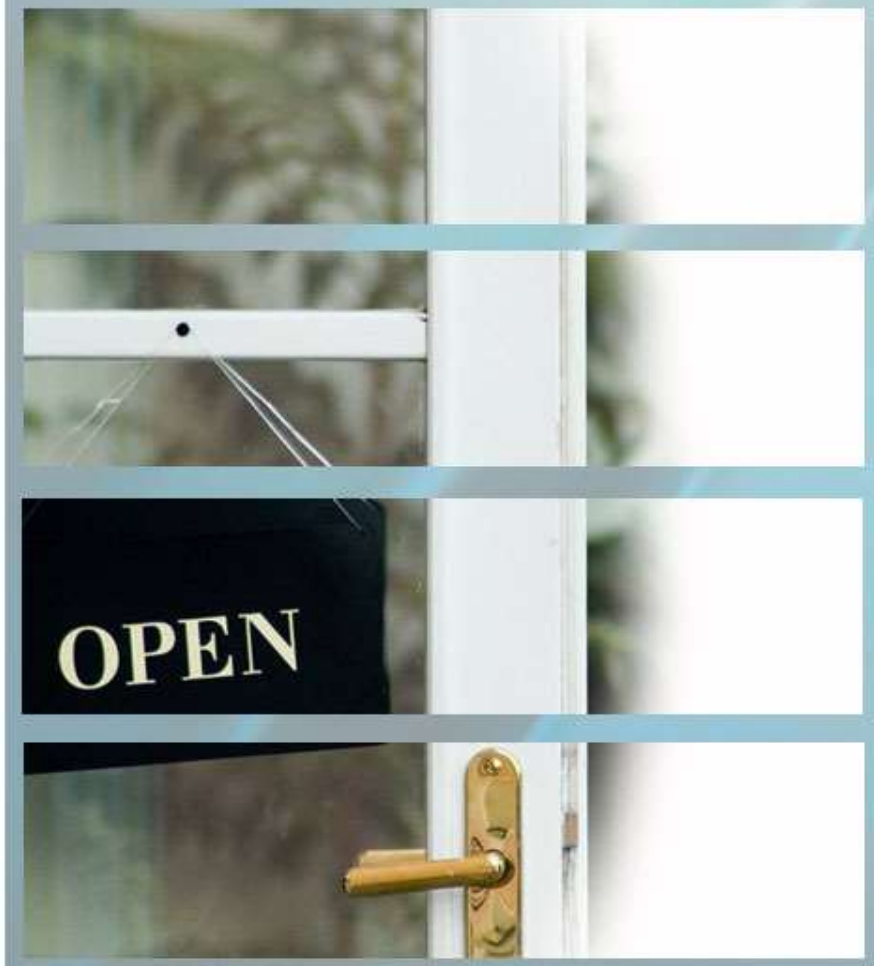
# Chapter 15-19
## Comprehensive Application

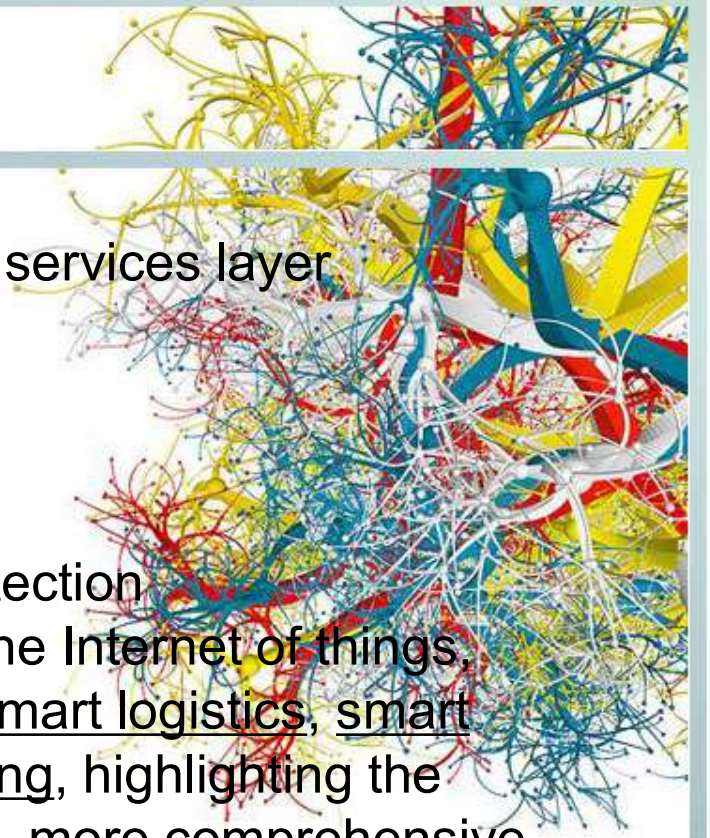




The rich connotation of Internet of things promotes more extensive applications.

This paper will introduce the **Comprehensive Application Layer** of the Internet of things. Through five typical application fields, it presents the characteristics of diversified, large-scale and industrial applications of the Internet of things.

内容提要

# Review



Chapters 10-14 introduce the management services layer

- Database system
- Mass information storage
- Search engine
- The intelligent decision
- Information security and privacy protection

This chapter focuses on the application of the Internet of things, including smart grid, smart transportation, smart logistics, smart green buildings and environmental monitoring, highlighting the characteristics of more thorough perception, more comprehensive connectivity and deeper intelligence.

# Content

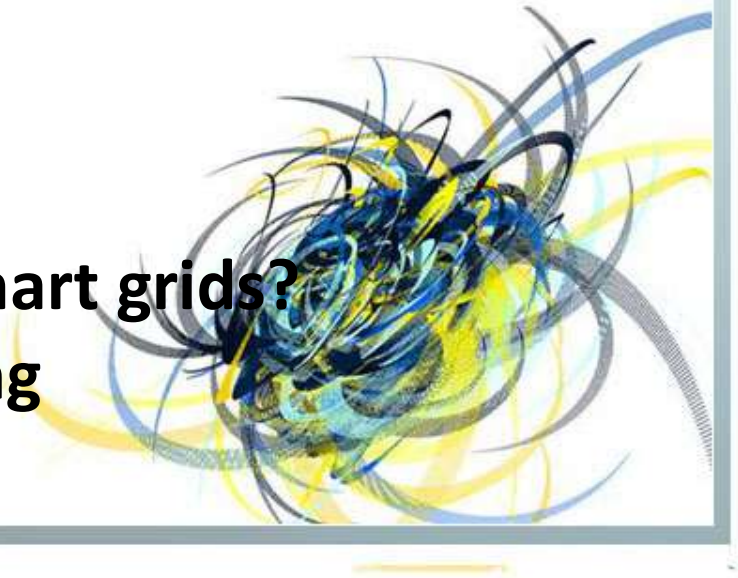
## 15 Smart grid

16 Intelligent transportation

17 Intelligent logistics

18 Smart green building

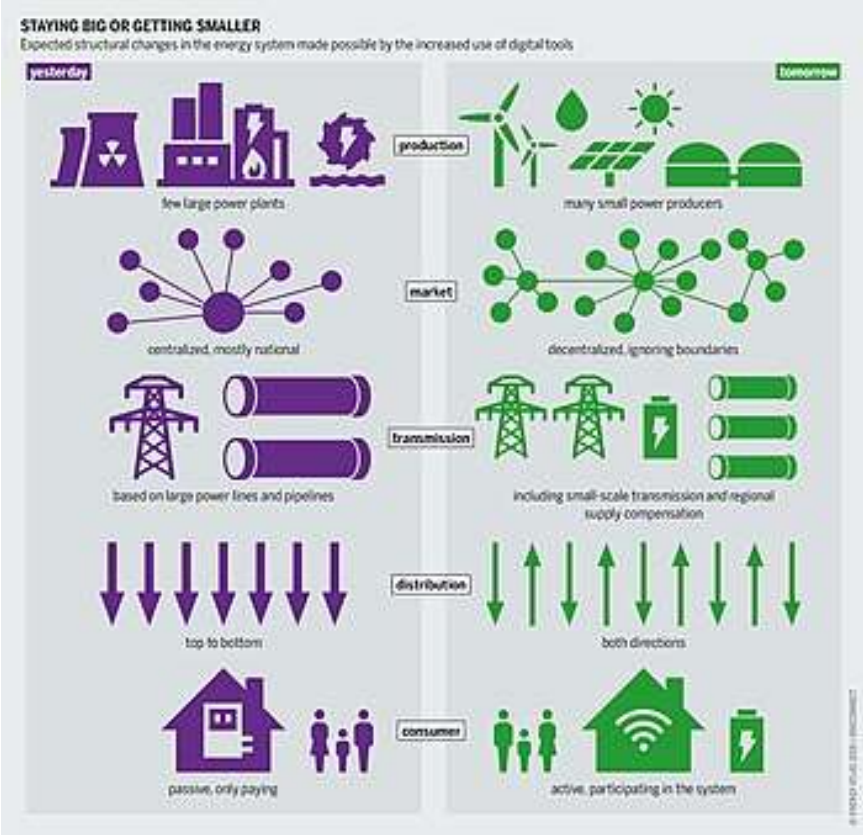
19 Environmental monitoring



What are the characteristics of smart grids?

What is the direction of developing smart grid in China?

# 15.1 Origin and development of smart grid




**Typical power system components**



# What is Smart grid?

- **Power system** is a power generation and consumption system composed of power generation, transmission, transformation, distribution and utilization.
- **Power network** is a part of a power system other than power generation equipment and electrical equipment (transmission, transformation and distribution).
- The core connotation of **Smart grid** is to realize the informationization, digitization, automation and interactivity of the grid, featuring nine major features: self-healing of the grid, user interaction, equipment compatibility, quality management, system security, information integration, management optimization, asset optimization and market coordination.



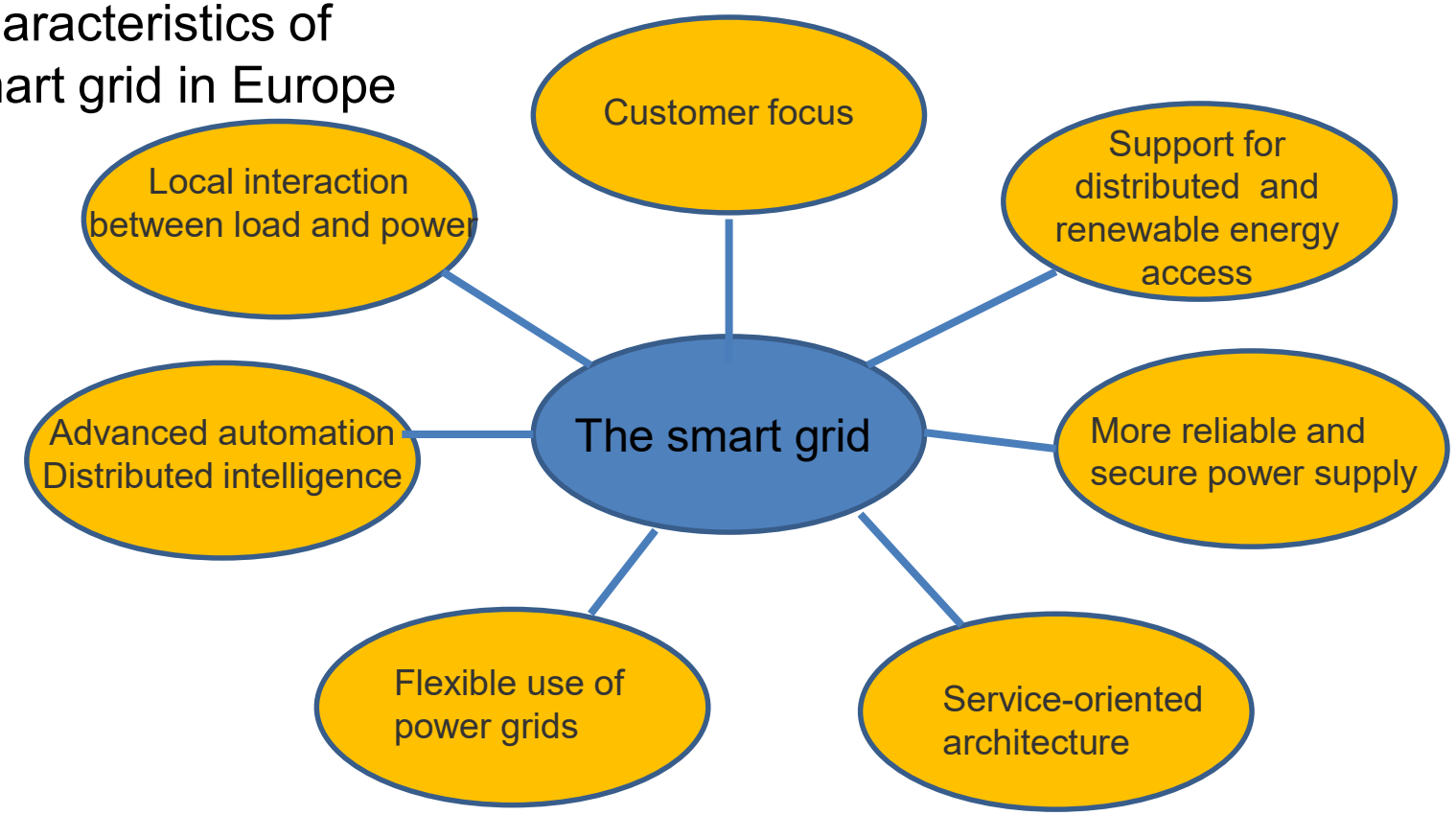
# Characteristics of smart grid in Europe and America

## Characteristics of smart grid in America

1. **Optimize:** the utilization of resources and equipment
2. **Predict:** effectively ahead of time and be proactive, not reactive
3. **Coordinated:** management of distributed resources, equipment, and information systems across geographic and organizational boundaries
4. **Integrated:** monitoring, control, protection, maintenance, scheduling, background system integration
5. **Security:** against grid attack has higher security
6. **Self-healing:** power grid has the ability to adapt and recover from faults
7. **Interaction:** with users and the power market has a good interaction ability

# Characteristics of smart grid in Europe and America

Characteristics of smart grid in Europe



## The latest development of smart grid

**The smart grid in the United States** is mainly at the distribution layer, with special emphasis on the intelligentization of electricity consumption.

The construction of smart meter system is the top priority.

**Europe's smart grid** mainly emphasizes the access of distributed energy, including the use of new energy and energy storage system, and the development of power electronics technology is the key.

**China's smart grid** has a more comprehensive coverage, and is an overall upgrade of the six major links of dispatching, power generation, transmission, transformation, distribution and electricity consumption.

# Smart grid and Internet of things: development and utilization of new energy

**Downstream applications of new energy** are divided into grid-connected power generation, off-grid power generation and renewable fuels.

Energy source

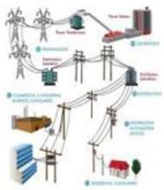




Connected to the grid

Off-grid applications

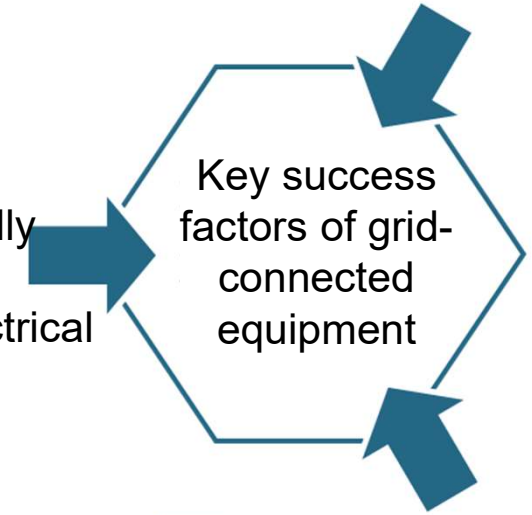
Key research areas



Mainly refers to the new energy transmission and distribution equipment relying on smart grid

It is applied to off-grid or partial grid-connected energy applications such as building, automobile, municipal, agriculture and civil consumption Equipment field is not attractive, can pay attention to the application promotion link

# Development and application of new energy: grid-connected power generation




1

## Industrial base

Smart grid equipment manufacturers are usually based on the existing infrastructure of the electrical equipment industry

2

## Research and development conditions

Smart grid equipment requires high technical requirements, and good research and development conditions and talent foundation are important conditions for enterprise development

3

## Stable channel relationship

As the downstream of the industry has a high monopoly, a good channel relationship between power grid enterprises is the key to the success of equipment manufacturers

# Development and application of new energy: Off-grid application

| | |
|---|---|
| Building | • It includes BIPV, ground source heat pump, integration of solar and thermal building and application of energy-saving materials in building field |
| Car | • Mainly refers to new energy vehicles and related charging station equipment |

| | |
|---|---|
| Municipal | • Including solar lighting equipment, solar transportation facilities and other municipal applications |

| | |
|---|---|
| Agricultural | • Off-grid systems that use solar and wind power for heating<br>• Fuel equipment using biomass fuel |

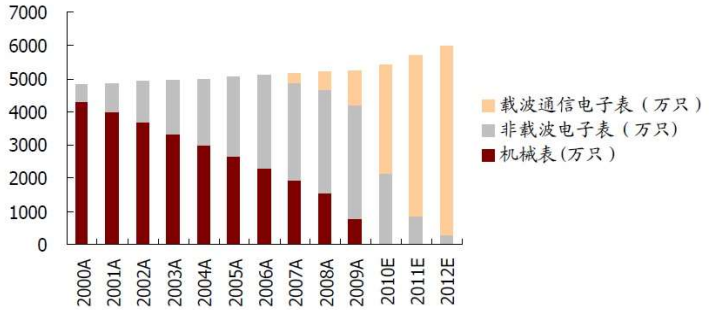
| | |
|---|---|
| Good | • A wide variety of new energy replacement equipment, including chargers, consumer appliances, furniture, etc |

# Smart grid and Internet of things: power transmission and transformation detection and control

- For a long time, China's electric power system adopts the method of periodic maintenance.
- State maintenance, that is, the maintenance opportunity is determined according to the running state of equipment, which can overcome the limitation of regular maintenance and improve the pertinence of maintenance.
- Online monitoring technology (real-time detection of equipment running state) is an important application of the Internet of things in power grid system, and is the basis of state maintenance.
- Oil chromatography on-line monitoring system is a precision equipment integrating control, measurement and analysis technology.

# Smart grid and Internet of things: distribution management

- The goal of allotment management is to save the invalid cost of electric energy.
- Electric energy meter is the legal measuring instrument of electric energy, divided into mechanical and electronic meters.
- Electronic table instead of mechanical table, carrier communication is the mainstream development direction, is also an important link to save costs.



# Smart grid and Internet of things: distribution management

## Smart meter applications

Smart grid user terminal management



# Smart grid and Internet of things: real-time power dispatching

- Real-time power grid dispatching automation system is a general term. Due to different specific conditions of each power grid, different specifications, grades and functions of power grid dispatching automation system can be adopted.

- Intelligent scheduling is another important application of Internet of things technology. Compared with existing dispatching automation, ideal intelligent dispatching has six characteristics: digitization, integration, networking, standardization, marketization and intellectualization.

# Smart grid and Internet of things: grid security

- As an indispensable basic link of smart grid terminal information perception, sensor network has wide application space in power system.
- The application of sensor network in the field of security monitoring can protect the safety of power grid more efficiently. For example, in the deployment of towers and protective lines to solve the problem of line fault, through the online configuration of sensor equipment to detect the real-time situation of the line to ensure the safety of equipment and electricity in place.



# 15.3 Future prospects of smart grid

- **Deeper environmental awareness:** the device is embedded with an identifiable smart chip containing its information, and USES wireless/wired technology to network each device to achieve comprehensive online monitoring.
- **More comprehensive information exchange:** the Internet of things technology can effectively connect the power supplier, transmission and distribution management and power users, and through the Internet technology, realize the information exchange and sharing among various participants in the grid system, making distributed grid system possible.
- **More intelligent power grid construction:** the intelligent power grid system based on Internet technology can realize the whole process of intelligent network control from energy access, transmission and distribution management, security monitoring, relay protection to user billing and metering.



# Future prospects of smart grid

## In 2010

- Construction began on the follow-up "two vertical and two horizontal" uhv ac projects, and the scale of trans-regional dc projects reached 12.9 million kw. We increased investment in the construction of distribution networks, completed smart pilot projects on schedule, and made new progress in research on key technologies, equipment research and development, and the formulation of standards

## In 2015

- A strong national power grid with uhv at its core has taken shape, and its informatization, automation and interactivity levels have been significantly improved to meet the needs of large-scale renewable energy access and transmission
- Intelligent electricity meters are widely used, and the layout of charging and discharging stations of electric vehicles basically meets the needs

## In 2020

- The formation of "sanhua" uhv synchronous power grid as the receiving end, northeast uhv and northwest uhv 750 kv power grid as the feeding end, connecting the major coal, water, nuclear power and large renewable energy bases
- Uhv and cross-regional power transmission capacity can meet the power demand of access to major energy bases and load centers

国家电网公司 STATE GRID CORPORATION OF CHINA



# Future prospects of smart grid

## New energy field

- We will support and guide the optimization and adjustment of the power supply structure, and gradually increase the installed share of non-fossil energy sources such as hydropower, nuclear power, wind power and solar energy

## Smart grid equipment

- Signed memoranda of understanding on smart grid equipment cooperation with ABB and Siemens
- Set up research groups to tackle key problems in smart grid technology

## Power grid planning

- Plans for a smart grid are being developed

中国南方电网
CHINA SOUTHERN POWER GRID

# Content



What is intelligent transportation?
What Internet of things technologies are being used in intelligent transportation?
What are the typical applications?

# What is intelligent transportation?

**Intelligent Transportation Systems (ITS)** improves the safety, manageability, and efficiency of Transportation Systems while reducing energy consumption and negative impact on the earth's environment through the extensive application of information and communication technologies in infrastructure and vehicles.



# "Intelligent earth"

In IBM's intelligent earth concept, intelligent transportation requires the following characteristics.

- **Environmentally friendly transportation:** significantly reduce emissions of greenhouse gases and other pollutants and energy consumption.
- **Convenient transportation:** provide the best route information and one-time payment of various transportation costs and other services through ubiquitous mobile communication to improve the passenger experience.
- **Safe traffic:** real-time detection of hazards and accidents and timely notification to relevant departments.
- **Efficient traffic:** real-time cross-network traffic data analysis and prediction, optimize traffic scheduling and management, maximize traffic flow.
- **Visible traffic:** integrate all public transport vehicles and private cars into unified data management, providing a single view of network status.
- **Predictable traffic:** continuous data analysis and modeling, improved traffic flow and infrastructure planning.



# 16.2 Internet of things technology in intelligent transportation

- **Wireless communications**
  - ✓ Short range wireless communication can be realized by using IEEE 802.11 series protocols, among which WAVE and DSRC standards are mainly promoted by intelligent transportation association of America and the department of transportation.
  - ✓ Long-distance wireless communication solutions are implemented over infrastructure networks such as WiMAX /GSM/3G.
- **Computing technology**
  - ✓ Future vehicles will have fewer but more powerful processors.
  - ✓ The new embedded system platform will support more complex software applications, including model-based process control, artificial intelligence and pervasive computing, among which the widespread application of artificial intelligence technology is expected to bring a qualitative leap for intelligent transportation systems.

# 16.2 Internet of things technology in intelligent transportation

- **Sensing technology**
  - ✓ Sensors in the transport infrastructure are embedded in roads or peri-road facilities such as buildings.
  - ✓ The vehicle awareness system includes the deployment of electronic beacons from road infrastructure to vehicles and from vehicles to road infrastructure for identification communication, and the continuous monitoring of suspicious vehicles in hot spots using closed-circuit television technology and automatic license plate number recognition technology.
- **Video vehicle monitoring**
  - ✓ The use of video camera equipment for traffic flow measurement and accident detection belongs to the category of vehicle monitoring.

# 16.2 Internet of things technology in intelligent transportation

- **Global positioning system**
  - ✓ The onboard embedded GPS receiver can receive signals from several different satellites and calculate the vehicle's current position, with a positioning error of several meters.
  - ✓ Because GPS signal reception requires vehicles to have satellite views, the technology can be limited in urban centers by building blocks.
- **Detecting vehicles and equipment**
  - ✓ The vehicles, usually taxis or government-owned vehicles, are equipped with wireless communications equipment.
  - ✓ The detection vehicle reports its speed and location to the traffic operations management center, which integrates and analyzes the traffic flow over a wide area to detect the location of traffic jams.

# 16.3 Intelligent transportation applications

**No parking toll system**

- ✓ The Electronic toll collection (ETC) system automatically collects fees when vehicles pass through tollbooths at normal speeds, reducing the probability of traffic congestion near tollbooths.
- ✓ Most previous e-tolling systems were based on onboard wireless communications using proprietary protocols. Many international organizations now want to standardize such agreements.


# No parking toll system

- **Application of ETC system in Norway**
  - ✓ The Norwegian government has adopted AUTOPASS as an "open toll" program, which USES DSRC technology to identify vehicles and video image capture technology to collect tolls for vehicles that have not been fitted with electronic tags or that are illegal.
  - ✓ The electronic toll lanes are equipped with DSRC read-write equipment and video cameras, which eliminate traditional traffic lights, toll signs and railings, and allow vehicles to travel at speeds of up to 60km/h.
- **ETC system application in Germany**
  - ✓ Hundreds of thousands of trucks on German highways have been fitted with satellite truck tolling systems, which rely on satellites to record their movements and pay their bills.
  - ✓ The system deploys infrared surveillance systems on 300 elevated control Bridges, reads license plate Numbers, and is patrolled by numerous surveillance vehicles with monitors and computers.

# No parking toll system

- **ETC system application in Singapore**
  - ✓ Singapore's Electronic Road Pricing (ERP) is a specialized small-range wireless information system, consisting of three main components, the vehicle unit, the ERP display board, and the control center.
- **Application of ETC system in France**
  - ✓ Because road infrastructure is often run by different companies, electronic tagging and billing systems between companies are often not universal. So companies are starting to negotiate the possibility of offering a uniform service, known as a "one-card" charge, on all motorway networks.
  - ✓ The technical considerations of the "one-card" system include the formulation of international standards, the selection of service models, the issuance of invoices, the organization of transactions, how to use and modify existing charging stations, and cost control.

# 16.3 Intelligent transportation applications

- **Real-time traffic information service**
  - ✓ Real-time traffic information service is one of the most important applications of intelligent transportation system, which can provide real-time information for drivers, such as traffic routes, time delays caused by traffic congestion, traffic accidents, safety tips, weather conditions, road repair projects ahead, etc.
  - ✓ The intelligent transportation system can also provide passengers with further information services, such as Internet access service in the car and music movie downloading and online watching.

# 16.3 Intelligent transportation applications

- **Real-time traffic information service (Next)**
  - ✓ Providing real-time traffic information service includes three main components: information collection, information processing and information dissemination. Each part requires different platforms and technical equipment support.
  - ✓ Information devices are becoming increasingly common in U.S. vehicles, with 28 percent carrying advanced information devices in 2009 and 40 percent by 2012, according to analysts.

# 16.3 Intelligent transportation applications

- **Intelligent traffic management**
  - ✓ Intelligent traffic management mainly includes traffic control devices such as traffic signals, ramp control and dynamic traffic information boards on highways (providing drivers with real-time traffic flow and highway status information).
  - ✓ At the same time, the traffic management center of a city or province needs to get the traffic flow condition of the whole region in order to timely detect accidents, dangerous weather events or other potential threats to traffic lanes.

# 16.3 Intelligent transportation applications

- **Intelligent traffic management (Next)**
  - ✓ The adaptive traffic signal control technology can dynamically control traffic signal and intelligently adjust the time of signal switch.
  - ✓ If the traffic signal device can detect the information of waiting vehicles or the vehicle can communicate with the signal device and send this information to the signal device, we can optimize the time control scheme of traffic signals, improve the traffic flow on the road and alleviate the traffic congestion.
  - ✓ Intelligent ramp control can also bring significant benefits to traffic management.
  - ✓ About 20 large U.S. cities already use various forms of ramp control technology.

# Content



What is the development course of logistics?
What Internet of things technologies are used in intelligent logistics?

# What is logistics?

**Logistics** is a process of planning, execution and control for effective circulation and storage of goods, service and related information from the source point to the final consumption point to meet the needs of customers.

**Logistics development stage**

- Extensive logistics (1950s-1970s)
- Systematic logistics (1970s and 1980s)
- Electronic logistics (1980s ~ late 20th century)
- Logistics of logistics (early 21st century ~)

# Extensive logistics

**Background:**

The world economy recovered rapidly after world war ii

**Features:**

Big retailers have sprung up

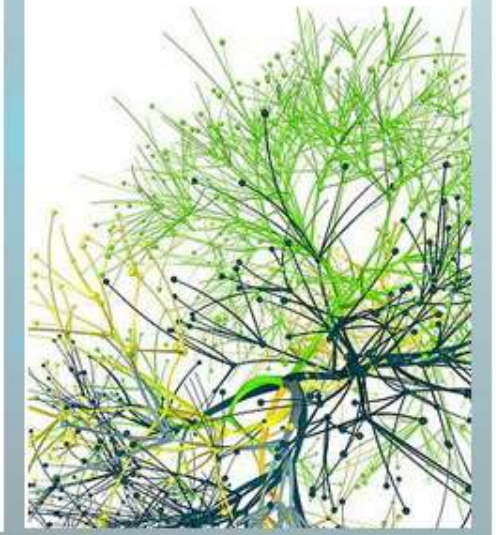
Mass production, mass consumption

**Disadvantages:**

Large inventory, low efficiency and lack of inter-departmental coordination

Carrefour 家乐福

Walmart



# Systematic logistics

**Cause:**

- Logistics has become a comprehensive science
- Enterprises begin to pay attention to the cost and benefit of logistics

**New logistics technology**

- Real-time production system
- Container technology

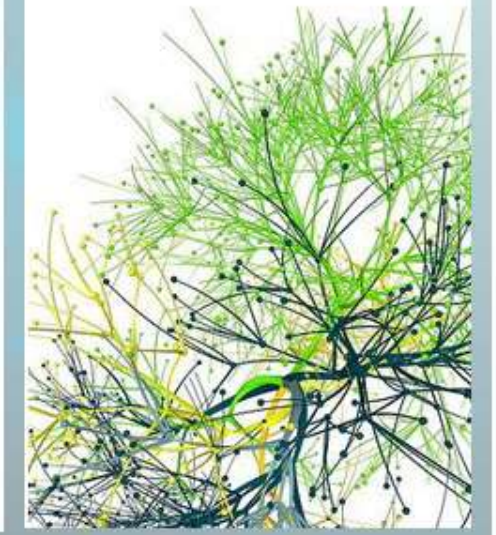
**New logistics business**

- Air express


图片来源：http://gallery.pictopia.com & AirLiners.net

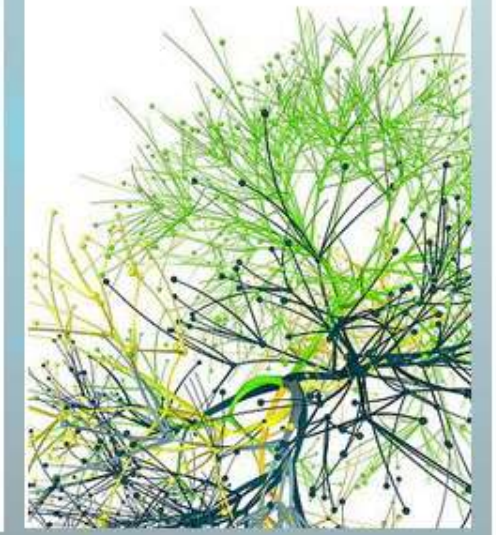
*"We started out with 8 planes and we covered something like 35 or 40 cities and we added each month."*

-Fred Smith, founder of FedEx



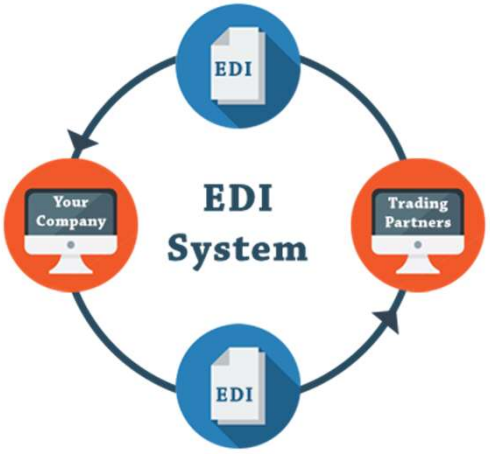
# Electronic logistics

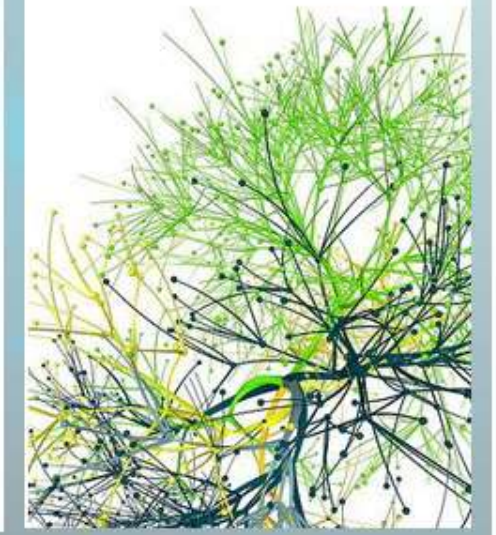
- The beginning of modern logistics
- The key technology
  - ✓ EDI
  - ✓ Bar code
- Typical applications
  - ✓ UPS World Port

# Electronic Data Interchange (EDI)

- Demand background
  - ✓ Unified computer data format
  - ✓ The paperless trade
- The early standard
  - ✓ X12
  - ✓ UN/EDI FACT
- Key support
  - ✓ The Internet

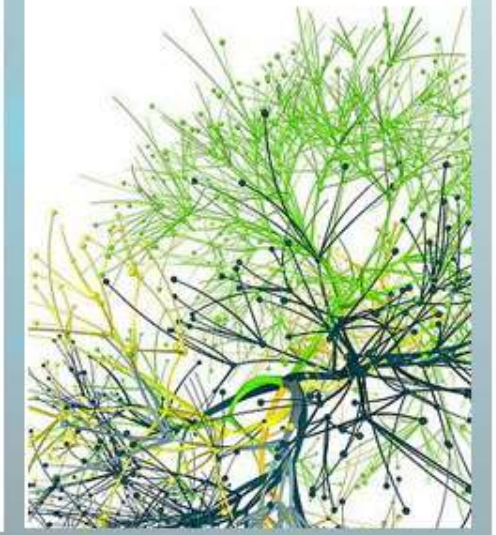


# Logistics of logistics

**Problems faced by modern logistics**

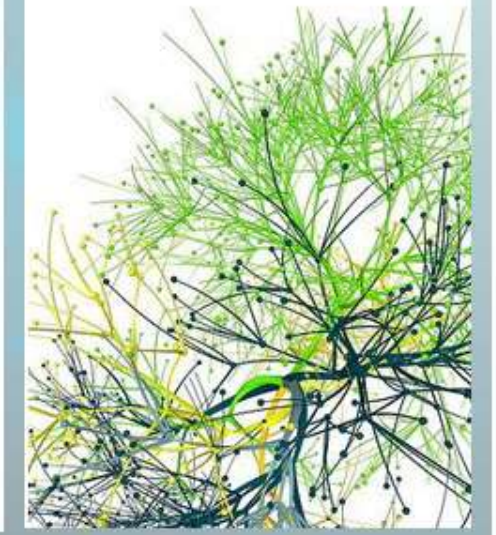
- Inadequate connectivity
  - ✓ Standards are difficult to unify and lag behind
  - ✓ Heterogeneous network and equipment, information sharing is not enough
- Perception is not timely and thorough
  - ✓ Lack of real-time awareness
  - ✓ The information collection method is single, the information collection type is limited
- Lack of intelligent computing support and services
  - ✓ Low level of application
  - ✓ Lack of synergy



# Logistics of logistics

**Intelligent logistics**

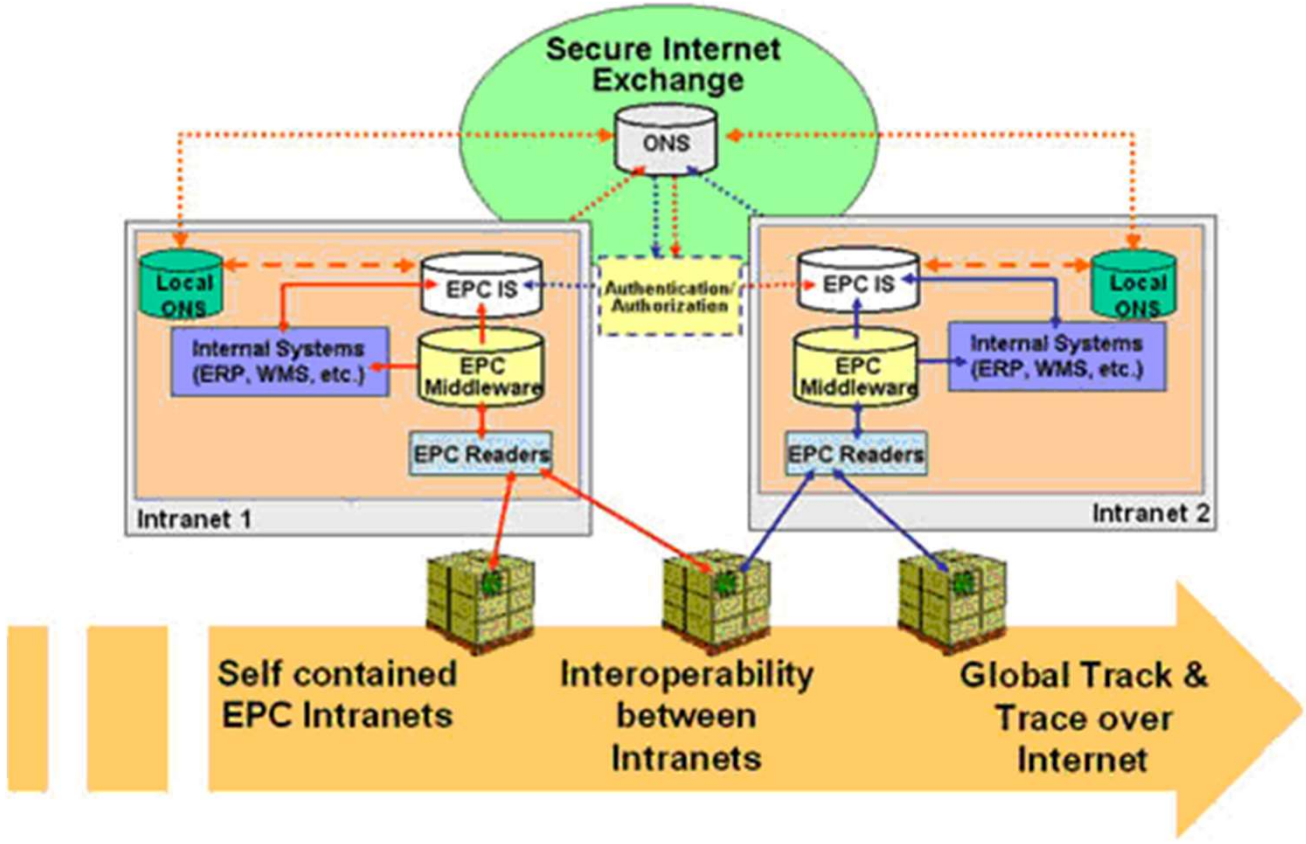
- Development opportunity
  - ✓ The Internet of things
- The characteristics
  - ✓ Precision: cost minimization, zero waste
  - ✓ Intelligent: intelligent software, intelligent equipment and network
  - ✓ Synergy: the integration of capital flow, logistics and information flow



# Typical application of intelligent logistics: EPC

- Commodity logistics needs to solve the first problem: who am I?(Tagging)
- Electronic Product Code
  - ✓ Target: "Internet address system"
    Each object or electronic device has an independent and unique EPC Code
    Object Naming Service (ONS)
    The whole logistics field is connected into EPC Internet of things

# EPC Internet of things architecture





## Typical application of intelligent logistics: RF-ITV system of US army

- Logistics problems in the gulf war
  - ✓ Lack of effective and accurate logistics management, low efficiency
  - ✓ Material piling up disorderly, serious waste
- Solution: visualize in-transit Asset Visibility In Transit
  - ✓ Accurate positioning, reduced stacking, timely delivery
  - ✓ Help decision-making, grasp the situation
  - ✓ Rational supply, optimize procurement rationing plan

# RF-ITV key technology: RFID technology

- Joint asset visualization system (JTAV)
  - ✓ RFID tags
  - ✓ Extensive use of active tags, sensor tags
- Globalization read/write identification device deployment architecture (Global Interrogator Infrastructure)
- International Transportation Information Tracking



## Typical application of intelligent logistics: food logistics

- The particularity of food logistics
  - ✓ Storage, transport conditions, high requirements
- Intelligent Internet of things technology and food logistics
  - ✓ Sensors collect various parameters to be monitored
  - ✓ Bar codes and RFID tags support secure backtracking
  - ✓ Electronic ear tags facilitate rapid customs clearance
- The development direction
  - ✓ Means of enrichment perception
  - ✓ Improve intelligence

# Content



What are the green buildings
in the context of the Internet of things?



# What is green building?

**Traditional green buildings:**

- Green space, garden

**Green building in modern sense:**

- Do not destroy the ecological environment of the building, building to create a good environment

**Objectives of green building:**

- Provide a comfortable and environmentally friendly working or living environment (basic requirements)
- Reduce the energy consumption of buildings in use and maintenance, and alleviate the energy crisis (survival demand)
- Reducing the ecological impact of urban development (development needs)


# What is green building?

**Green building from the perspective of architecture:**

- Single building structure
- Building materials: solar insulation film, water purification system, fire prevention materials, external wall insulation, plant materials
  → such a green building still stay on the surface

**Green building from the perspective of Internet of things:**

- From single to comprehensive
- The Internet of things provides evaluation basis for green buildings
- It is the only way for green buildings to integrate into nature



## Evaluation criteria for green buildings

| Country | Standard | Year |
|---|---|---|
| English | BREEAM | 1990 |
| America | LEED | 1995 |
| Hong Kong | HK-BEAM | 1996 |
| Canada | GBC | 1998 |
| Japan | CASBEE | 2002 |
| China | GB/ T 50378 -2006 | 2006 |

# Typical applications of green building

- **Building management:** intelligent management of building construction
  - ✓ Building structure monitoring
  - ✓ Construction site monitoring
  - ✓ Building quality control
  - ✓ Exception handling during construction
- **Low carbon buildings**
  - ✓ Building low-carbon technology: low radiation glass, water treatment, internal and external insulation, solar energy, fresh air system, rainwater circulation system

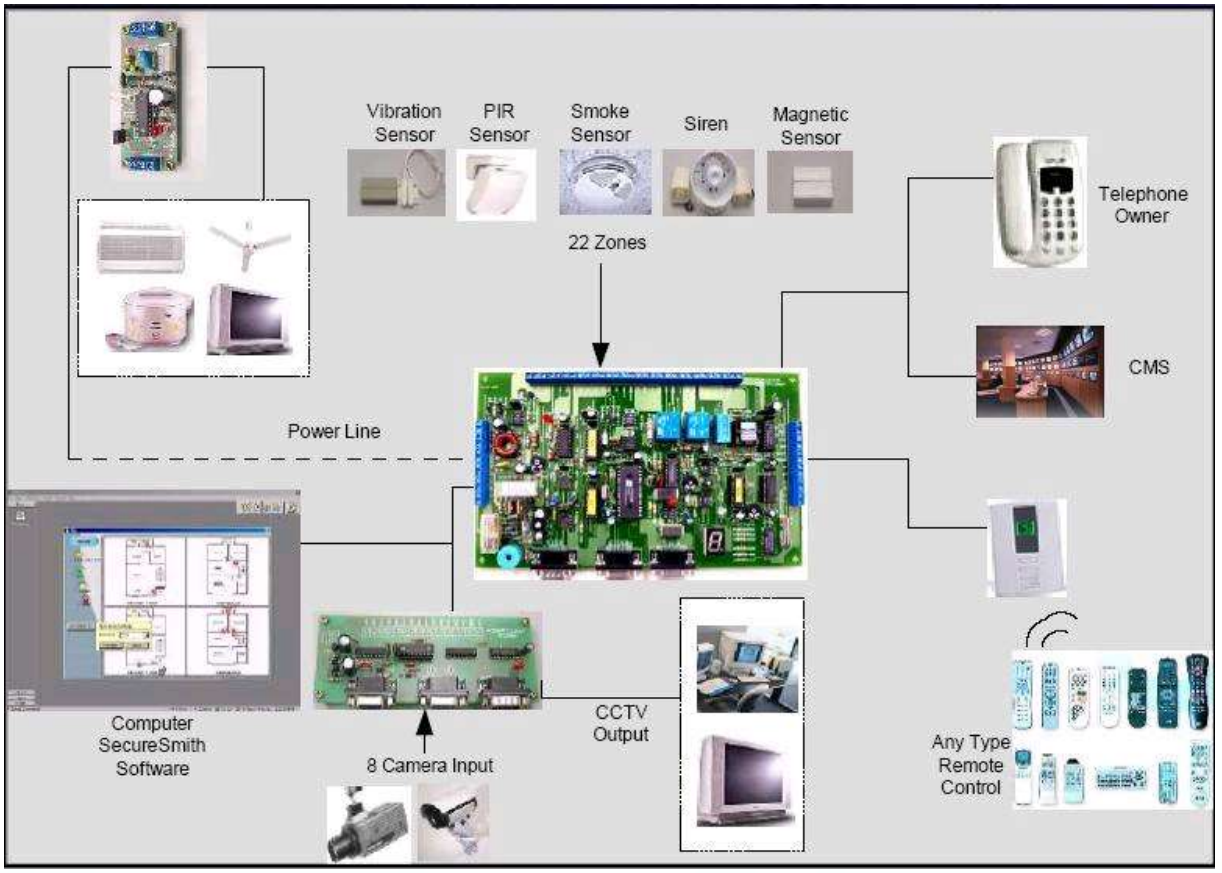
# Typical applications of green building

- **Smart building:** interconnection of devices within the building
  - ✓ Realize intelligent energy saving
  - ✓ Provide intelligent security for buildings
  - ✓ Provide intelligent services for building staff
  - ✓ Intelligent management of building facilities
- **Smart office**
  - ✓ Intelligent office platform, wireless connectivity
  - ✓ Video conference system, humanized service

# Typical applications of green building

- **Smart home:**

It is an efficient, comfortable, safe, convenient and environmentally friendly living environment integrating system, structure, service and management.





## Challenges and opportunities of green building

- Advantage
  - ✓ Huge market size
  - ✓ Government support
- Challenge
  - ✓ Low awareness
  - ✓ High technical threshold
  - ✓ Construction cost increase

# Content



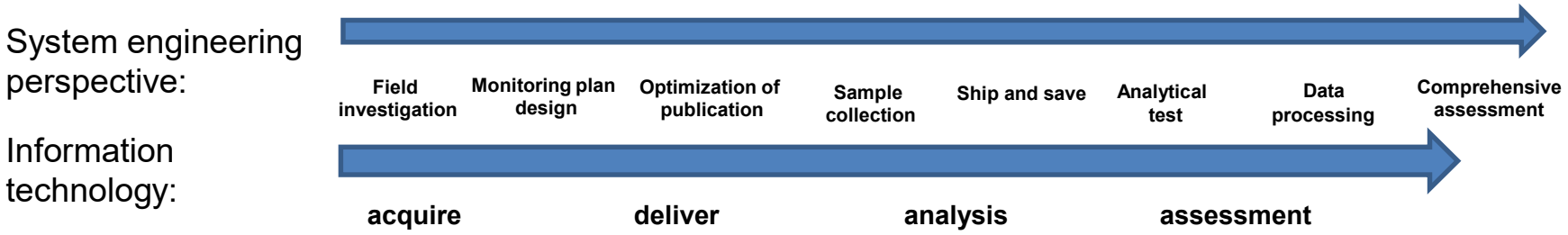
# The concept of environmental monitoring

**Environmental monitoring aims:** to detect state parameters, track quality changes and determine quality levels

**Environmental monitoring objectives:** to provide basic information, method guidance and quality assurance for environmental management, pollution control, disaster prevention and reduction, etc.

**Objects of environmental monitoring:** natural factors, human factors, other environmental hazards caused by pollution, as well as biological and ecological changes.

**Different stages of environmental monitoring:**





# Development of environmental monitoring

- Empirical observation
  - ✓ To know the laws of nature from natural factors;
  - ✓ The reflection of natural law is not comprehensive, accurate and objective.
- Systems science monitoring
  - ✓ In the 1950s, passive monitoring of heavily polluted sites;
  - ✓ In the 1970s, the scope of monitoring was extended to include discrete measurements of other physical factors.
- Automatic monitoring
  - ✓ Computer control and auxiliary processing;
  - ✓ Monitoring environment has breadth, frequency and depth.
- Wireless sensor network

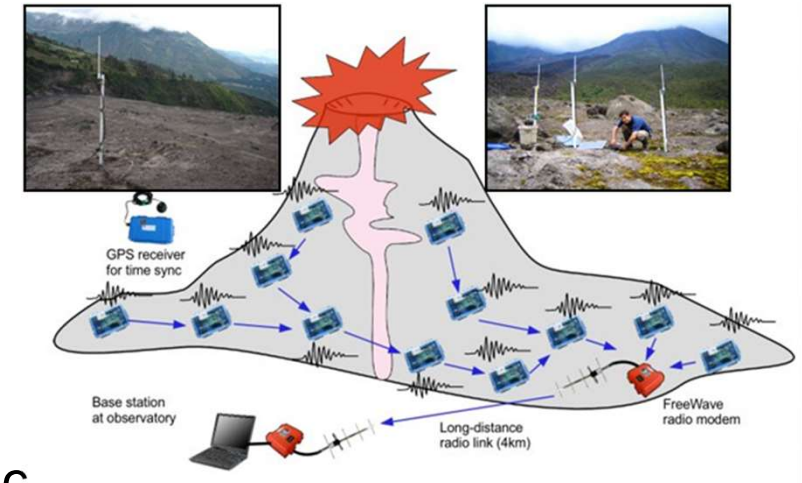
# Environmental monitoring sensor network: typical application system deployment

- University of California, Berkeley, 2002
- Great Duck Island
- 32 MICA nodes
- **Data collection:** temperature, humidity, light and atmospheric pressure
- **Monitoring objectives:** to continuously monitor the behavior of petrel during the breeding season and collect relevant environmental data for analysis by zoologists.

Big duck island sensor network node and deployment environment

# Environmental monitoring sensor network: typical application system deployment

- Harvard University, 2004
- Active volcanoes around Ecuador
- 16 nodes
- 19 days to capture 229 earthquakes, volcanic eruptions and other seismic wave events.
- **Data collection content:** continuous collection of seismic wave and acoustic wave intensity at 100 Hz frequency.
- **Monitoring objective:** to explore the transmission reliability, data verification and calibration in the process of high-frequency data acquisition.




Ecuador volcano monitoring sensor network deployment environment

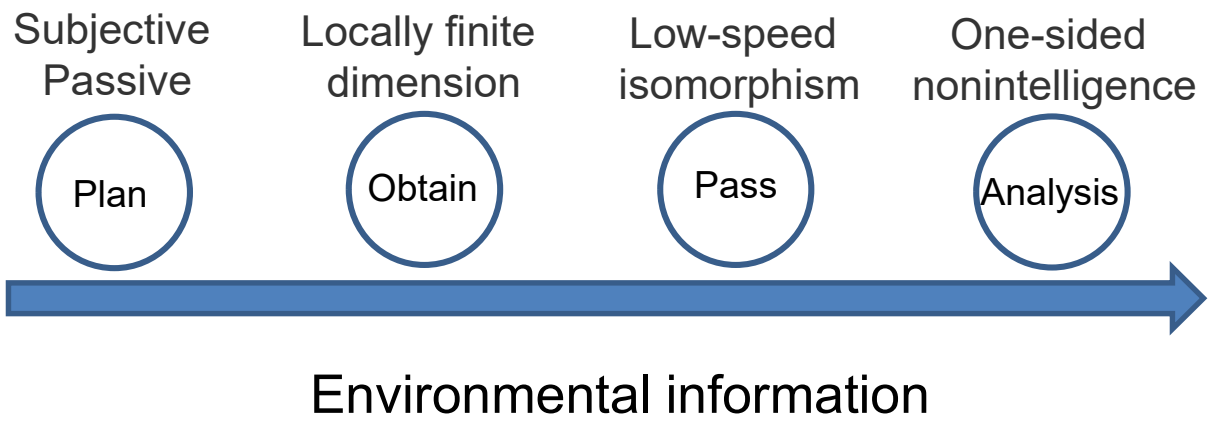
# Environmental monitoring sensor network: typical application system deployment

- University of Basel, the university of Zurich and the federal institute of technology Zurich 2006
- Swiss Alps
- **Data collection:** climatic conditions, geological structure and surface environment.
- **Monitoring objective:** to study the impact of climate on the environment and predict natural disasters such as avalanches and landslides in advance.

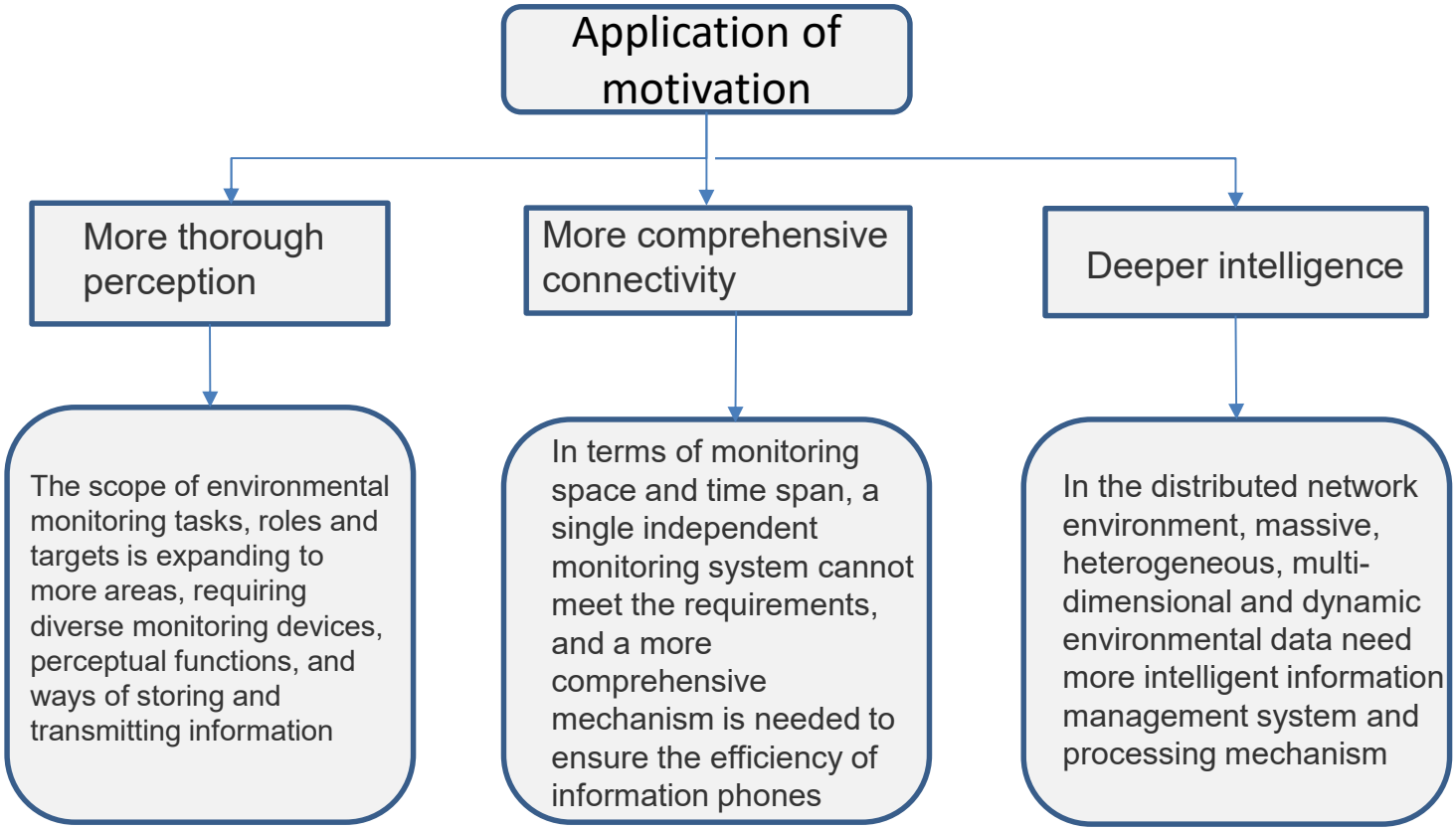

PermaSense System deployment

# Environmental monitoring sensor network: patterns and characteristics

- Monitoring process: unidirectional and one-dimensional;
- Local and targeted collection and measurement can be completed;
- It does not meet the requirements of deep monitoring, comprehensive measurement and intelligent utilization.



# Environmental monitoring Internet of things: application motivation



## Environmental monitoring sensor network: patterns and characteristics

- Monitoring process: three-dimensional, evolutionary, two-way;
- Environmental information feeds back into planning;
- The monitoring results reflect the objective environment comprehensively and truly;
- The transmission link combines information transmission and storage to realize heterogeneous network fusion in the Internet.

# Environmental monitoring Internet of things application: forest ecological Internet of things

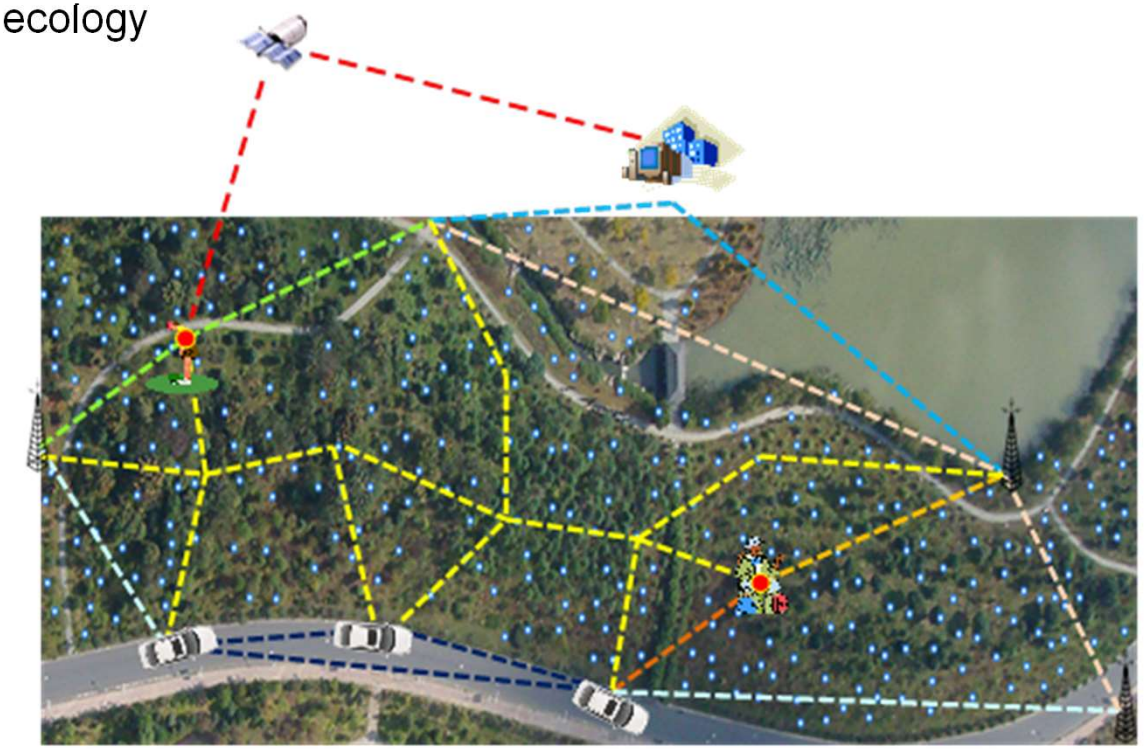
•Application objective: to conduct long-term large-scale monitoring of the earth's environment centered on forest ecology

Units:

- Tsinghua university,
- Hong Kong university of science and technology
- Xi ‘an Jiaotong university
- Zhejiang agriculture and forestry university

Composition:

- Wireless sensor network
- On-board network
- Mobile 3 g
- The Internet



# Internet of things in forest ecology: application background

We should address global climate change and maintain the balance of nature.

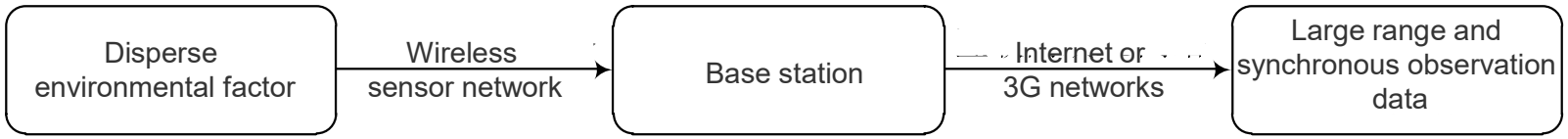
- On February 16, 2005, the Kyoto protocol came into force, which explicitly proposed that the carbon sequestration potential could be increased through effective management of forests and other ecosystems, thus offsetting the carbon emission reduction share. Determine the role of forests in mitigating global CO2.
- On September 22, 2009, President Hu Jintao proposed at the G20 climate change summit in New York that "forest carbon sinks" should be used to mitigate climate change.
- On December 18, 2009, premier Wen Jiabao attended the Copenhagen climate change conference.



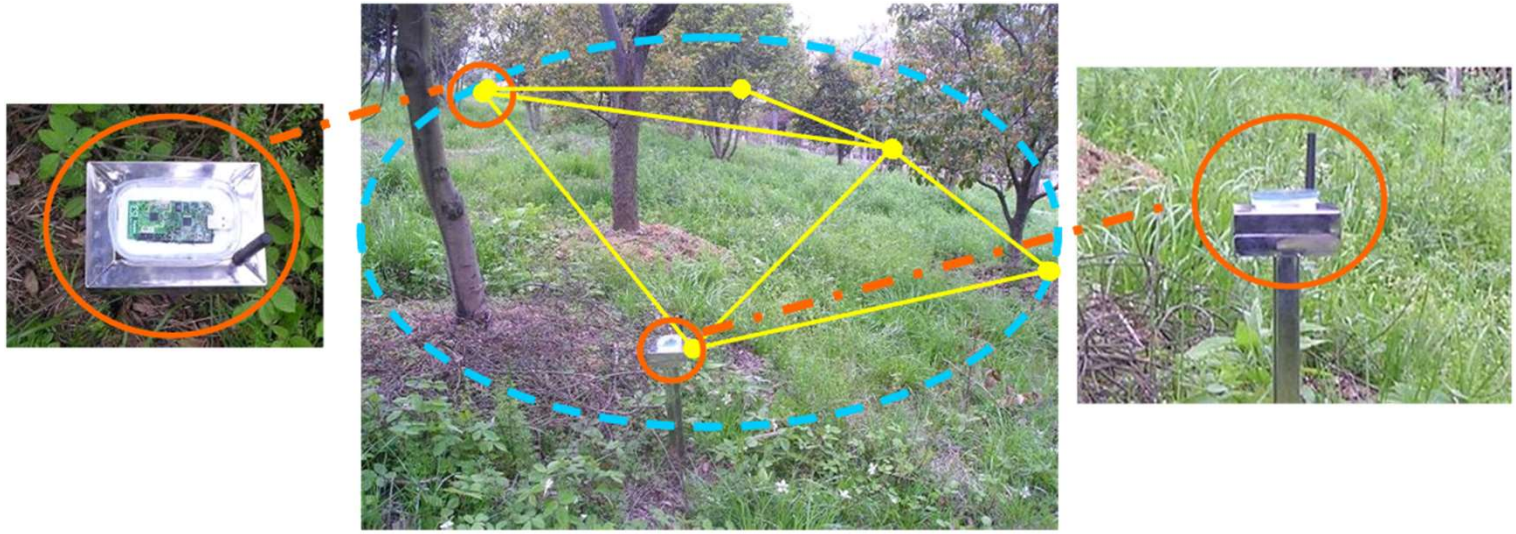

# Internet of things in forest ecology: a typical application scenario

Carbon-water flux observation tower

- Forest carbon sink measurement
- Biodiversity research



# Internet of things in forest ecology: a typical application scenario

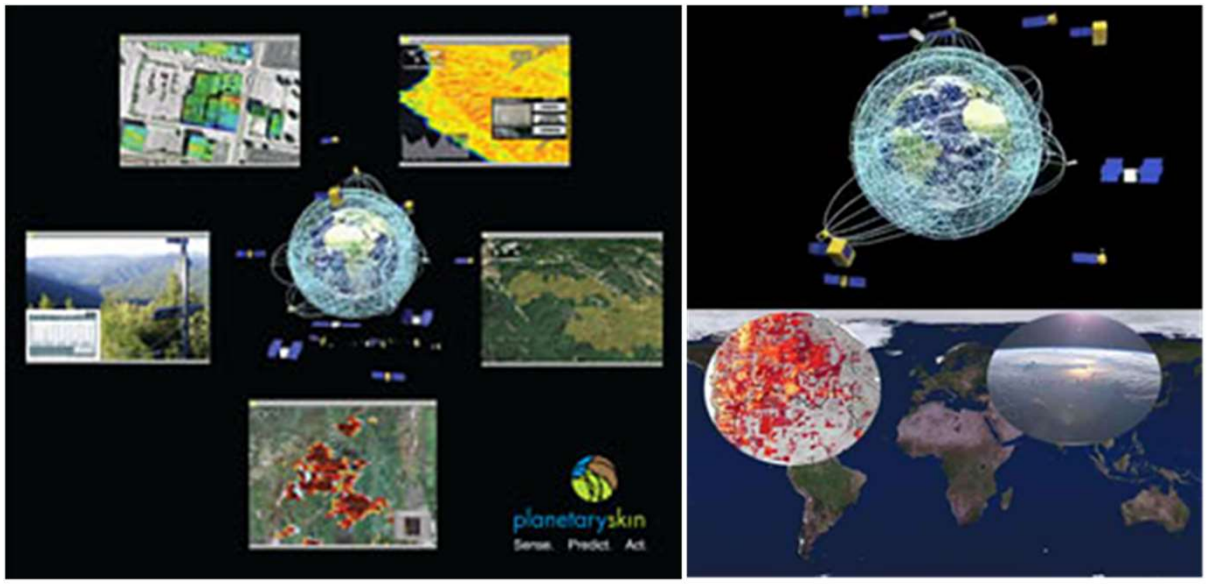


Forest biomass sampling monitoring system

- Monitoring of forest ecological security
- Forest ecotourism navigation and safety guarantee
- Intelligent management of forestry production and urban forest planning

## Environmental monitoring applications for the Internet of things: Planetary Skin

The goal of the CISCO (CISCO) and NASA programs is to meet the challenge of global climate change and provide environmental information quantitative assessment and decision support system for mankind.




Planetary Skin Project diagram



## Environmental monitoring applications for the Internet of things: Planetary Skin

**Application background:**

- Resource shortage and information enrichment dominate the development and social progress of today's world
- It is difficult to define the responsibility and obligation of energy conservation and emission reduction

**Typical application scenarios:**

- Onshore carbon sequestration
- Food safety
- Water resources management
- Conflict coordination of land for fuel, food, fiber products and feed production

# Conclusion

## Review

This paper introduces the comprehensive application layer of Internet of things, including five typical application fields of smart grid, smart transportation, smart logistics, smart green building and environmental monitoring.

## Key Points

- Understand the basic concepts of power system, power network and smart grid, master the core connotation and nine characteristics of smart grid.


# Conclusion

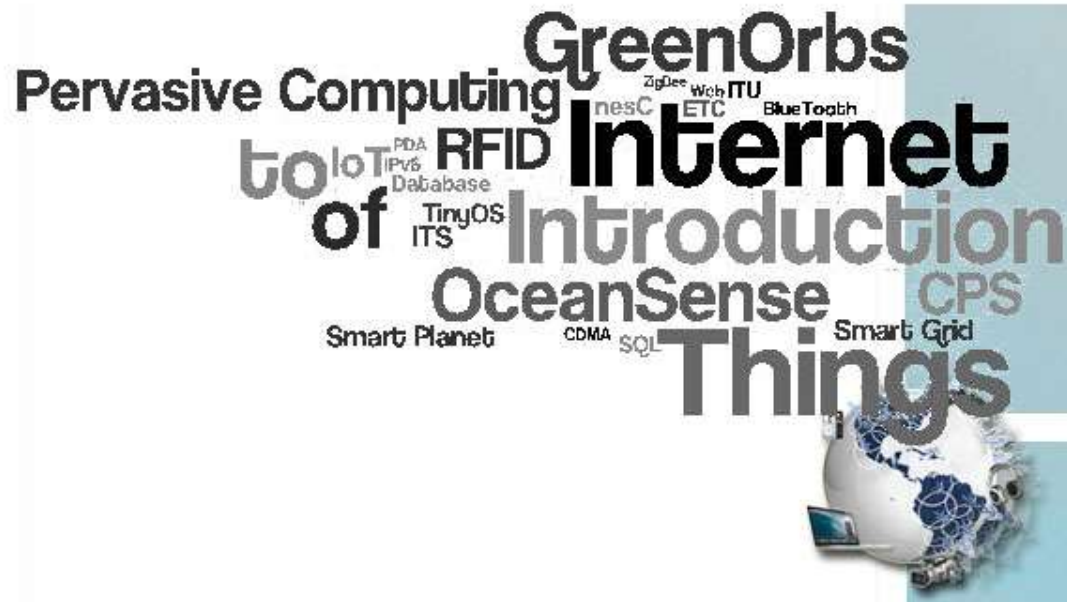
## Key Points

- Examples are given to illustrate the application of smart grid under the background of Internet of things (development and application of new energy, power transmission and transformation detection and monitoring, power allocation management, real-time power dispatching, power grid security).
- Understand the concept of intelligent transportation, illustrate the Internet of things technology in intelligent transportation and typical intelligent transportation applications.
- Understand the development process of logistics (extensive → systematic → electronic → linked things), and illustrate that modern logistics needs to be realized with the help of Internet of things technology (EPC, RF-ITV, food logistics).

# Conclusion

## Key Points

- Illustrate the comprehensive application of green building environmental protection technology, energy saving technology, information technology and network technology.
- Comparison of environmental monitoring sensor network and environmental monitoring Internet of things monitoring process, main characteristics and typical applications.






# Thank you!

Internet of Things