Ubiquitous Networks

Dr. Hitomi Murakami
General Manager, IT Development Division
KDDI Corporation

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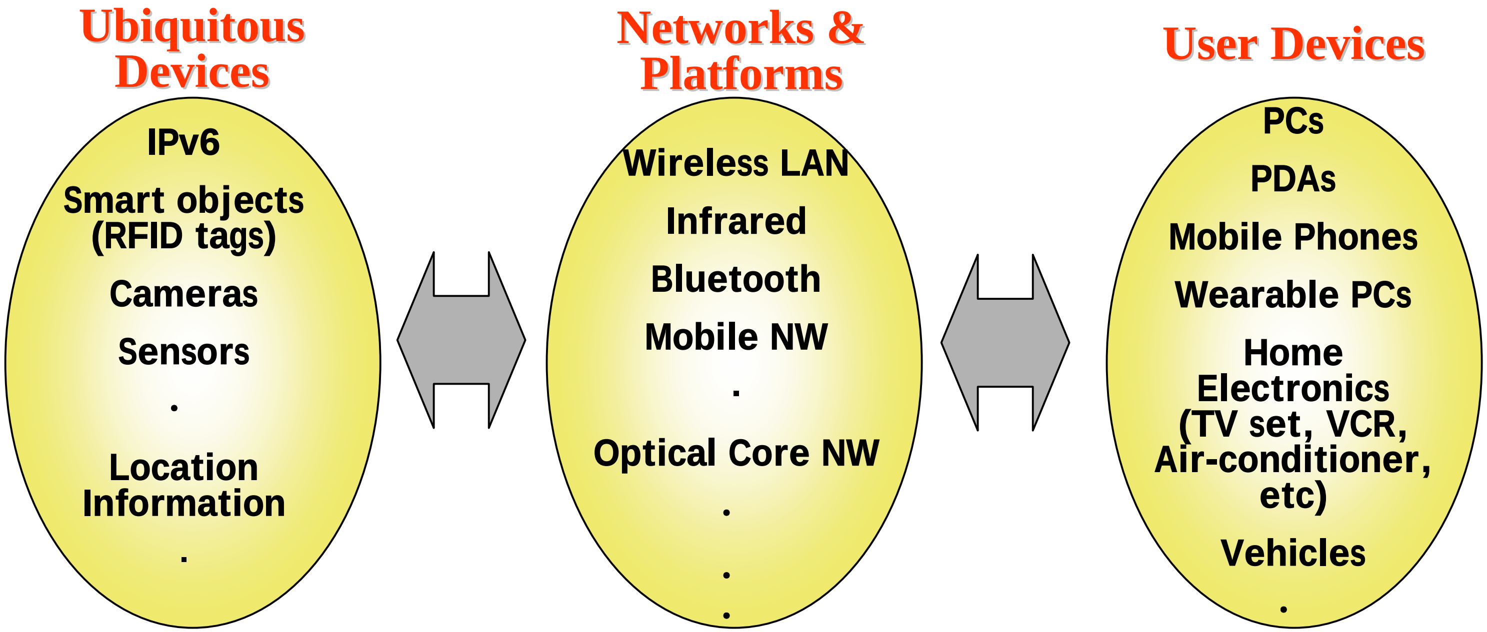
1. Overview of ubiquitous networks

- Ubiquitous network consists of innumerable number of computing devices embedded in almost everything around us, platforms and networks that interconnect them, and user devices that make use of and act on the available information.



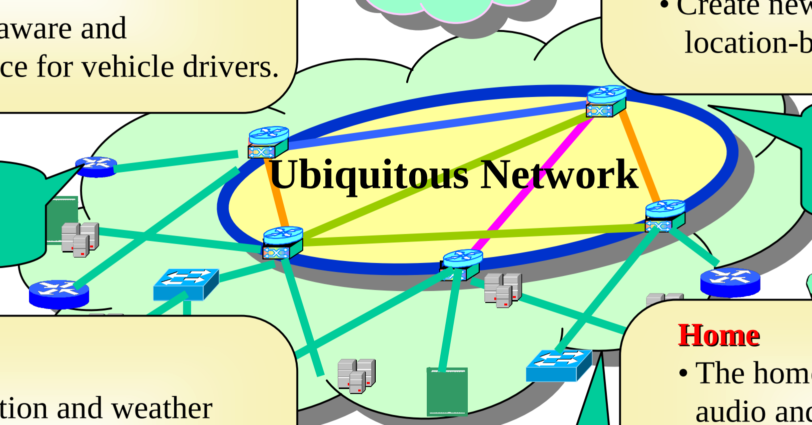
1. Overview of ubiquitous networks

1.1 Our future life with ubiquitous networks

- When fully implemented around 2010, Ubiquitous Network will change our daily life by providing us with the information and services we need with less efforts.

Urban areas
- Routing support to permit seamless roaming among networks and media types by maintaining active TCP/UDP connections.
- Provide location-aware and personalized advice for vehicle drivers.

Office
- Collaboration with other group within a company and with suppliers and customers can reduce cost from fluctuating supply and demand.
- Create new business from real-time and location-based commerce.



Location-aware
Personalized advice

Multimedia conference
Automatic meeting minutes
Searchable notes

Public facilities
- Real-time congestion and weather information-based traffic management can increase road capacity.
- Monitoring secular change of road and building could prevent accidents caused by incidents and natural disasters.

Home
- The home is constantly monitored using audio and video observation methods, and even monitors its inhabitants' medical conditions.
- Support social connections of elderly people promoting peace of mind for the family.

Food/recipe management
On-line ordering
Kitchen monitoring

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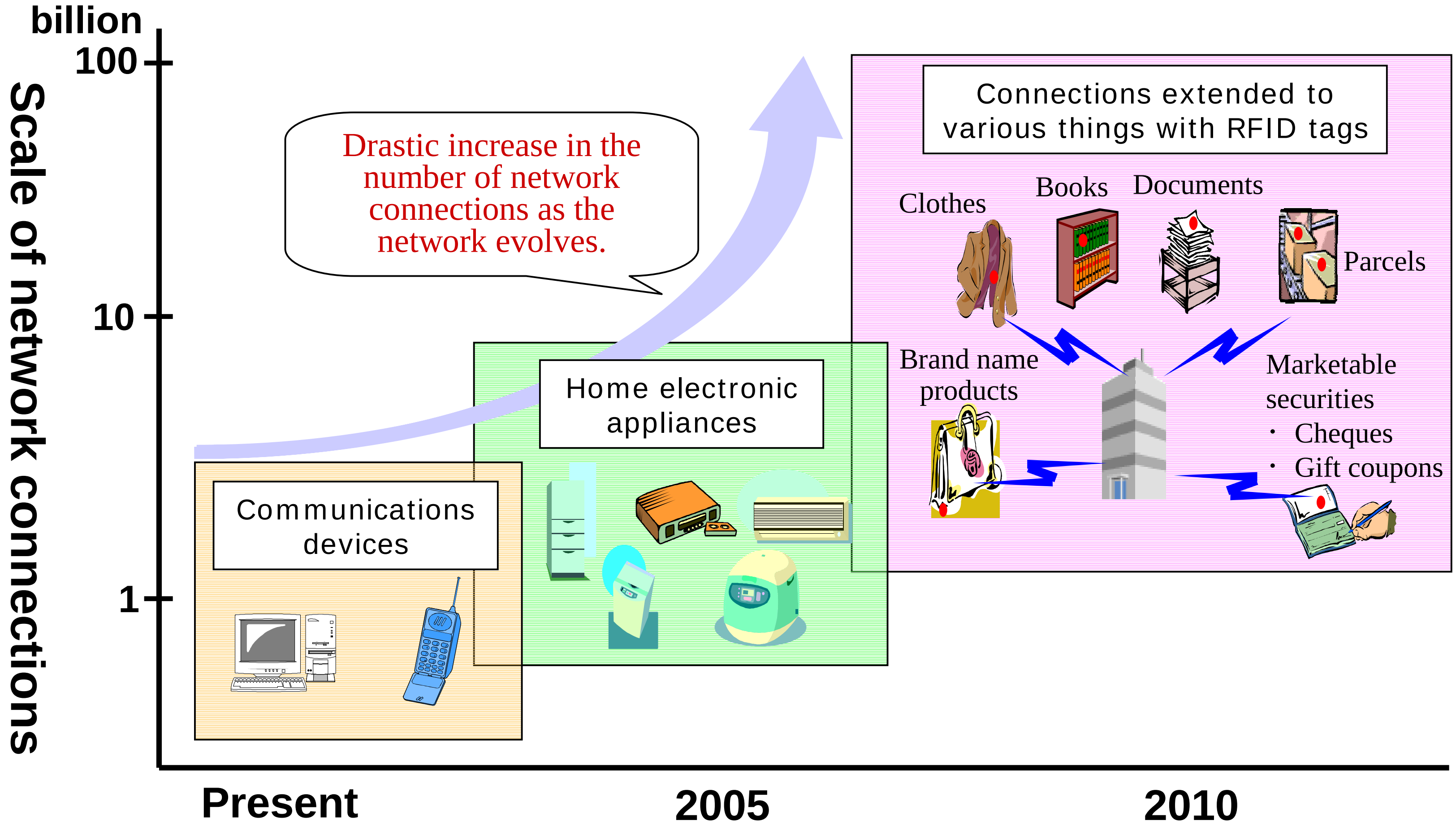
1. Overview of ubiquitous networks

1.2 Development into ubiquitous networks

- As the ubiquitous network evolves, it will add new entities such as home electronic appliances, followed by various things around us embedded with RFID tags.



1.3 Impact on NGN

- Ubiquitous networks will create new and huge demands for communications owing to :

  1) New Internet access method:
  As broadband access and services prevail, television sets and VCR/DVD recorders will be connected to the network, creating additional requirements for capacity.

  2) Home electronic appliances:
  In a few years, common electronic appliances such as air conditioners, microwave ovens, refrigerators, etc, will be connected to the network.

  3) M2M communications:
  While the demands for person oriented (P2P and P2M) communications will someday saturate due to the limitation in the number of subscribers, M2M communications between thousands of RFID tags (smart objects) will create new and unprecedented amount of demands.

NGN should support the capacity and functions/technologies to handle communications demands created by ubiquitous networks.

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2. Technologies supporting ubiquitous network

2.1 WiFi and future Wireless technologies

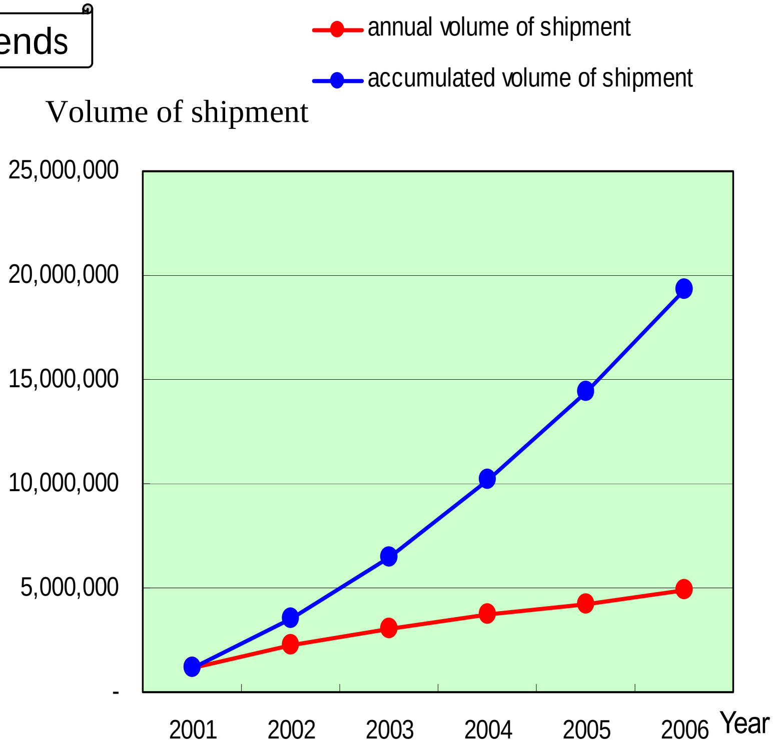
Wireless technologies play an important role in ubiquitous networks.
- Wireless avoids plug and unplug problems.
- Wireless permits easy use of installed local infrastructure.

Emerging new technologies and market trends

WiFi hot spot networks
- 802.11b has made itself a dominant technology for hot spot.
- 802.11a and 11g technologies are in tiptoe.
- Bluetooth will be complementary.
- WiFi operators will incorporate into cellular networks and billing.

Multi hop networks
- P2P wireless, self-configuring, self-healing networks.
- Ease saturation in densely populated area.

4G networks
- Japanese operators, DoCoMo and KDDI, announced 4G experiments, services around 2010.



Estimated volume of shipment:
WiFi equipments in Japan

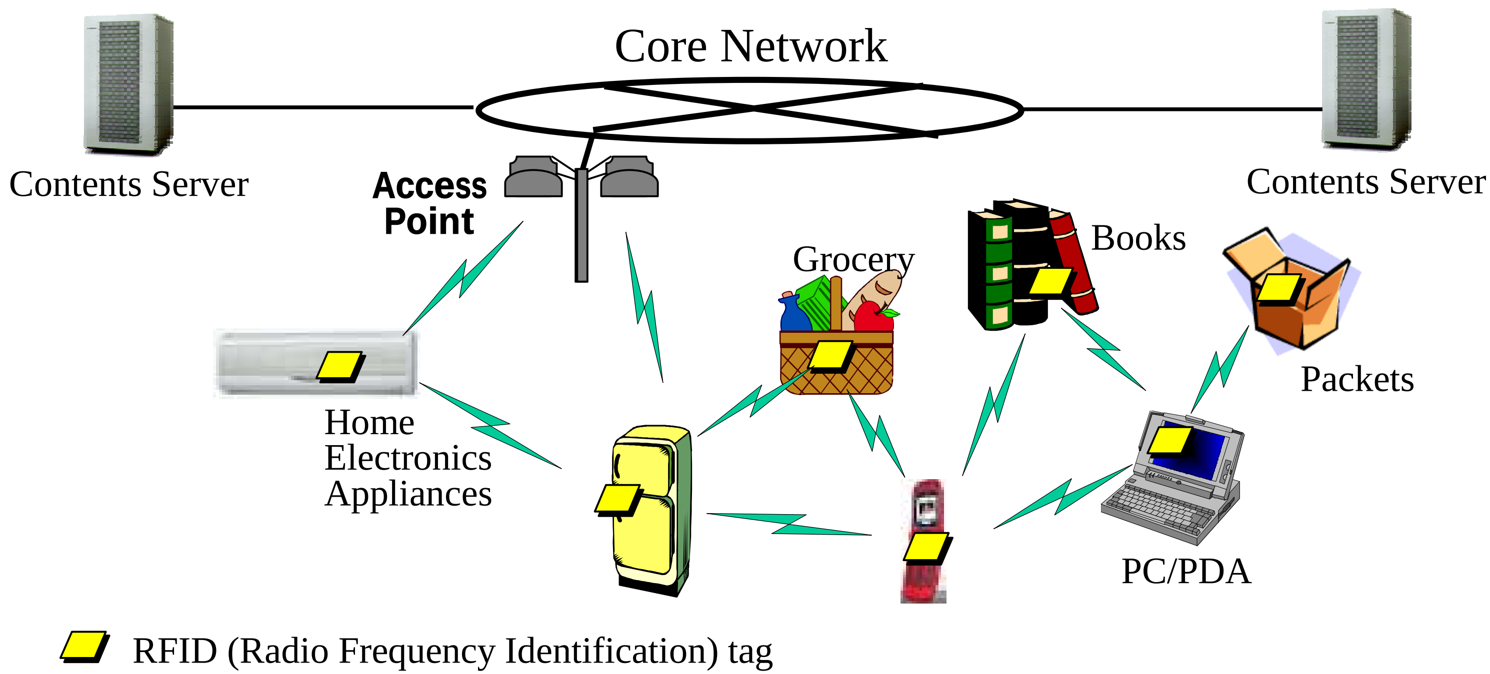
2. Technologies supporting ubiquitous network

2.2 RFID Tags

(Radio Frequency Identification)

RFID tags will play a major roll in ubiquitous networks.

- Being very small, they can be embedded in numerous household goods around us, and can make them part of the network.
- Their communications capability allow them to be managed and controlled from the network, thereby supporting our daily life.



Numbering and Addressing of RFID

- ID’s have two functions:
  - (1) To identify an object/product in the real world
    - RFID tags are embedded in every object/product in the real world.
    - The ID written into an RFID tag notifies the network of the identity and property of the object/product.
  - (2) To serve as an address/number to uniquely identify the location of an entity on the network
    - Two or more entities on the network can communicate with each other using the ID (address)
- Assignment of ID’s should be such that they associate an object in the real world with its virtual address on the network.
- Development and standardization required in the area of:
  - Assignment and management of ID’s
  - Length of ID codes
  - Security and privacy considerations

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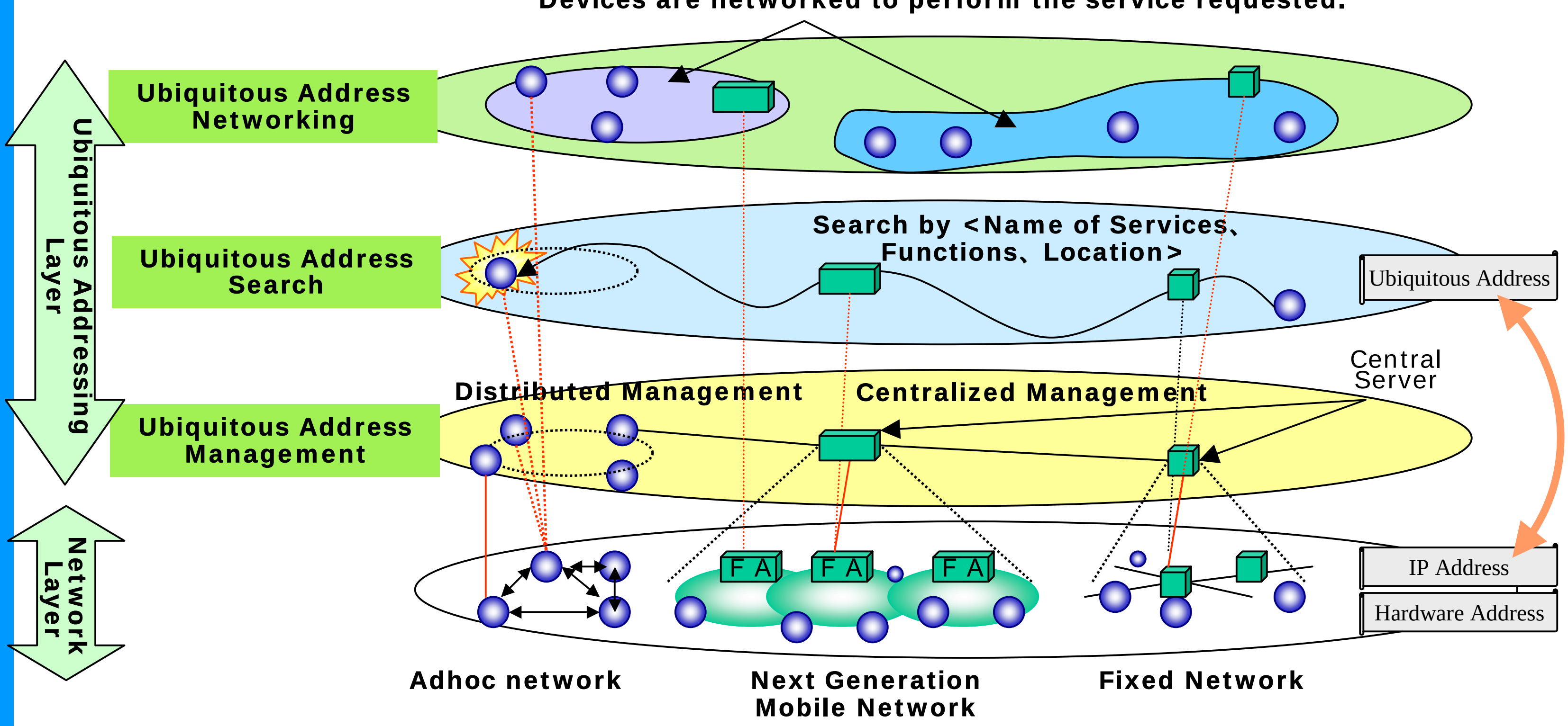
Ubiquitous Address Management

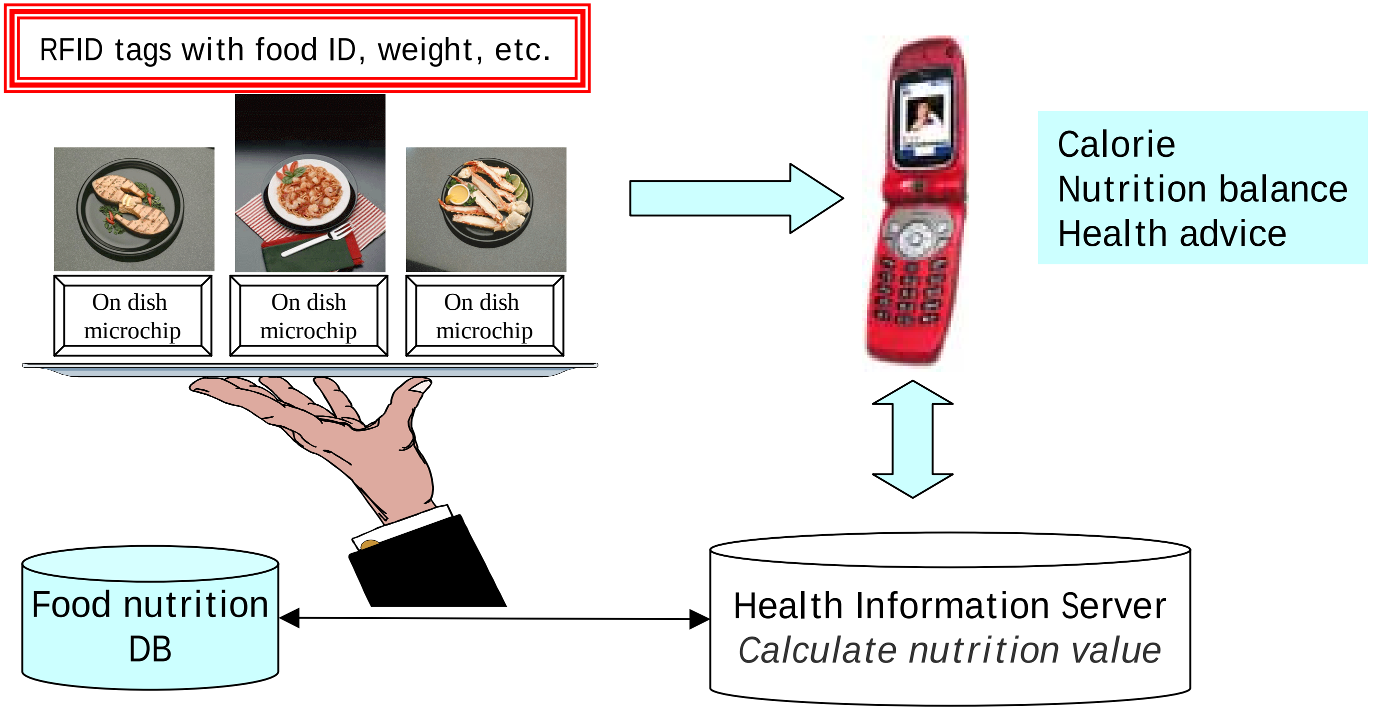
- Properties of ubiquitous devices such as functions and services, physical location, are registered with central or distributed servers.
- Services are available by searching for an address having a set of properties that matches the user's requirements.



2. Technologies supporting ubiquitous network
2.2 RFID Tags

Application of RFID Tags
(1) Health information management

- Daily management of nutrition information is bothersome.
- Automatic nutrition control by using RFID tags (smart objects) on dishes may contribute to health care and improve revenue/expenses balance of the national health insurance.

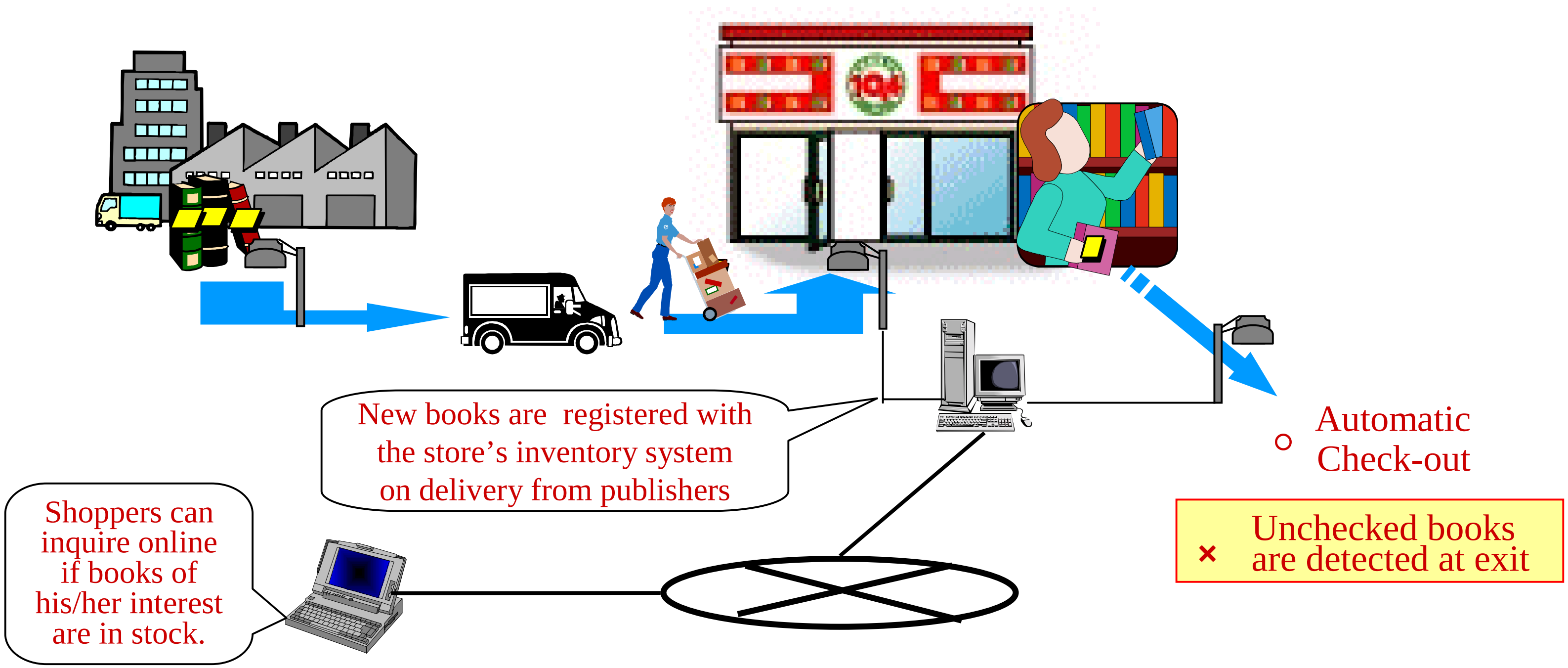


2. Technologies supporting ubiquitous network

2.2 RFID Tags

Application of RFID Tags
(2) RFID Tag on Books

- Japanese publishers considering to embed RFID tags on every book they publish, starting around 2005.
- The purposes are twofold:-
  - Inventory control at publishers, warehouses, delivery and stores
  - Prevention of shoplifting (to replace magnetic tags)



2.3 Context Awareness

Context is the information about the circumstances of a user.

To provide the user with a service of his or her needs in the ubiquitous network, it is essential that the network has the knowledge of his or her context.

- Location and time are simple examples of context.

User needs:

Applications that are context aware and allow personalization based on his or her interest.

Context aware applications:

- can capture the context,
- assign meaning to it, and
- change behavior accordingly.

Opportunities for business: Billing by location, time, users' age; and timely geo-dependent advertising.

2. Technologies supporting ubiquitous network
2.3 Context awareness

Navigation and location-aware communications

Role of navigation

Two key functions
- Position (Where am I?)
- Navigation (How do I get from A to B?)

Not always essential, BUT
- Enables geo-dependent service provision
- Potentially the greatest profit
- Position = Personalization = Revenue

Applications of navigation

Now
- Information on local restaurants, hotels, taxis
- Tourist information
- Web sites of interest, hobbies

Soon
- Geo-dependent advertising
- Multimedia navigation/tracking services
- Regional/local personalized portals

Location-aware communications realizes:

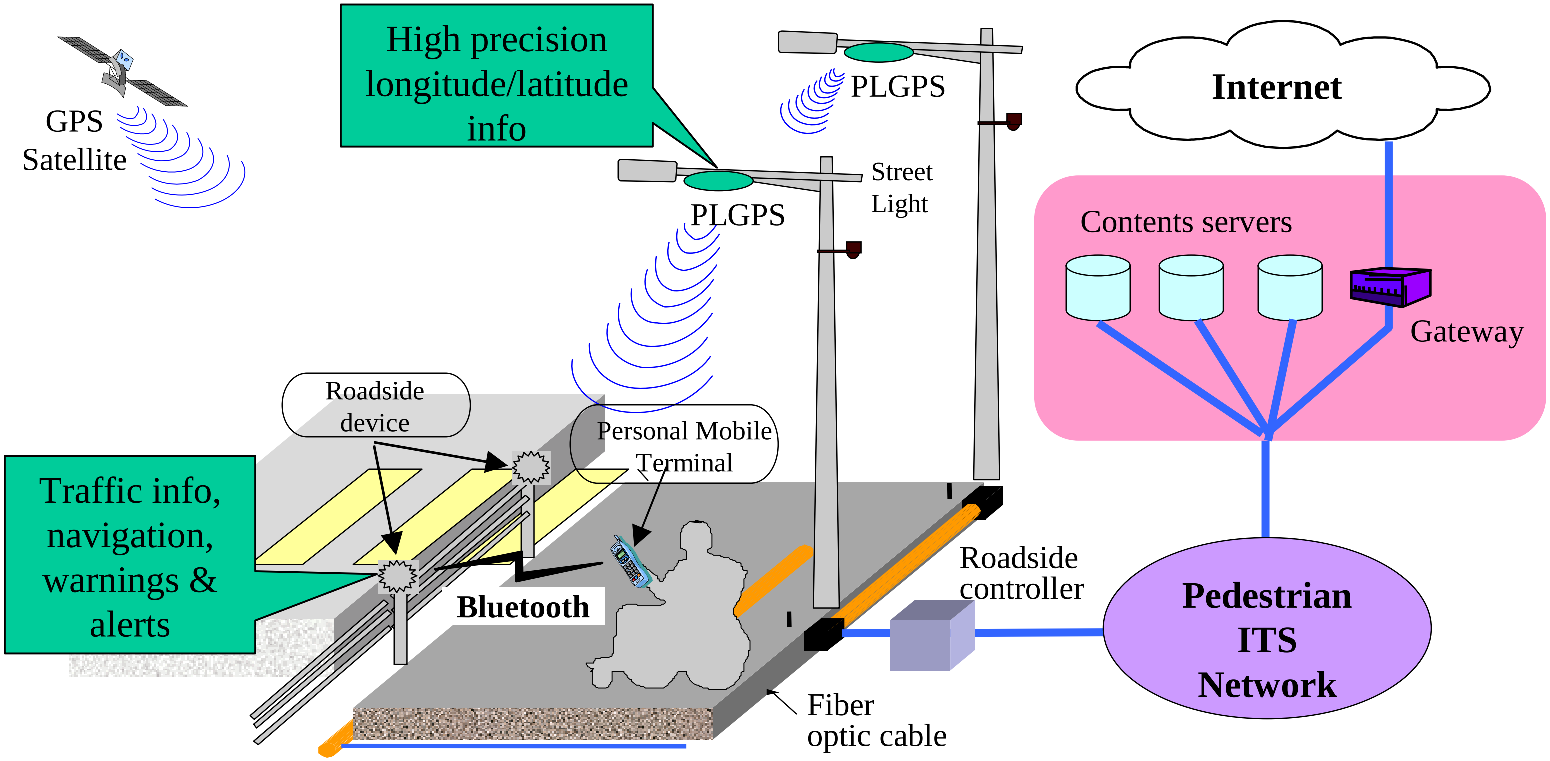
Seamless, interactive, intelligent access to multimedia information to support transport, business and leisure needs at the user location.

2. Technologies supporting ubiquitous network

2.3 Context awareness

Application of location-aware communications - (1) Pedestrian ITS

- Provide pedestrians including elderly and disabled people with an environment where they can move in a safe, comfortable and convenient way using ITS technology.
- System includes PLGPS (pseudo satellites), Bluetooth roadside devices, map database and communication networks.



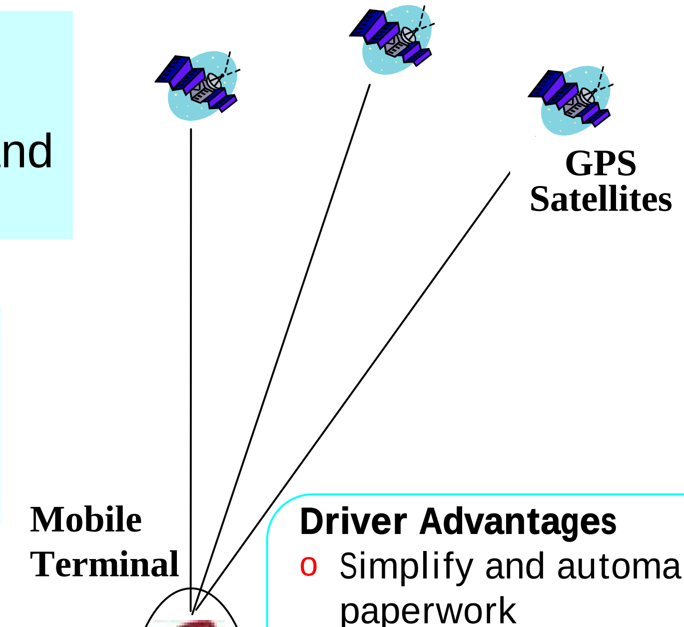
2. Technologies supporting ubiquitous network

2.3 Context awareness

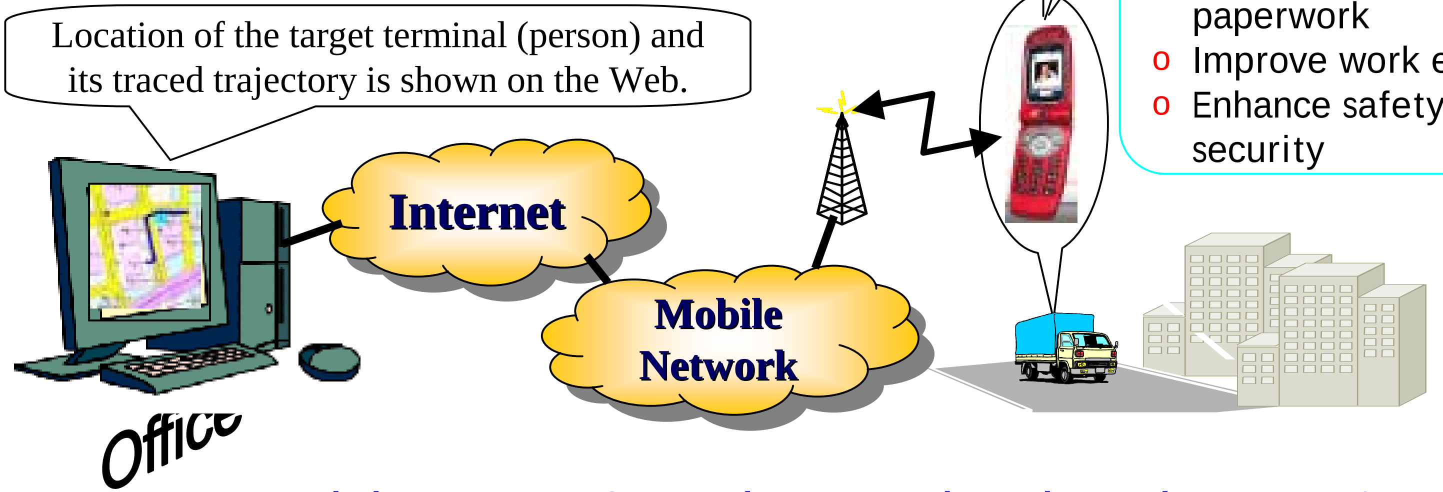
Application of location-aware communications - (2) Fleet Management

Support for:
- Delivery Service,
- Field Maintenance Service, and
- Medical Service.

Company Benefits
- Reduce operational costs
- Increase worker and fleet productivity
- Manage and control inventory
- Manage vehicle and driver performance
- Increase asset utilization



Driver Advantages
- Simplify and automate paperwork
- Improve work efficiency
- Enhance safety and security



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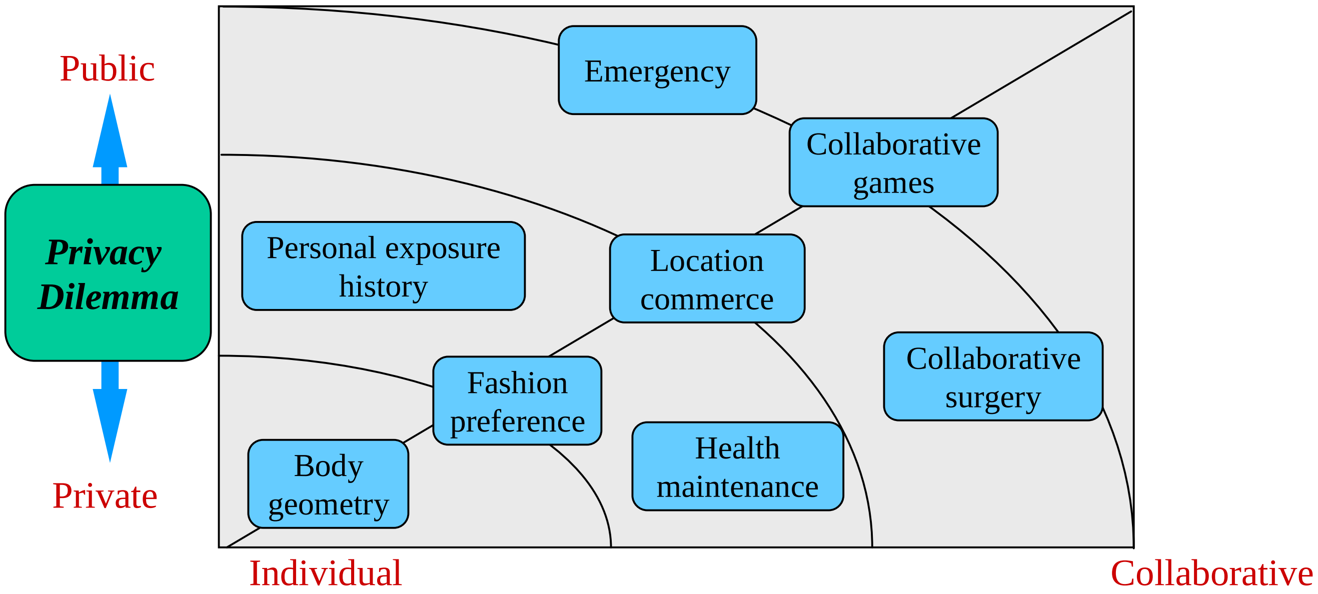
3. Security Issues

Privacy Dilemma

How do we manage the following tradeoffs?

1. **Ubiquity** - Who has access to my resources and services? Issues for confidentiality, authorization and access control.
2. **Context Awareness** - Who else knows where I am and what's going on around me? Matters for privacy and controlled information access including and beyond location.
3. **Invisible Computer** - Who am I interacting with and when? Defining suitable authentication and trust frameworks for ubiquitous communications.
4. **Smart Items (RFID)**– They are so small, can they protect themselves and who owns these things anyway?



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4. Conclusions

Ubiquitous networks redefine the human/computer relationship.
The following are key issues for further consideration.

- Development of ubiquitous networks requires collaborative efforts of academia, government, industry and network operators.
  - Open standard
  - Privacy awareness
- Full deployment of ubiquitous networks will take time, and promotion of advanced technologies is indispensable.
  - Evolution
  - Partial understanding
  - Experimentation

For a ubiquitous world to come true, it is essential to:
- Collaboratively develop, deploy and implement ubiquitous network technologies, and
- Design regulatory strategy to meet new and innovative business needs.

Appendix: Introduction on Japanese activites

Ubiquitous Networking Forum

Established on 11 June 2002, this Japan based forum seeks the following objectives:-

1. R&D and standardization of ubiquitous network technology
2. Liaison and coordination with outside bodies and organizations related to ubiquitous network
3. Promotion and enlightenment concerning ubiquitous network, including support for research and experimental trial

Organizational information:

Administrator

Chairperson : Tadao Saito Ph.D, Emeritus Professor, University of Tokyo

Vice-Chairpersons: Ken Sakamura Ph.D, Professor, University of Tokyo
Tomonori Aoyama Ph. D, Professor, University of Tokyo

Secretariat

The Telecommunication Technology Committee (TTC)

Members

Academia, telecommunication operators, broadcasters, electronics manufacturers, contents providers, and so on

URL (Japanese contents only)
http://www.ubiquitous-forum.jp/