Pervasive Networked Systems
FROM RFID TO THE INTERNET OF THINGS
6&7 March 2006, Brussels

Universal communications

-Towards ubiquitous networked society-

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  - Statistics of broadband and mobile communications from White Paper published by MIC.
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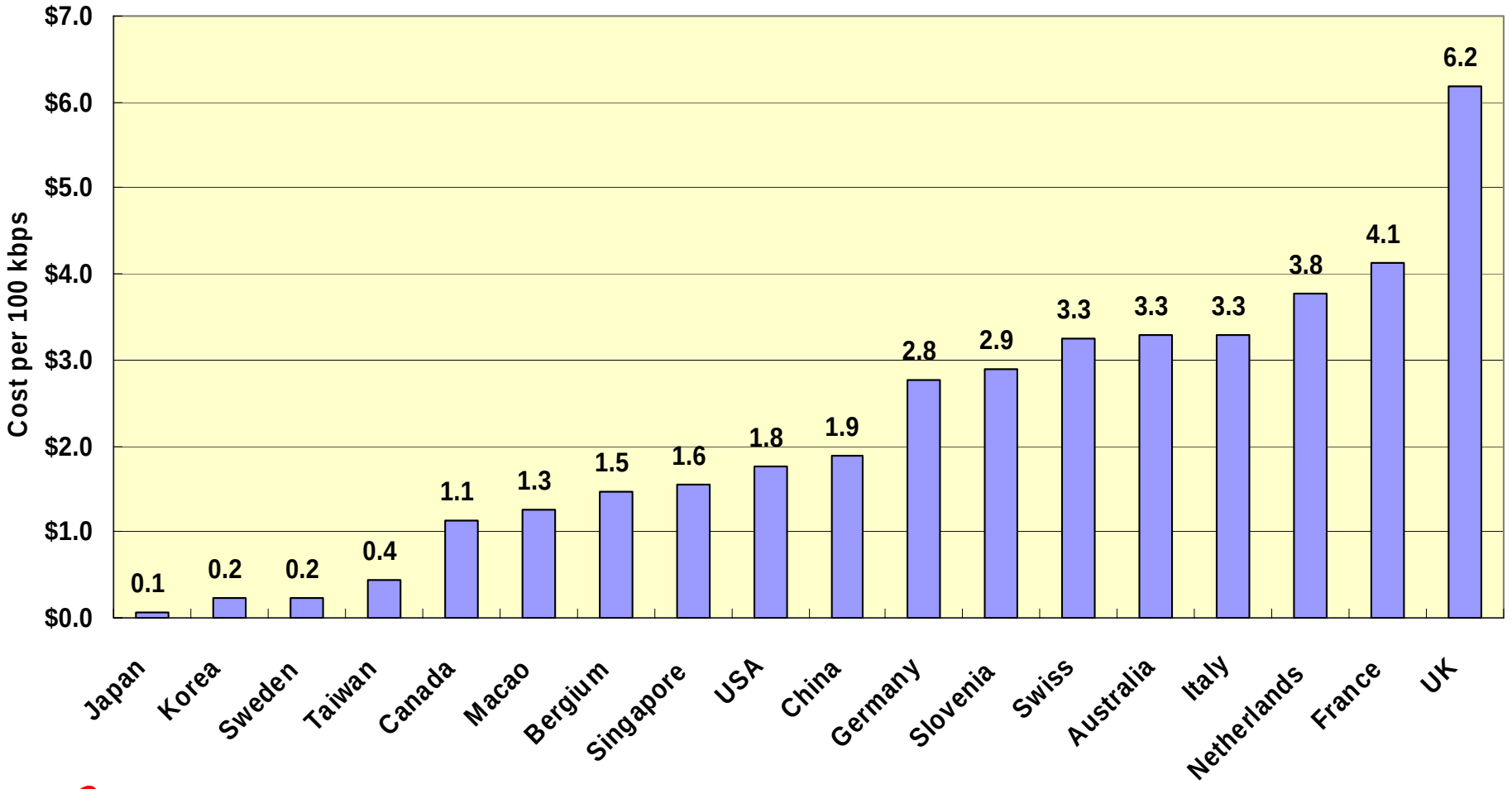
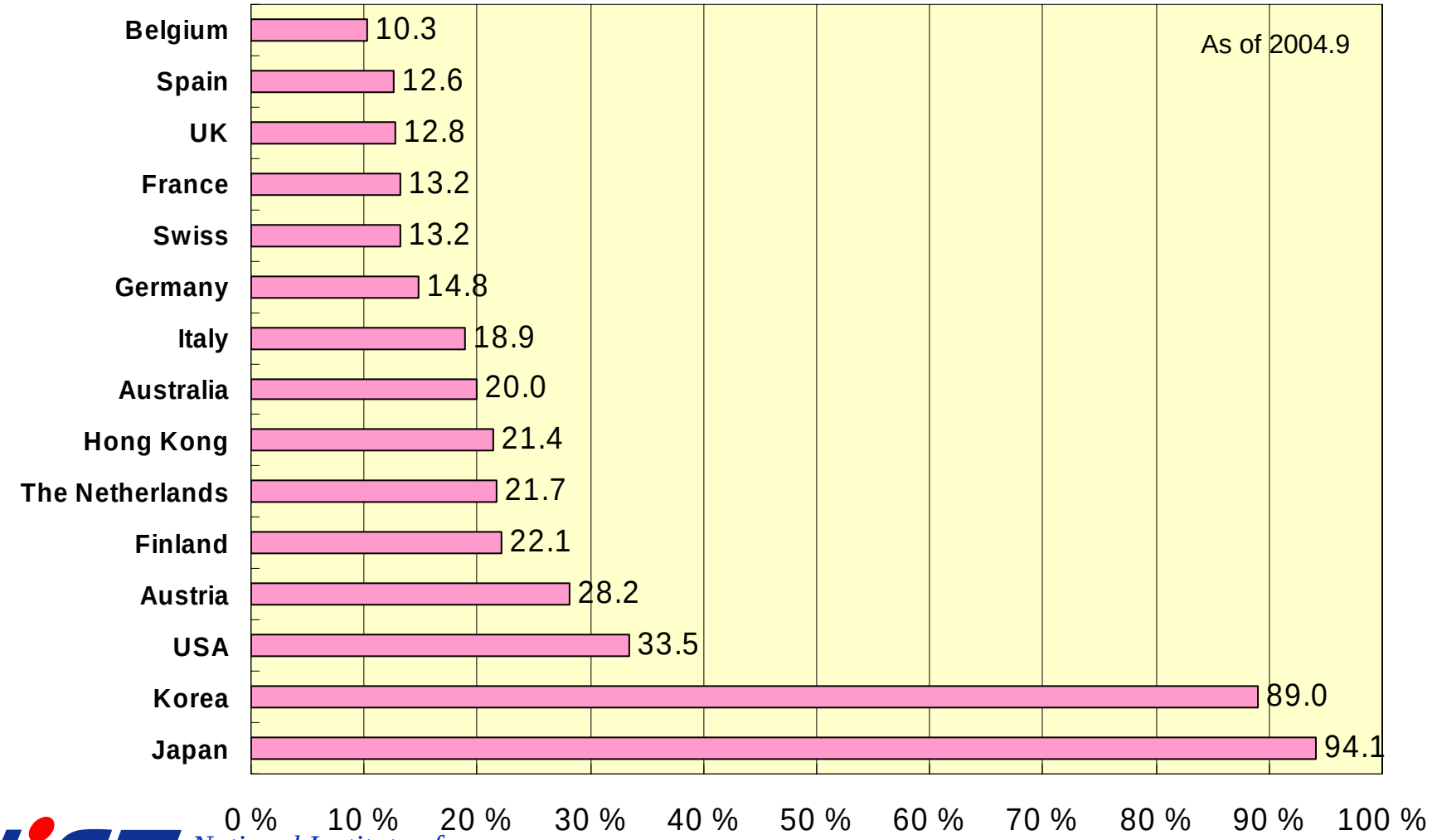
- Conclusion

Access Charges of Broadband Internet



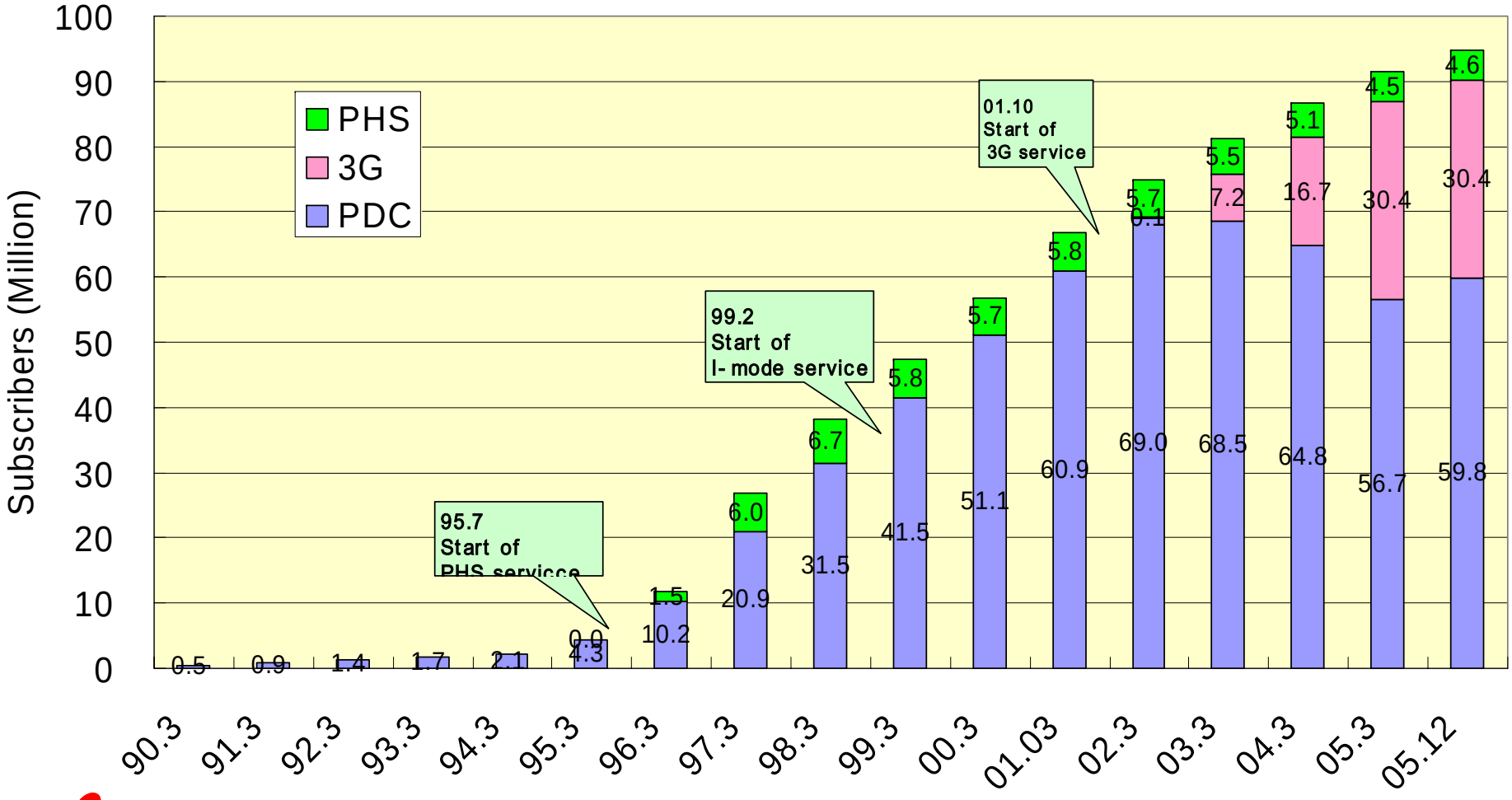
ITU「The Portable Internet (2004.9)

Ratio of *Internet Mobile phones* out of all Mobile Phones

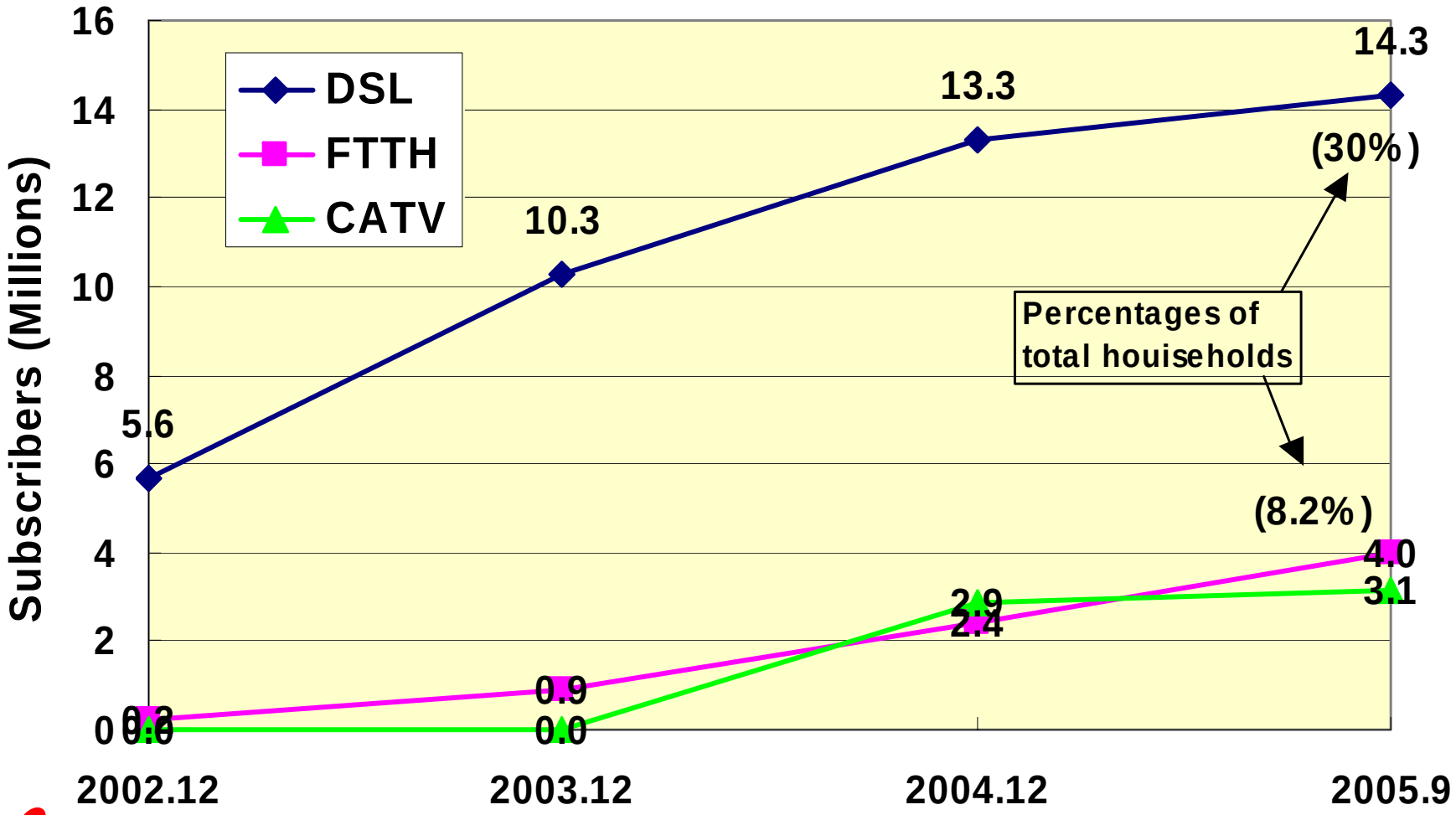


NiCT National Institute of Information and Communications Technology

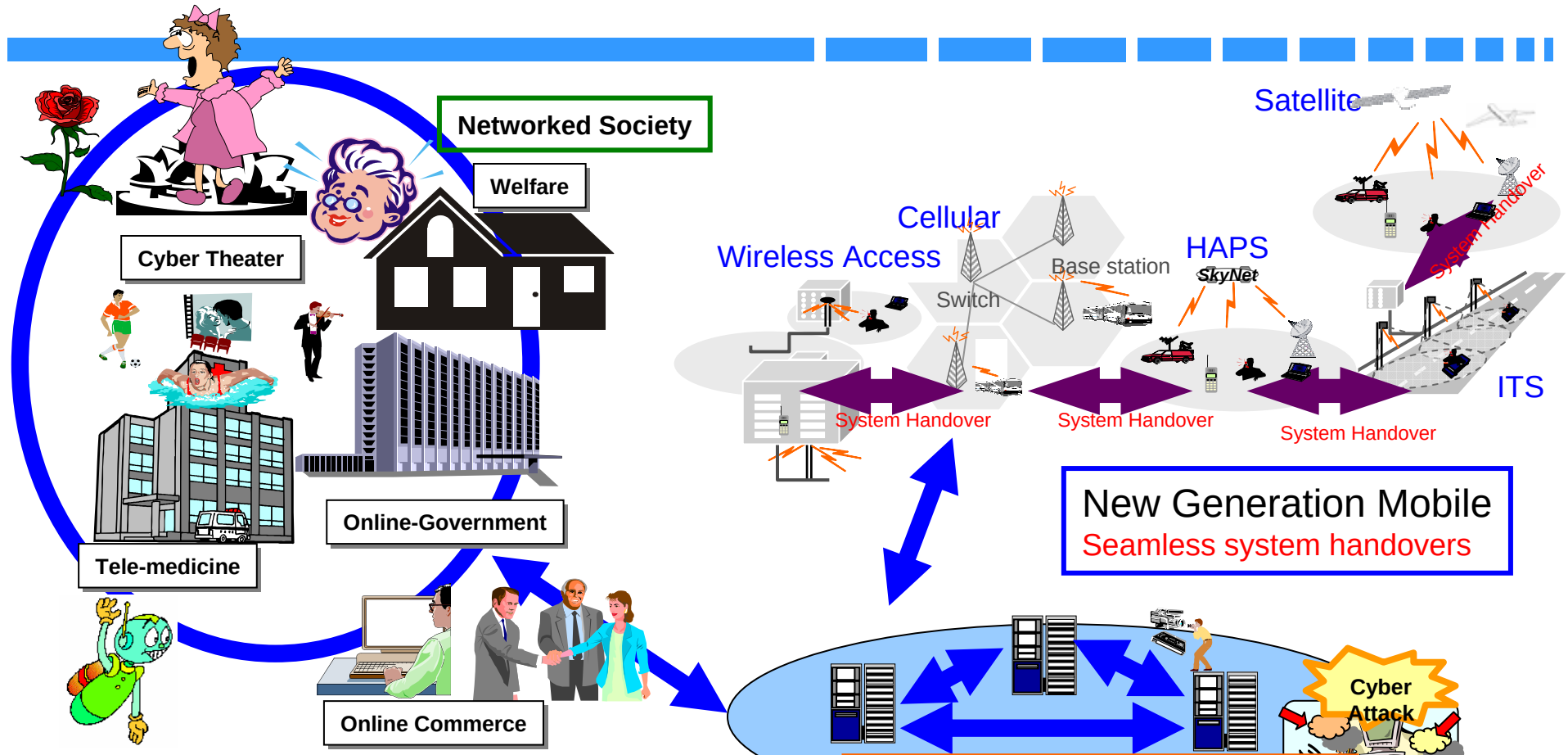
Subscribers of mobile phones in Japan



Subscribers of Internet access



Social Activities In Networked Society



ICT Technologies in Social Activities

- **Penetration of Internet**
  - Everything over Internet
- **Online government**
  - Application and report of administrative procedure by Internet
  - About 20% of local governments have already introduced (Japan).
- **Penetration of Internet mobile phones**
  - Anywhere and anytime by Internet
  - About 90% penetration rates of Internet mobile phones
- **Safety of food and Security**
  - Trace ability by using RF-tag
- **Online hospital and electric medical information**
  - Effective and secure treatments by networked hospitals
- **Support for social activities of aged and handicapped people**
  - Home electronics with sensors, which are connected to Internet

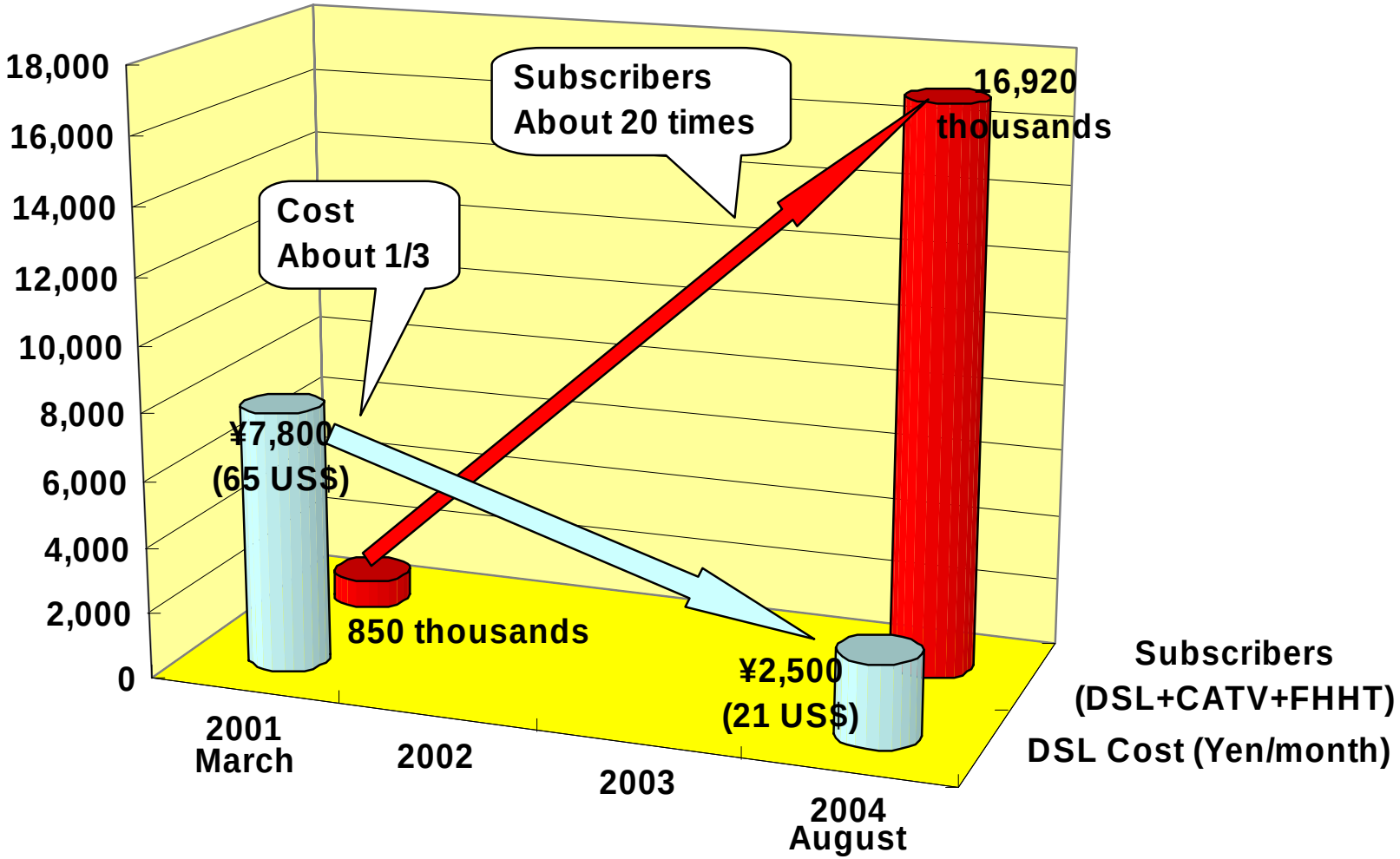
Government Policy in Information and Communications Technology

- The **IT Fundamental Law** was enacted in January 2001
- "**e-Japan Strategy**" was issued in January 2001
  - To make Japan to be one of the most advanced IT nations within 5 years

Targets		Results		Present
By 2005 **High speed environments** **30 million households** **(62 % of total households)**		**Achieved in 2002.10**		**At 2004** **High speed environments** **DSL 38 million households** **CATV 23 million households**
Super high speed environments **(30-100 Mbps)** **10 million households** **(20.7 % of total households)**		**Achieved in 2003.5**		**Super high speed environments** **FTTH 18 million households**

Total households : 48.3 millions

High speed Internet access costs and subscribers

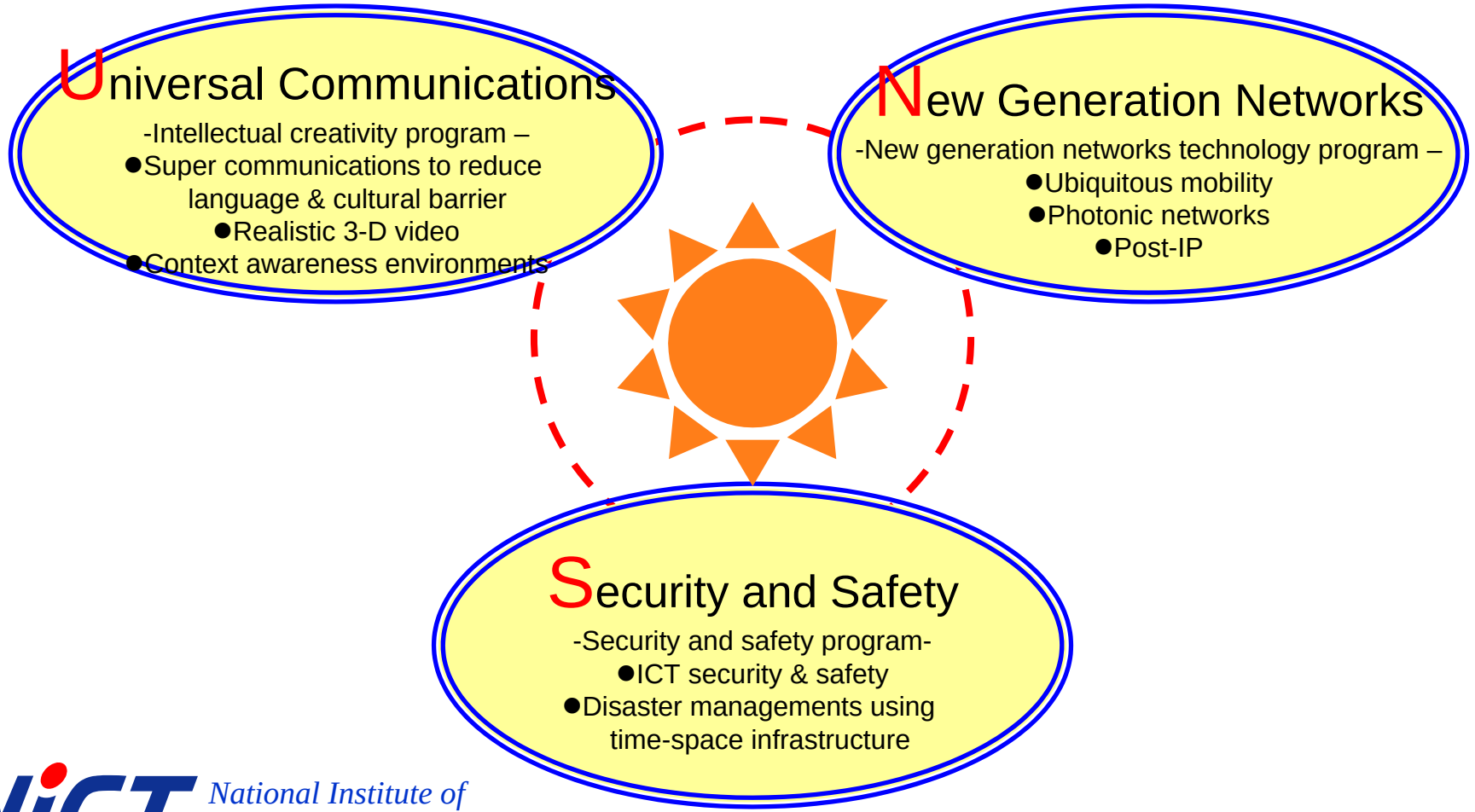


Next step after "e-Japan Strategy" is "U-Japan"

- **"UNS strategy" by Ministry of Information and Communications (MIC)**
  - MIC published the report of the strategy in July 2005.
  - "Universal Communications, New Generation Networks,New Security and Safety for the Ubiquitous Networked Society".
  - ICT policies of the government from 2006.

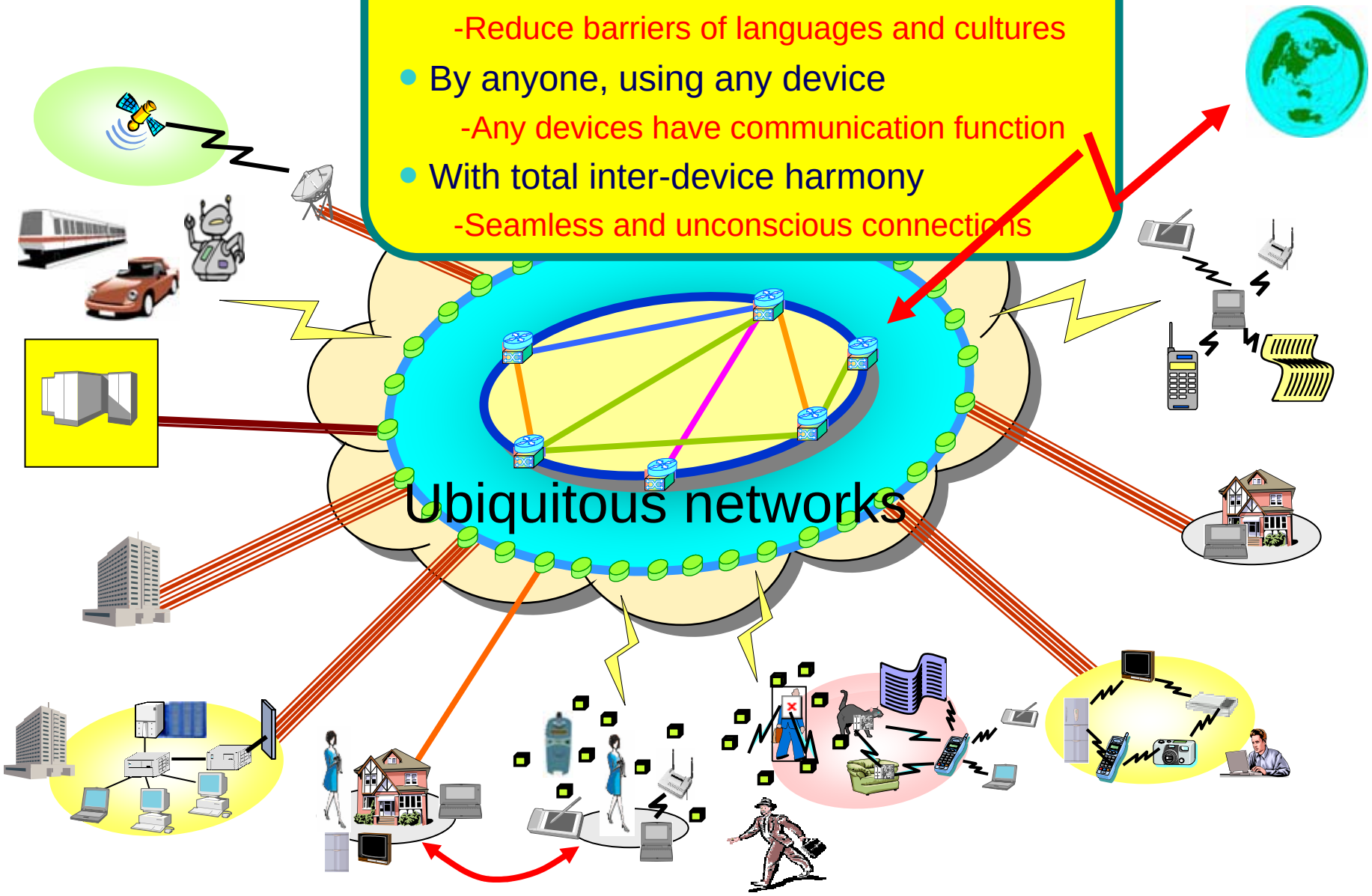
- **Main body of the report**
  - From "Deployment of IT infrastructure" to "Implementation ICT technologies to our social activities".
  - The vision of the forthcoming networked society in 2010.

Ubiquitous Networked Society



The Era of Universal Communications

- With anyone, anywhere in the world
  - -Reduce barriers of languages and cultures
- By anyone, using any device
  - -Any devices have communication function
- With total inter-device harmony
  - -Seamless and unconscious connections



Universal communications
-Ubiquitous Networked Society-

- "Ubiquitous"
  - Being or seeming to be everywhere at the same time
    - (The American Heritage Dictionary of the English Language)
- Ubiquitous Networked Society
  - Computers are naturally installed in real environments
  - Easy access to computers and networks without recognizing their existence
- Elements of Ubiquitous Networks
  - Everywhere sensors and RF-ID
  - Everywhere ad-hoc networks
  - Everything by personal area networks (UWB)

Key technologies of ubiquitous networks

- Network technologies
  - Flexible access and connections adaptive to user's environments and intention.
  - UWB, Ad-hoc networks, Beyond 3G
  - Photonic networks (10 Tbps photonic router)
- Software and application technologies
  - Context aware software, which will recognize user's intention
  - Multi-agent software, which will support user's operations
- Security and authentication technologies
  - Biometrics authentication
  - Proper and efficient handling of Copy right of digital contents

Ubiquitous home

–Basic concept and ideas –

- Distributed and Cooperative Functionality Infrastructure
  - Connecting the functions of appliances as individual units
  - Realization of cooperative services among appliances
  - Optimization of the user environment as a whole of home
- Context-aware Services
  - Obtaining information for residents
  - Interfaces adaptive to individuals
  - Realization of services according to user contexts

NICT
- Ubiquitous Home-

- Facility (Test-bed) to develop ubiquitous technologies at home.
- All home electronics devices are networked for comfortable life at home.

- Ubiquitous home is equipped with many kinds of home electronics and sensors, which are connected to network interfaces.
- Networked sensors recognize actions, movements and demands of people.

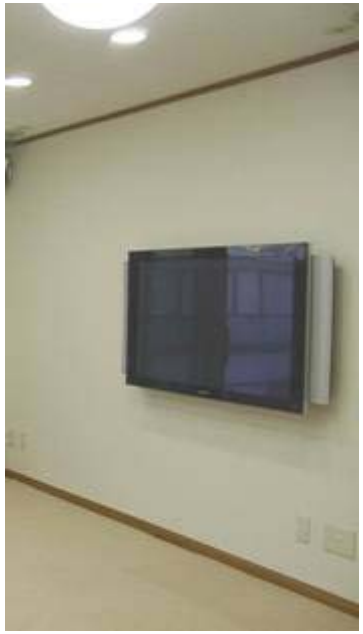
Sensors in “Ubiquitous home”

Infra-red sensors at each room entrance, which detect in and out of people.

Camera, microphone and speaker on the ceil.

Large volume server

Pressure sensors on the floor.



Large display in each room.

Demonstration video of Ubiquitous home

RF-ID used in a ubiquitous home

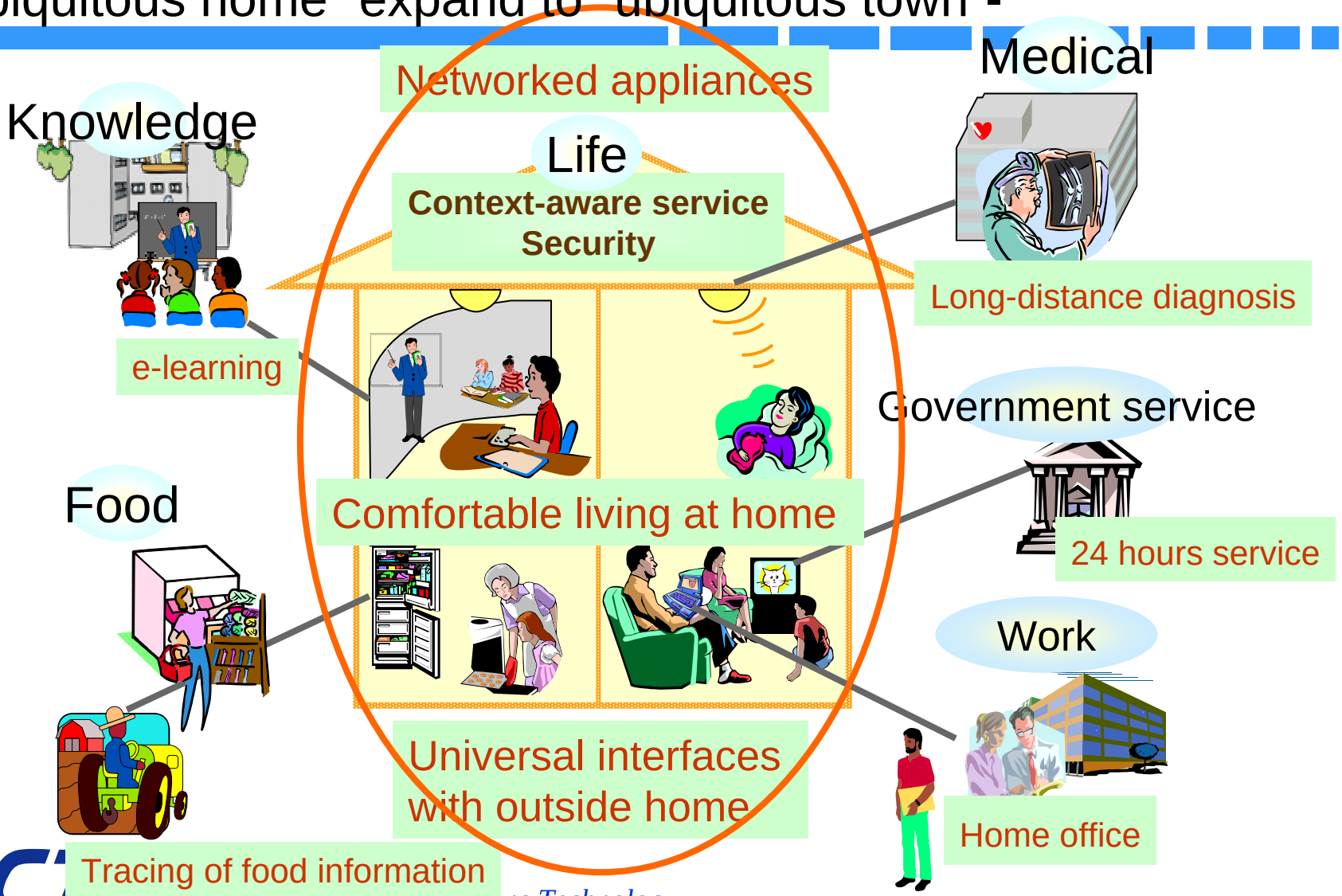
- **operating frequency 13.56 MHz**
- **transmitting power 0,5 to 10 W**

Antenna

RFID

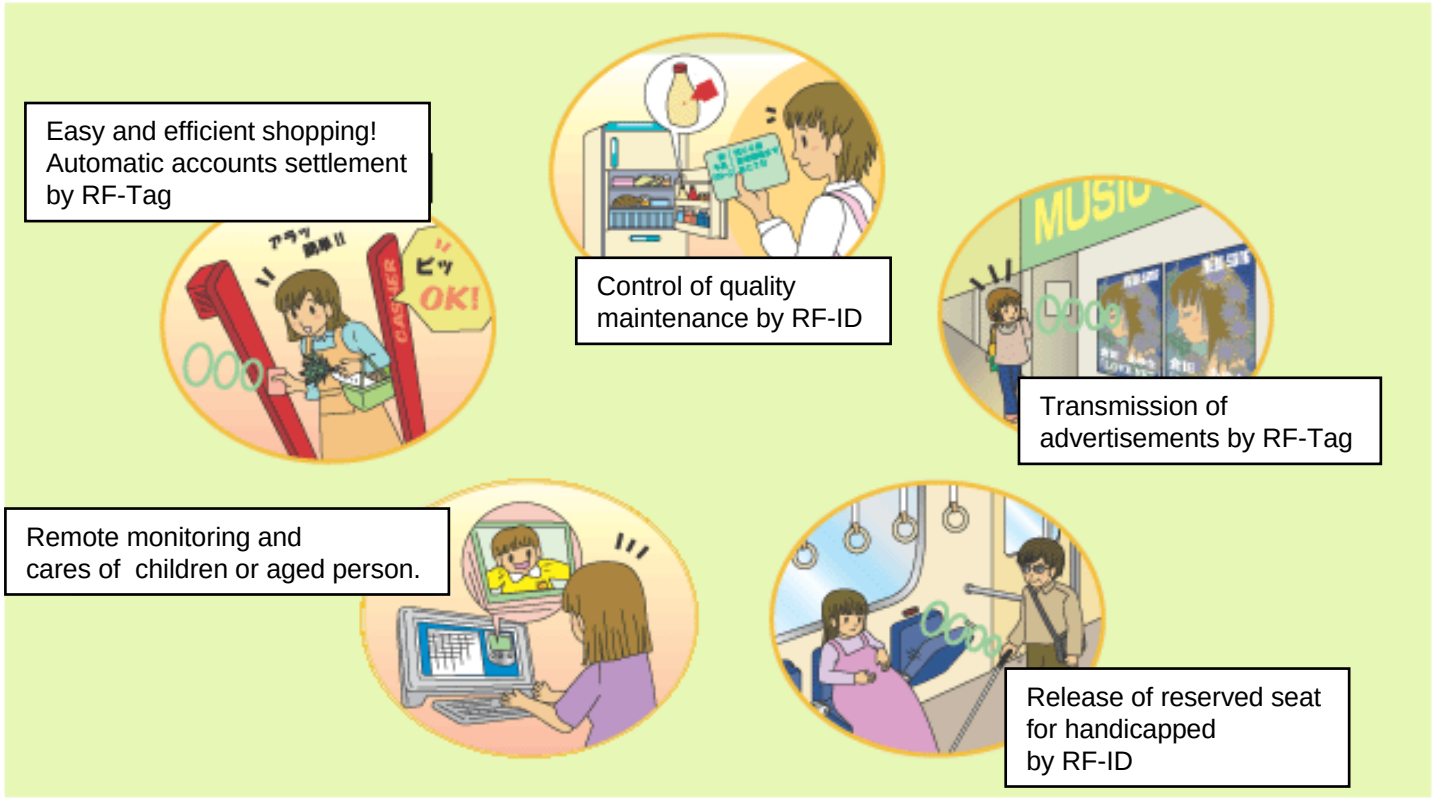
Ubiquitous Networked Society

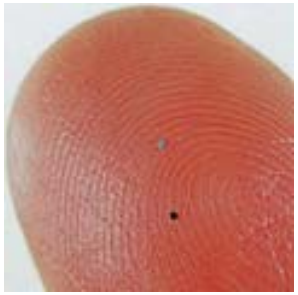
-"Ubiquitous home" expand to "ubiquitous town"-



Ubiquitous Networks by RFID

- RFID in ubiquitous networked societies.

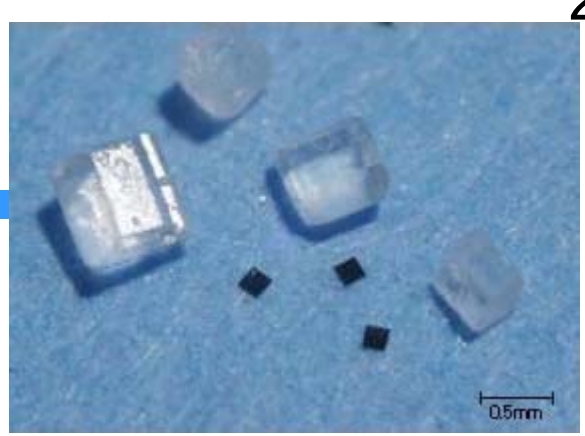




μ-chip

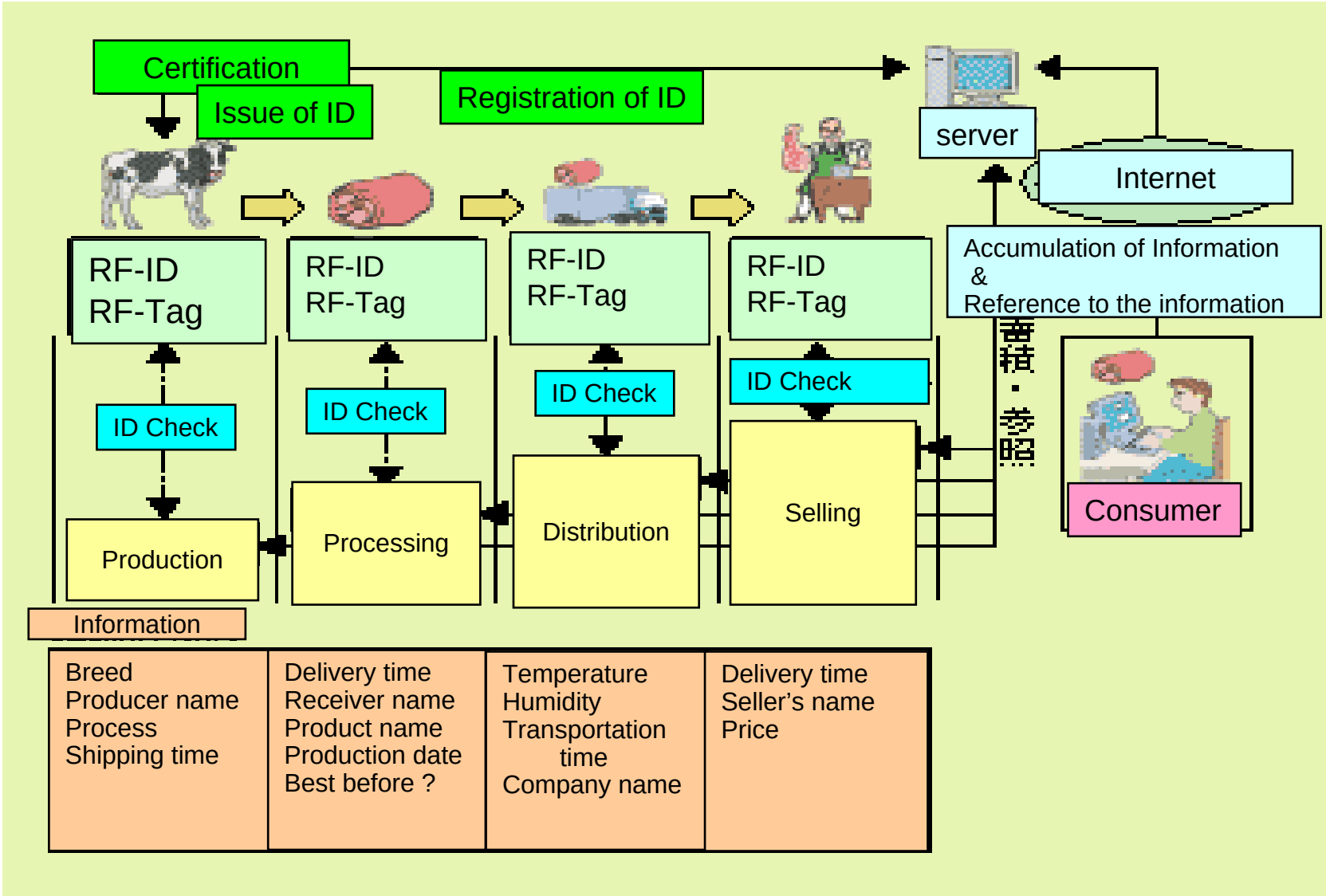
T-Junction

RFID Hitachi μ-chip



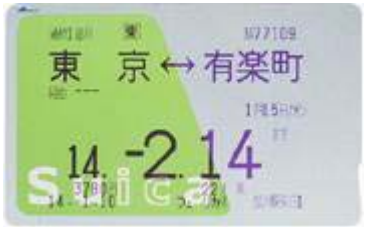
- **Smallest in the world**
  - **Size : 0.15mm square**
  - **Thickness : 7.5μm**
  - **¼ area, 1/8 thickness compared to the former version.**
- **μ-chip**
  - Non-contact IC-chip
  - 2.4 GHz operation with an outside connected antenna
  - Transmit 128-bit unique ID number written in ROM
- EXPO-2005 Aichi (May 25th-September 25th)
  - IC chip will be embedded on each admission ticket, in order to provide an ID number for each ticket and at the same time make ID confirmation easy by simply placing the ticket over a reading device.
  - Un-readable tickets were only about 200 out of 22 million visitors (error rates 10^{-5}).
  - No counterfeit tickets were detected.

Realization
Trace ability of Food by RFID



Commuter pass
Super Urban Intelligent CArd

- November 18, 2001
  - Service started at 424 railway stations in Tokyo area
- January 2003
  - Over 5.5 million users



- Expanding to other areas


モバイルSuicaサービス

FeliCa non-contact IC cards

Sony product

- **Developed by Sony**
- **felicity：great happiness**
- **ISO / IEC 15408 EAL4 (security evaluation standards)（RC-S860）**
- **Main technical charecteristics**

Main Characteristics	
Carrier	13.56 MHz
Sub-carrier	none
Modulation	ASK 10%
Coding	Manchester
Data rates	212 kbps (Fc/64)
Collision detect circuits	Time slot

http://www.sony.net/Products/felica/index.html

Frequency allocation for RFID

Frequency	under 135 KHz	13.56 MHz	433 MHz	860-960 MHz	2.45 GHz	5.8 GHz
Europe	○	○	○	△	○	△
USA	○	○	○	○	○	△
Japan	○	○	× (Amateur)	○ (950-958:RFID)	○ (ISM)	△ (ISM: DSRC)

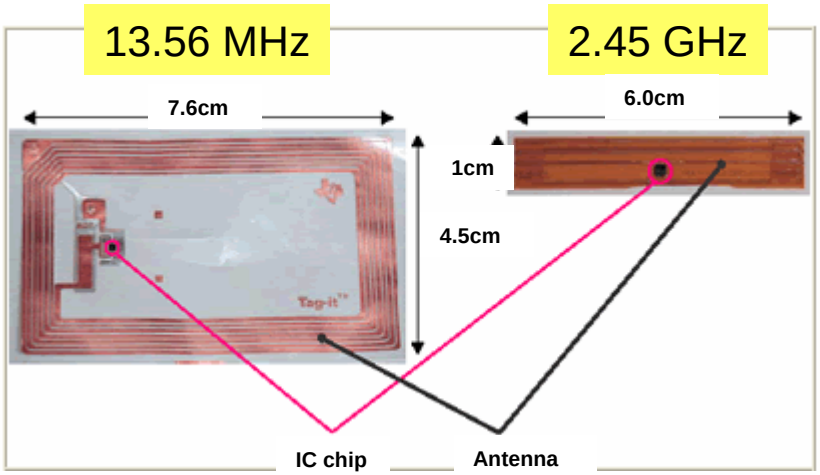
Tag and antenna sizes in three frequency bands

900 MHz

9.53cm

13.56 MHz

2.45 GHz



Ultra High Frequency UHF RFID 860MHz - 960MHz

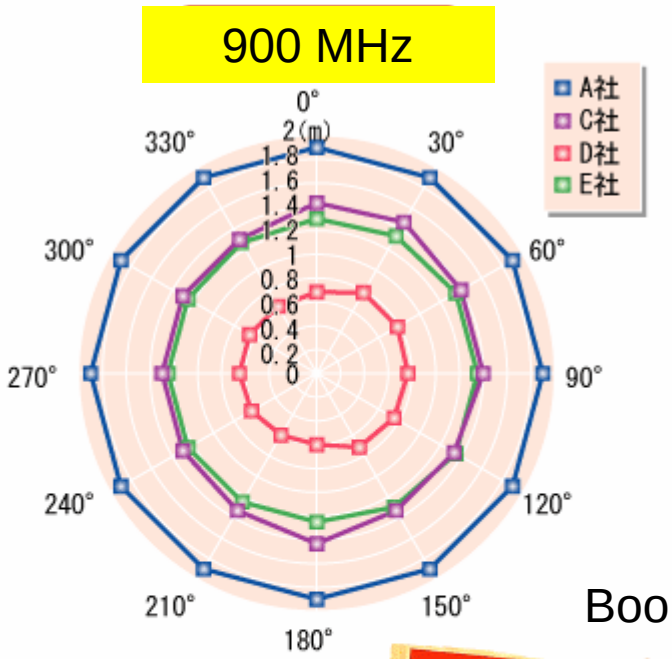
Radiation patterns of IC-Tag in different frequencies

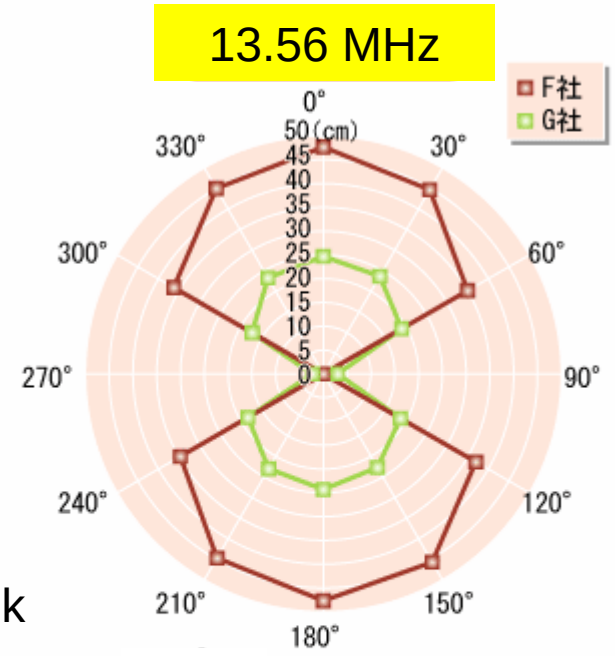
Distance

2m

Radiation pattern

Omni





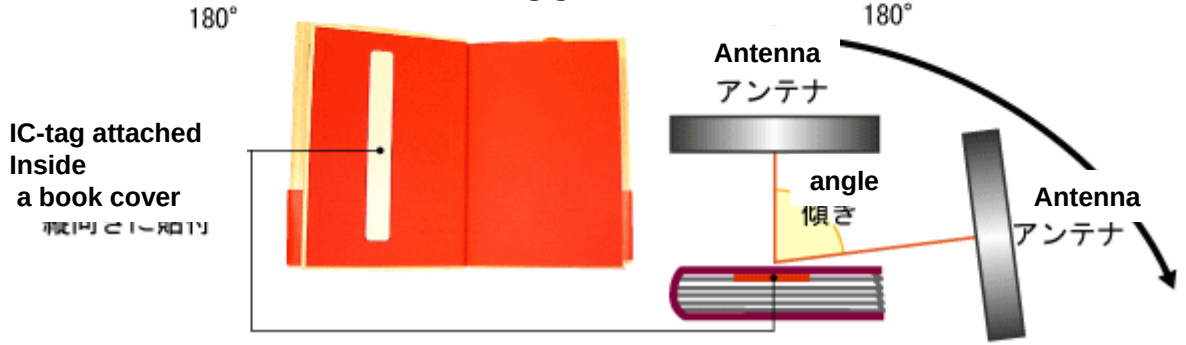
Distance

50 cm

Radiation pattern

8-figured

Book



http://itpro.nikkeibp.co.jp/article/RFID/20051215/226286/

Ultra wide band (UWB) communications

Ultra high speed data

- 1H TV program in About 15 seconds
- By wireless

Ultra low power Consumption

- Several years life with a battery

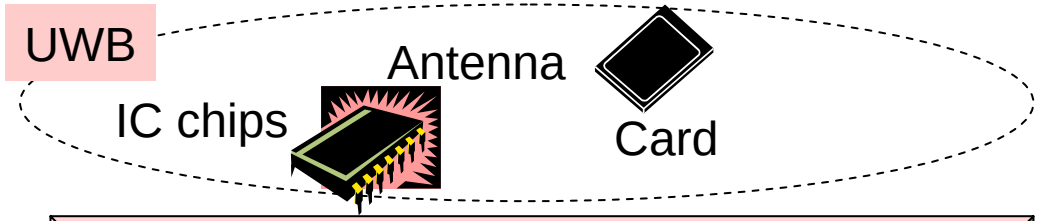
Ranging function

- Accuracy of about 10 am

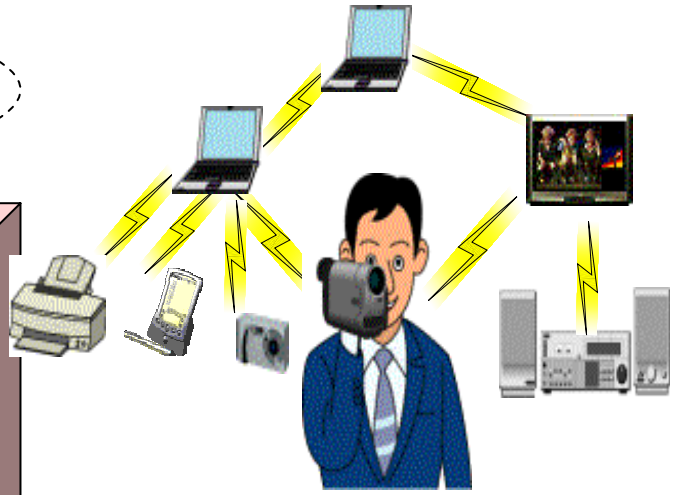
IEEE Standardization

802.15 3a:Ultra high speed/480 Mbps
802.15 4a:Ultra low power consumption/1 Mbps
(NICT/YRP consortium)

Short-range (within10 m)
High speed data (Max. 1 Gbps)



Wide range of applications
TV, Video, DVD, Computer, Office /home electronics, home, Automobiles, Handy phones, Security devices, RFID, IC cards, etc.



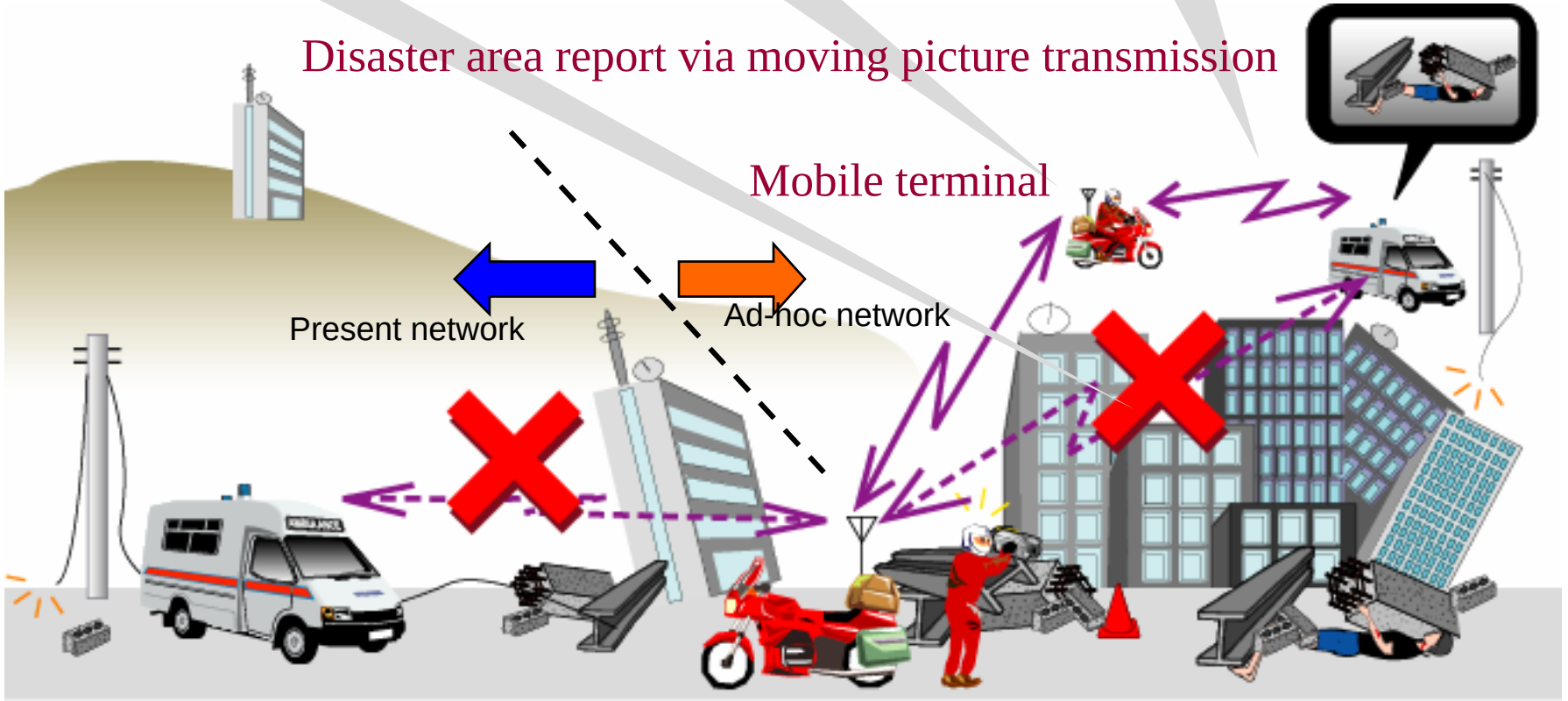
High speed PAN

Ad-Hoc Communication Terminal for VHF Band Based Disaster Radio

In the case direct packet transmission is difficult,

If another terminal exists between the user and the destination,

That packet is autonomously relayed to the destination.



Ad-hoc networks

-buckets relay communications effective in case of emergency -

Conclusion

- The Social keywords of Ubiquitous networks are:
  - “Universal” communications” for wealthy society.
  - “Friendly technologies for supporting social activities of our daily life.

- The Technical keywords of Ubiquitous networks are:
  - “Context aware network systems”.
  - “Ubiquitous environments by sensors, RFID and Ad-hoc networks”.