

Ubiquitous Sensing Network Research in NICT and Approach to Environment Measurements

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NICT:

**National Institute of Information and Communications Technology
Japan**

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Outline

1. **Outline of NICT: organization and activities;**
2. **Overview the Ubiquitous Network Society (UNS) Research Programs by MIC, Japan;**
3. **Research theme for the Ubiquitous Network Technology Research programs under UNS;**
4. **ICT security and safety programs in NICT: Environment monitoring for global change and natural hazard damage mitigation;**
5. **Proposed ubiquitous sensing network research for new application to environment monitoring and disaster damage mitigation;**

The NICT logo features the letters 'NICT' in a bold, blue, italicized sans-serif font. A small red dot is positioned above the letter 'i'.

情報通信研究機構

1. Overview of NICT

- Organization and activities -

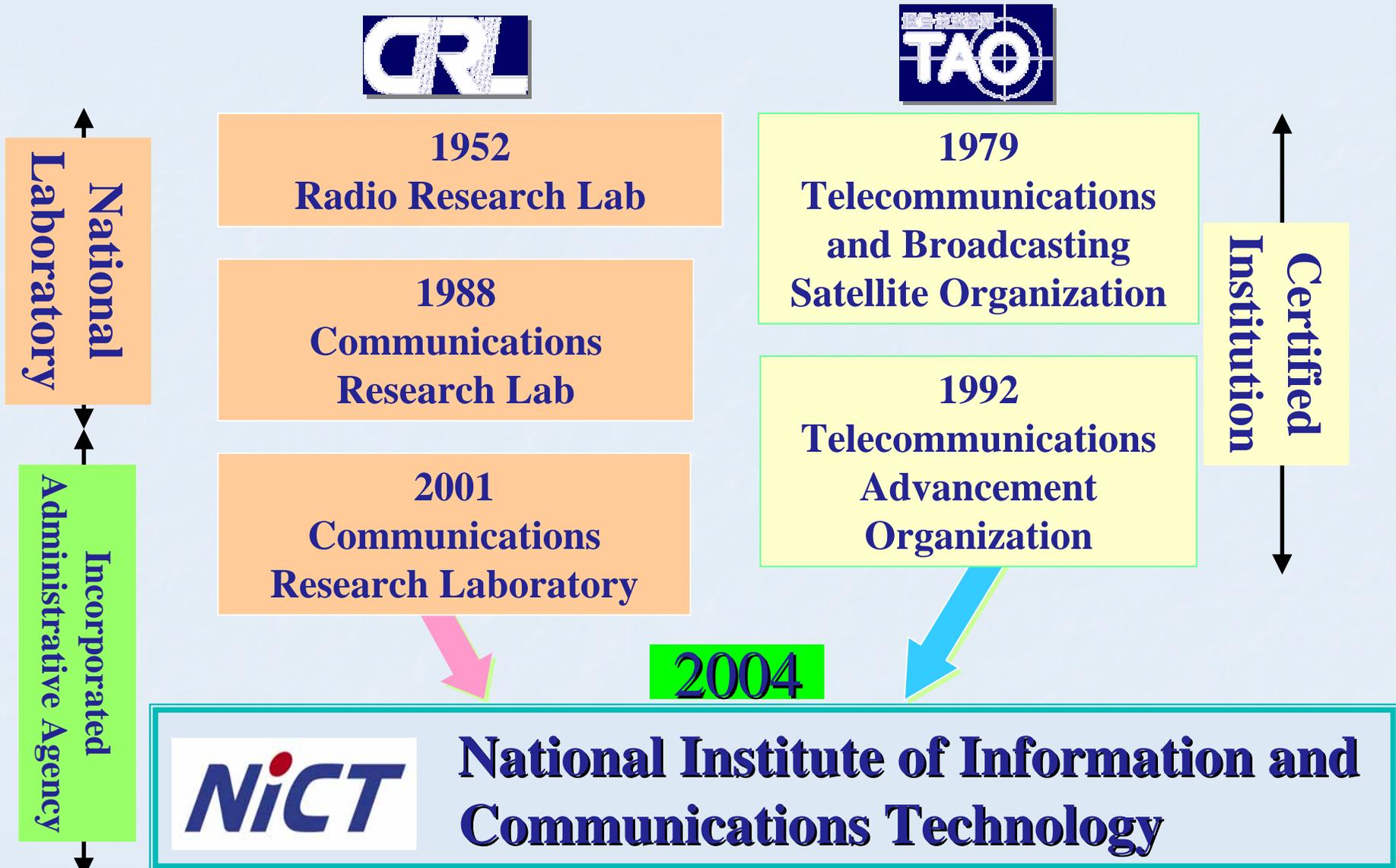


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NICT: after merger of CRL and TAO in April 2004



Outline of NICT

- ◆ Establishment date: April 1, 2004
- ◆ Mid-term plan: April 2001 through March 2006
- ◆ Budget & Personnel:
 - ◆ Budget: about ¥59.6 billion (US\$ 514 M)
- ◆ Personnel: Full-time employees, about 480
 - ◆ Tenure researchers: 305 (Ph.D: 186)
 - ◆ Non-permanent researchers: 600 (PD, Graduate students included)

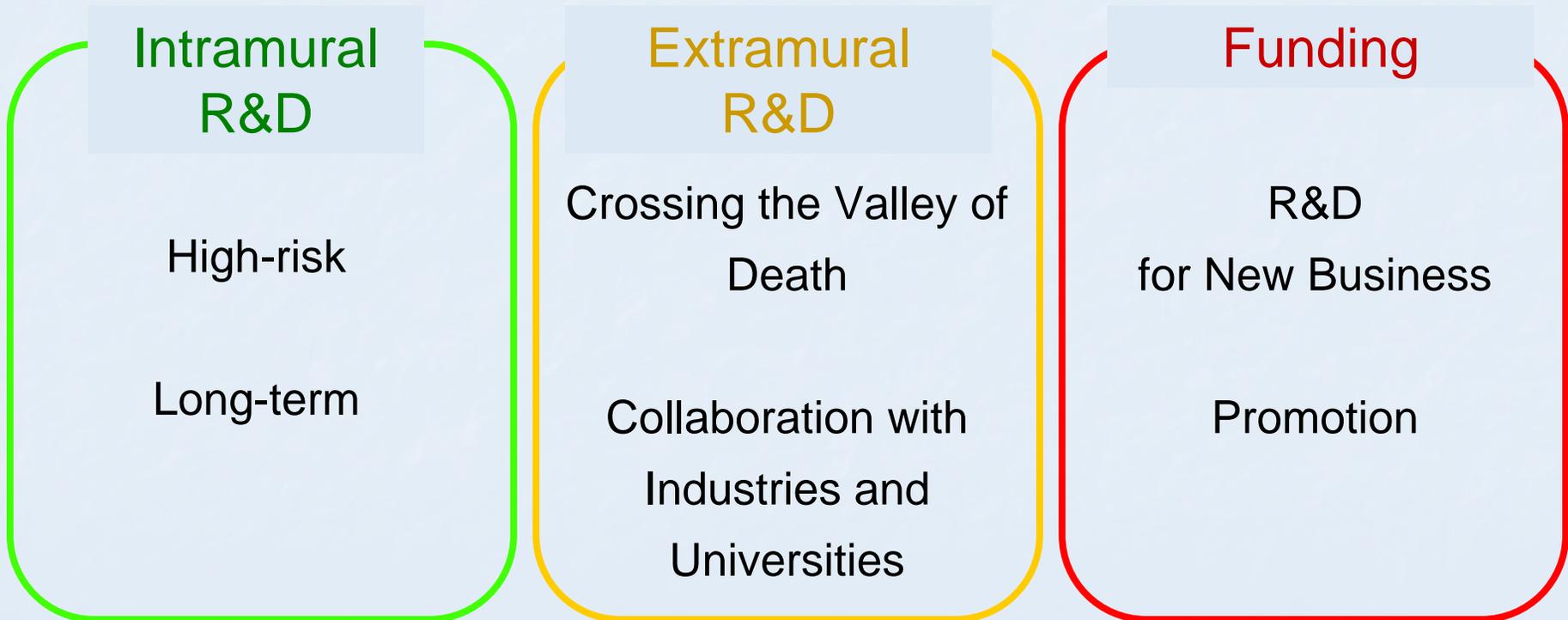
Incorporated Administrative Agency



Organizational structure of NICT



Basic Research, Applied research, and Funding for New Business

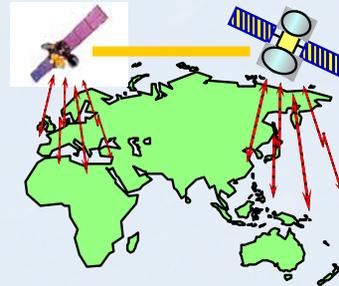


CORE (INTRAMURAL) R&D

Information and Network Systems

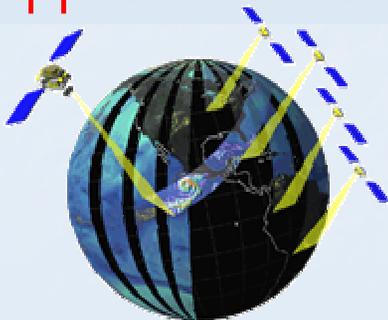


Wireless Communications

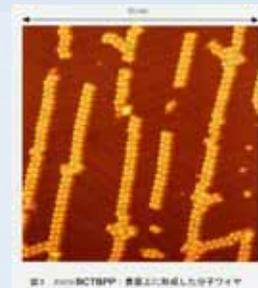
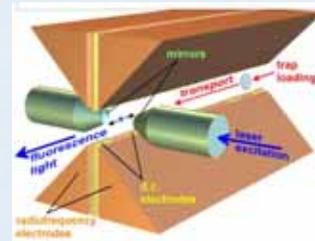


Basic and Fundamental Research, International Collaboration, and Standardization

Applied Research and Standards



Basic and Advanced Research



COLLABORATIVE (EXTRAMURAL) R&D

Extramural R&D



Collaborative R&D, Test-bed

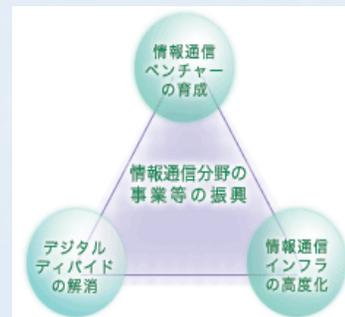


PROMOTION AND FUNDING

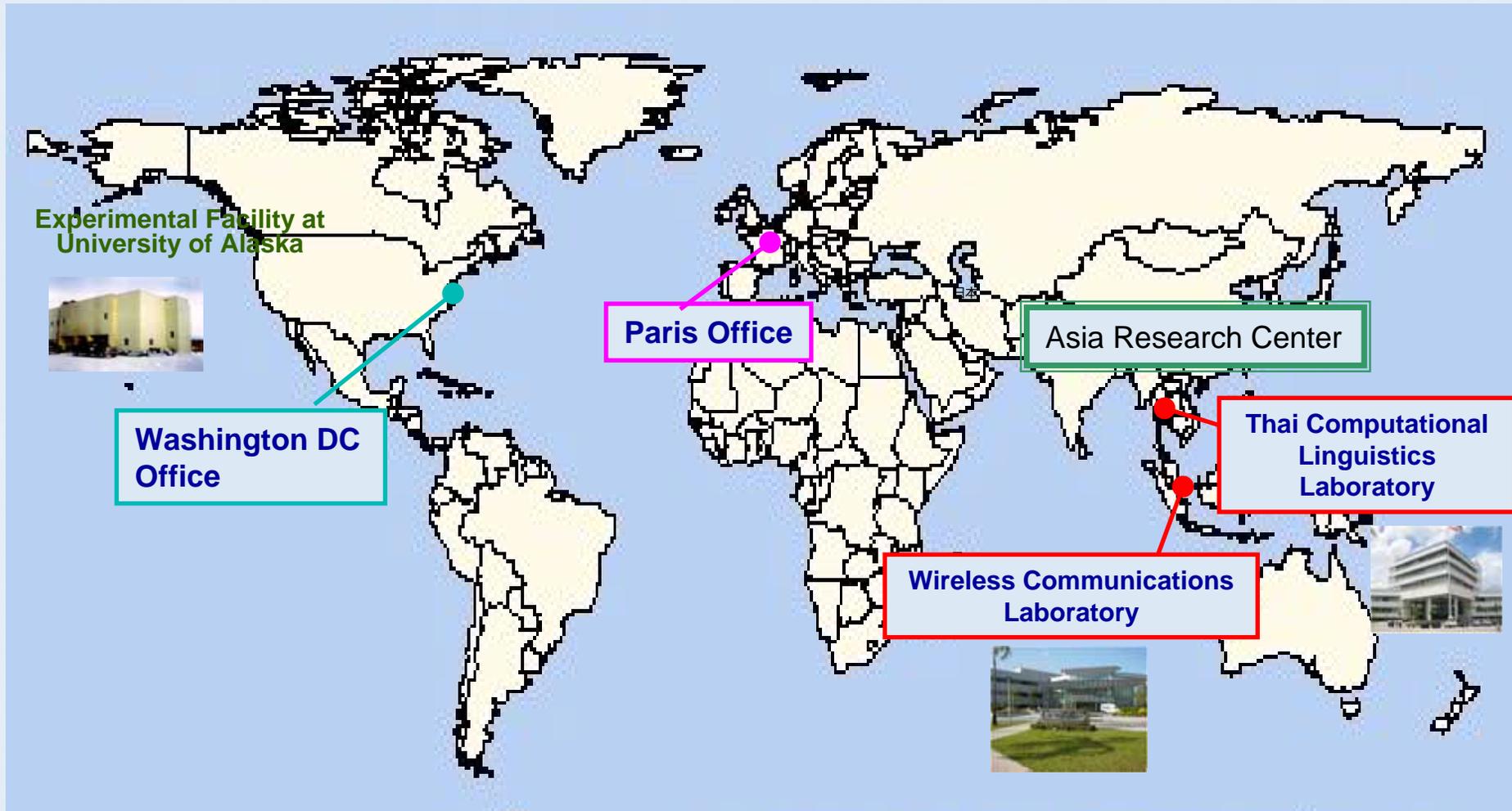
Funding



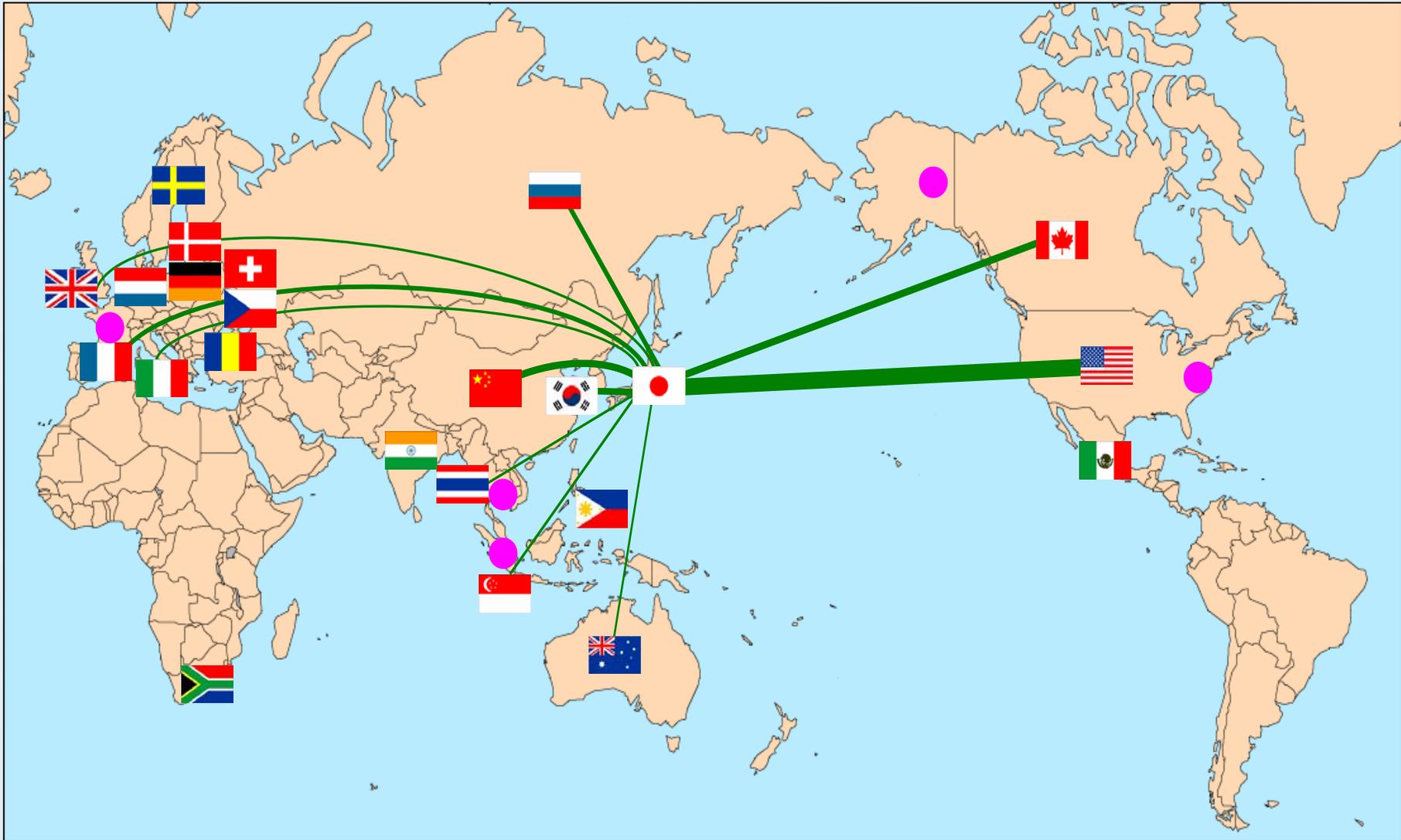
New Business Promotion



NICT Overseas Bases



International Collaboration

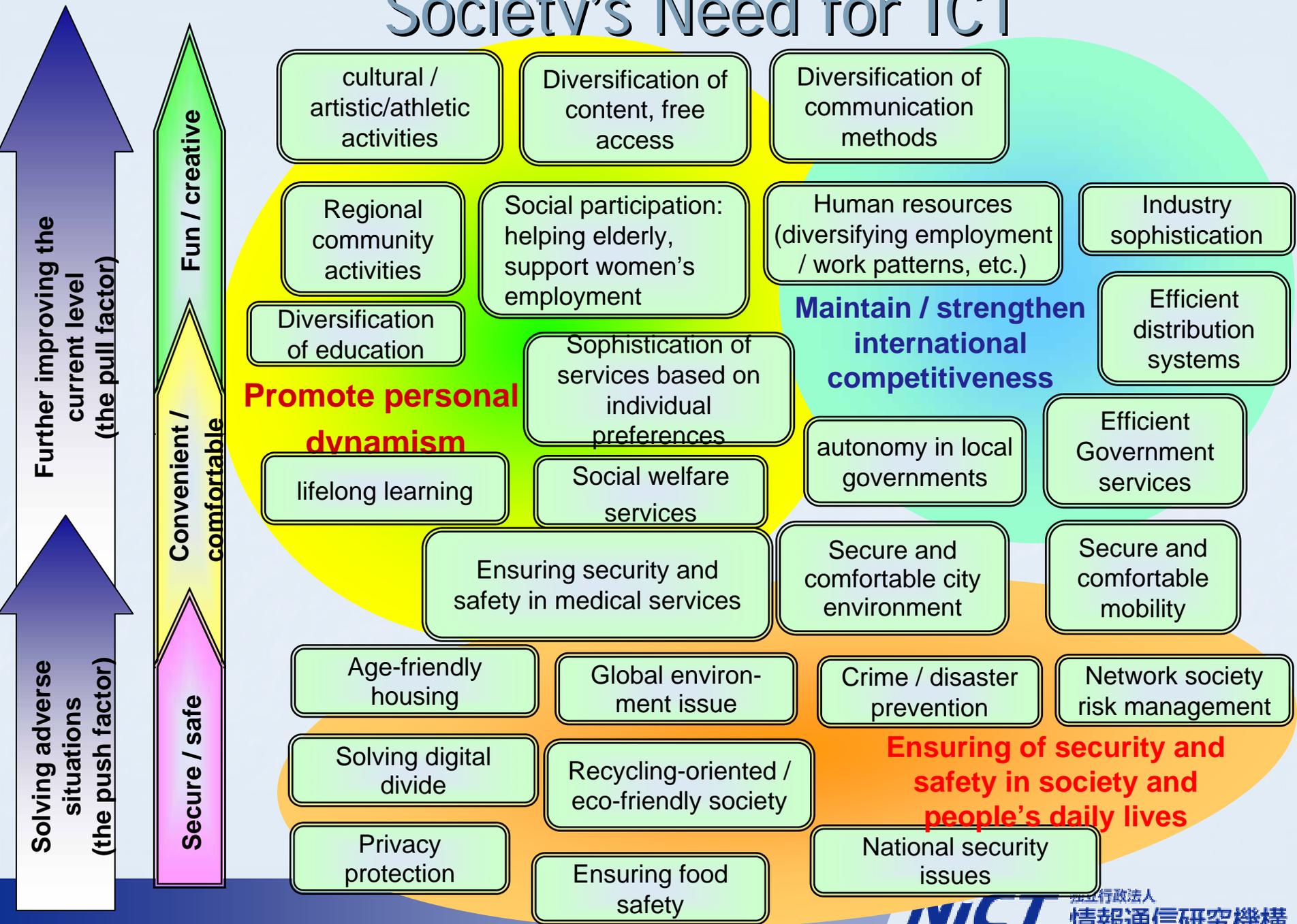


2. Overview of UNS Strategic Programs

ICT R&D Programs for the Ubiquitous Network Society

- ◆ For the Ubiquitous Network Society (UNS)
 - ◆ Universal Communications
 - ◆ New Generation Networks
 - ◆ Security and Safety
- ◆ The Telecommunications Council ; Ministry of Internal Affairs and Communications
- ◆ Issued July 2005

Society's Need for ICT



cultural / artistic/athletic activities

Diversification of content, free access

Diversification of communication methods

Regional community activities

Social participation: helping elderly, support women's employment

Human resources (diversifying employment / work patterns, etc.)

Industry sophistication

Diversification of education

Sophistication of services based on individual preferences

Efficient distribution systems

lifelong learning

Social welfare services

autonomy in local governments

Efficient Government services

Ensuring security and safety in medical services

Secure and comfortable city environment

Secure and comfortable mobility

Age-friendly housing

Global environment issue

Crime / disaster prevention

Network society risk management

Solving digital divide

Recycling-oriented / eco-friendly society

National security issues

Privacy protection

Ensuring food safety

Direction of ICT Research and Development

Maintain /improve international competitiveness

International competitiveness in ICT: contribute to the world through playing a leading role in international standardization; create new technology generating a paradigm shift.

International competitiveness through ICT: Enhance Japan's international competitiveness through the advanced use of ICT; develop the world's leading ubiquitous network society.

Establish a secure and safe society

ICT security / safety: Ensure the dependability of ICT as a social infrastructure as well as its security / safety.

ICT for security / safety: Utilize ICT to solve issues in various fields: healthcare, welfare, food, agriculture, crime prevention, disaster reduction, and the urban / natural environment.

Promote intellectual dynamism

Creating knowledge: Bring out the potential of individual and promote the creation of value through various areas of knowledge.

Using knowledge: Various issues in society can be solved and advanced; easy-to-use services as well as people-friendly communication realized.

Priority Areas in ICT Research and Development

Direction in R&D

Maintain / strengthen international competitiveness

International competitiveness in ICT

International competitiveness through ICT

Establish a secure and safe society

ICT security / safety
ICT for security / safety

Promote intellectual dynamism

Creating knowledge
Using knowledge

Priority areas in ICT research and development were set based on the direction of R&D

Priority areas in ICT Research and Development

New Generation Networks Technologies

- Enable Japan to maintain / strengthen international competitiveness in core technologies: optical, mobile, and devices
- Advanced basic technologies enable Japan to play a leading role in global ICT development

ICT Security and Safety Technologies

- Ensure security / safety of ICT networks that are the basis of social and economic activities
- ICT Technologies to ensure security to realize a safe / secure social environment

Universal Communications Technologies

- Content creation technologies promoting intellectual creativity of individuals
- Communication technologies transcending barriers in language, culture, and physical capabilities

Ubiquitous Priority R&D Strategy

Priority areas in ICT R&D

It is important to promote R&D with a focus on the entire system architecture.

New Generation Networks Technologies

- Network technology that enables Japan to maintain / strengthen international competitiveness in core technologies, including optical, mobile, and device technologies
- The most advanced basic technologies that enable Japan to play a leading role in global ICT development

ICT Security and Safety Technologies

- Technology that ensures security / safety of ICT networks that are the foundation of social and economic activities
- Technology that ensures security in a broad sense to realize a safe / secure social environment through ICT

Universal Communications Technologies

- Content creation technology that can promote the intellectual creativity of individuals
- Communication technology that can transcend the barriers of language, culture, and physical capabilities

Understanding technological trends in the three priority areas

Aspects that should be considered in Ubiquitous Priority R&D Projects

Promoting innovation and breakthroughs

Playing a leading role in developing system architecture

Open demonstration tests with an eye to providing an actual use for the technology

Developing human resources for the future

Creating new businesses

Strategic leading in international cooperation / competition

Solving social issues

Inspiring hope

UNS Strategic Programs

< Intellectual Creativity Program >

Universal Communications

< International Leadership Program >

New Generation Networks

< Security and Safety Program >

Security and Safety

10 R&D projects

New generation networks architecture

Ubiquitous mobility

New ICT paradigm

Ubiquitous platform

Secure networks

Sensing / Ubiquitous time-space infrastructure

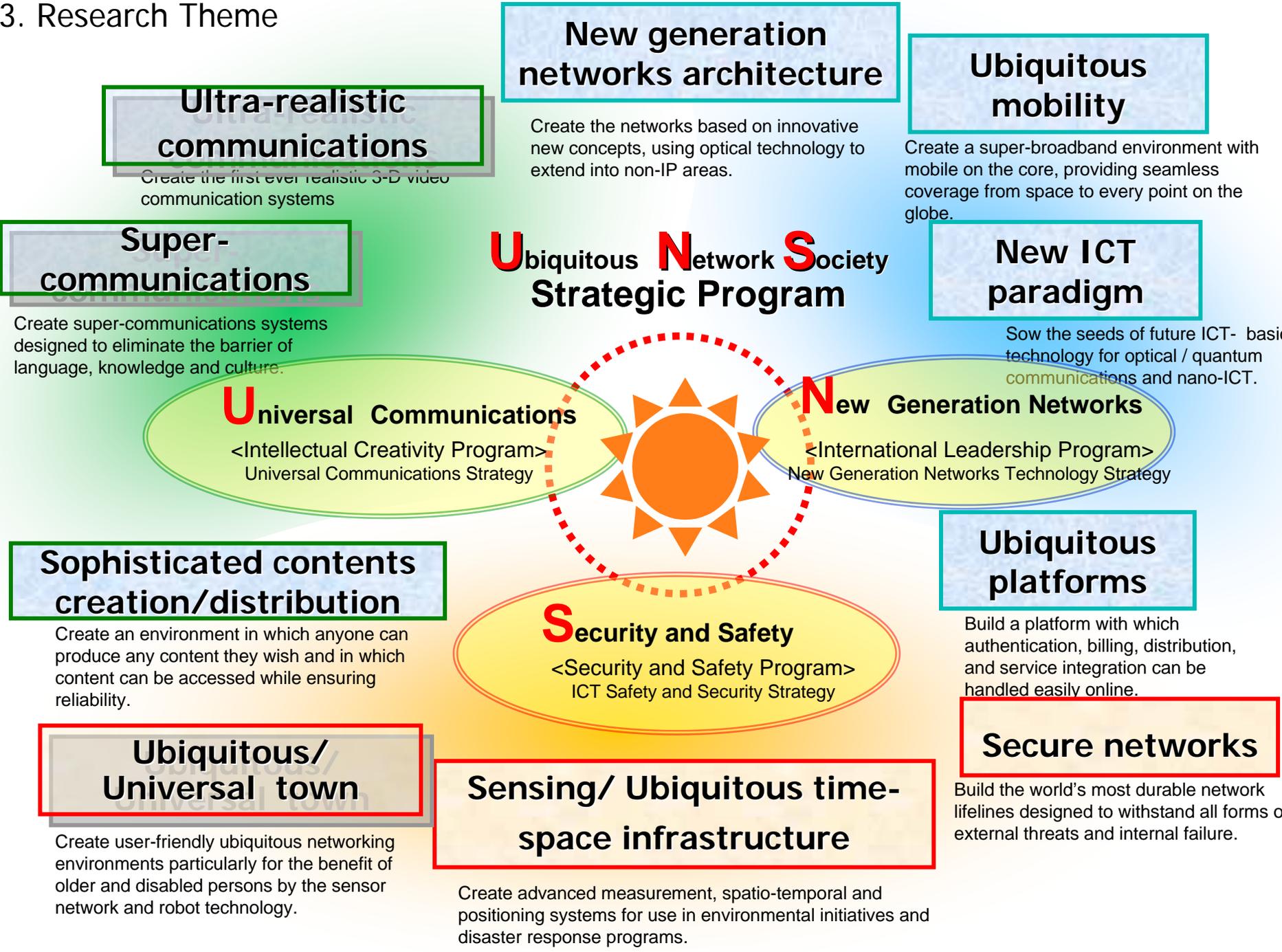
Ubiquitous / universal town

Sophisticated contents creation / distribution

Super-communications

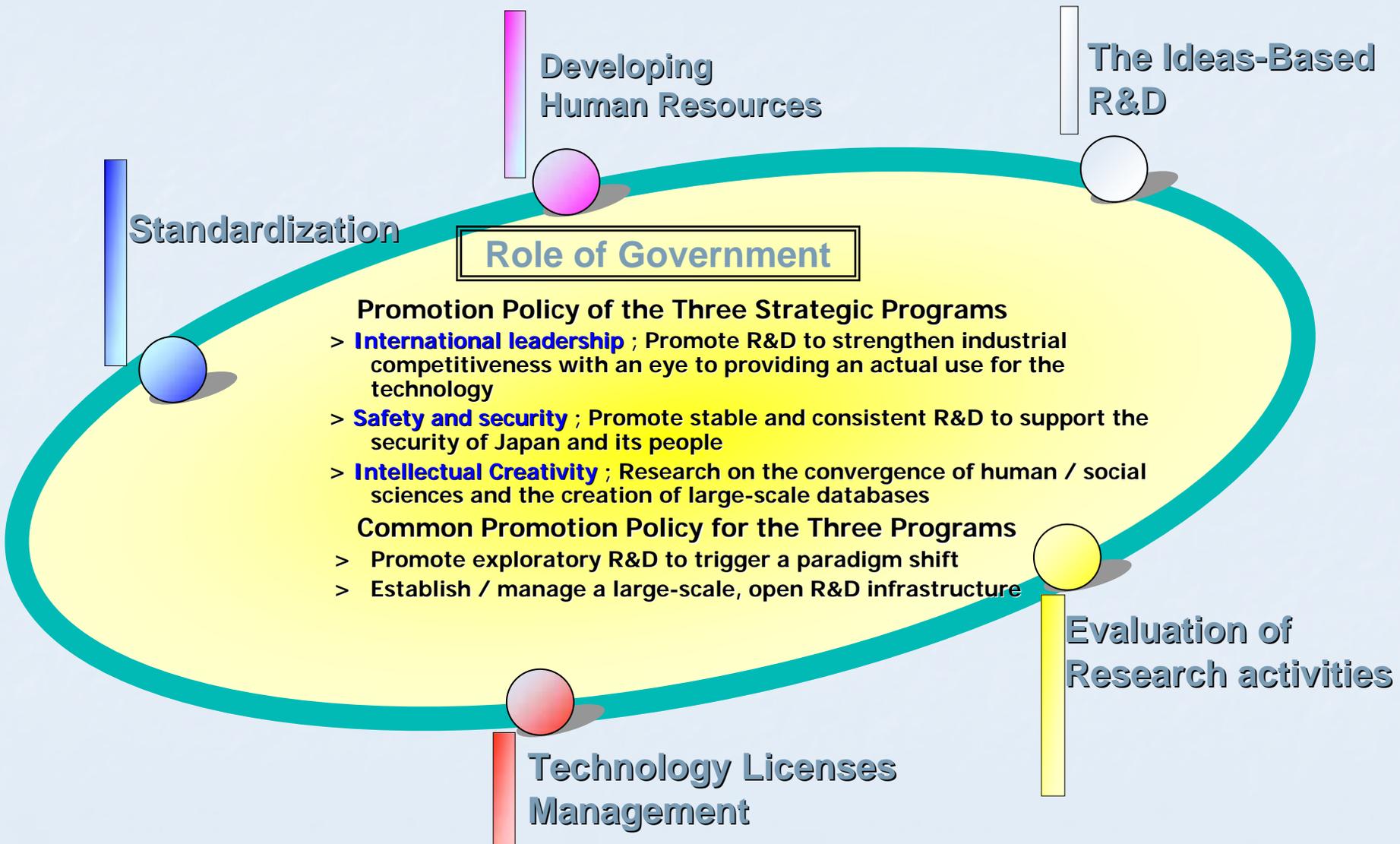
Ultra-realistic communications

3. Research Theme



Promotion of UNS Strategic Programs

-Role of government and associated support-



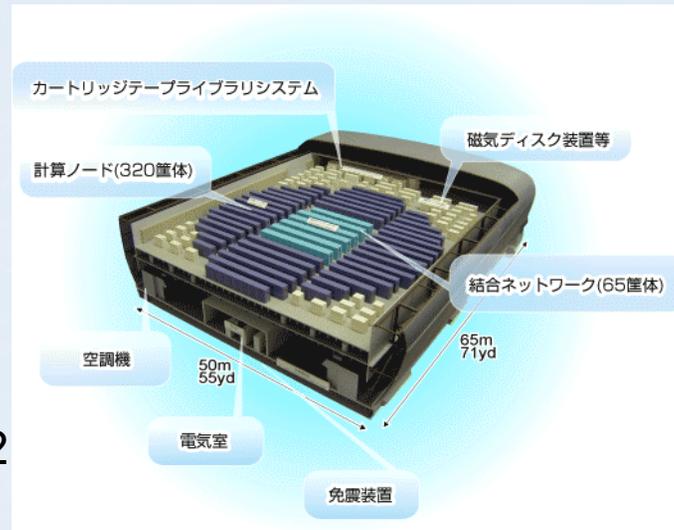
4. Environment monitoring for global change and natural hazard damage mitigation:

- **ICT application to the security and safety issue**
- Scope/ Targets
 - Monitoring global safety and security: Global change issue
 - Monitoring natural hazards and damage mitigation
- Technology/Platform
 - Remote sensing/ Global and regional
 - Satellite sensor technology/ ground based system
 - Data network system over international data transfer
 - Super-computer based model analysis

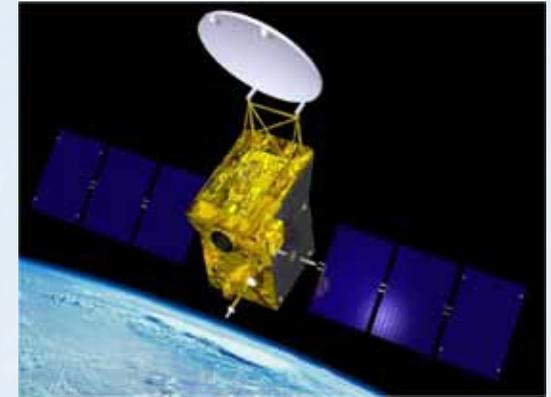
Efforts on global change studies in Japan



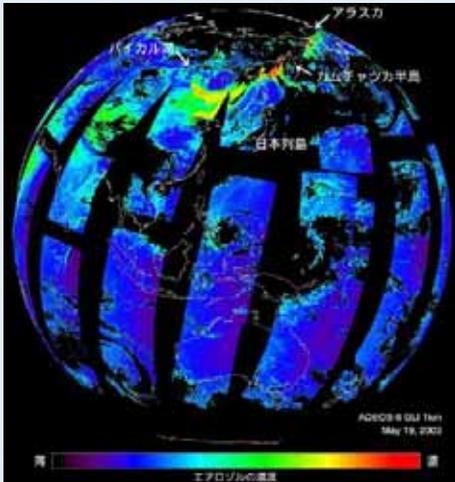
ADEOS-II launched in 2002 for global change monitor



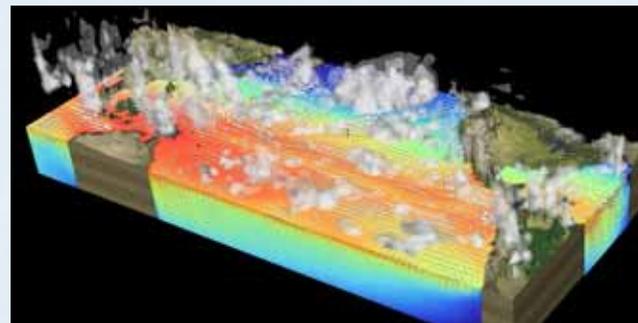
The Earth Simulator



Japan-Europe joint EarthCARE Program(2012) (NICT/JAXA/ESA)



Aerosol distribution taken by ADEOS-II (JAXA)



Atmosphere –Ocean Model results by the Earth Simulator (Earth Simulator Center)

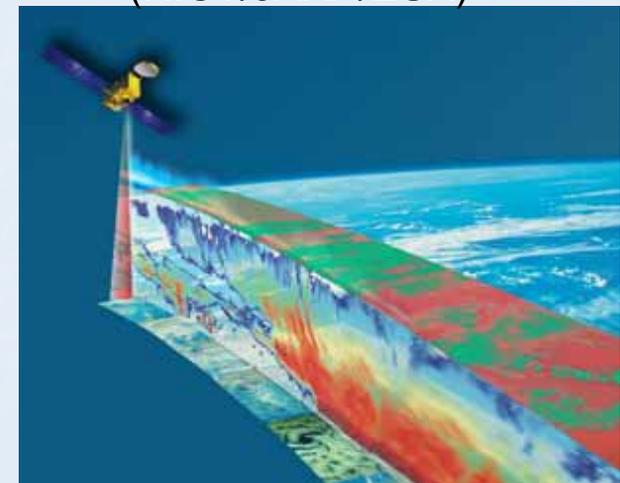
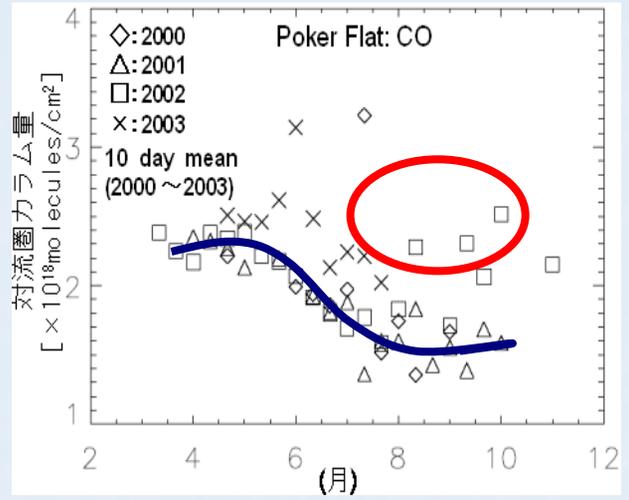
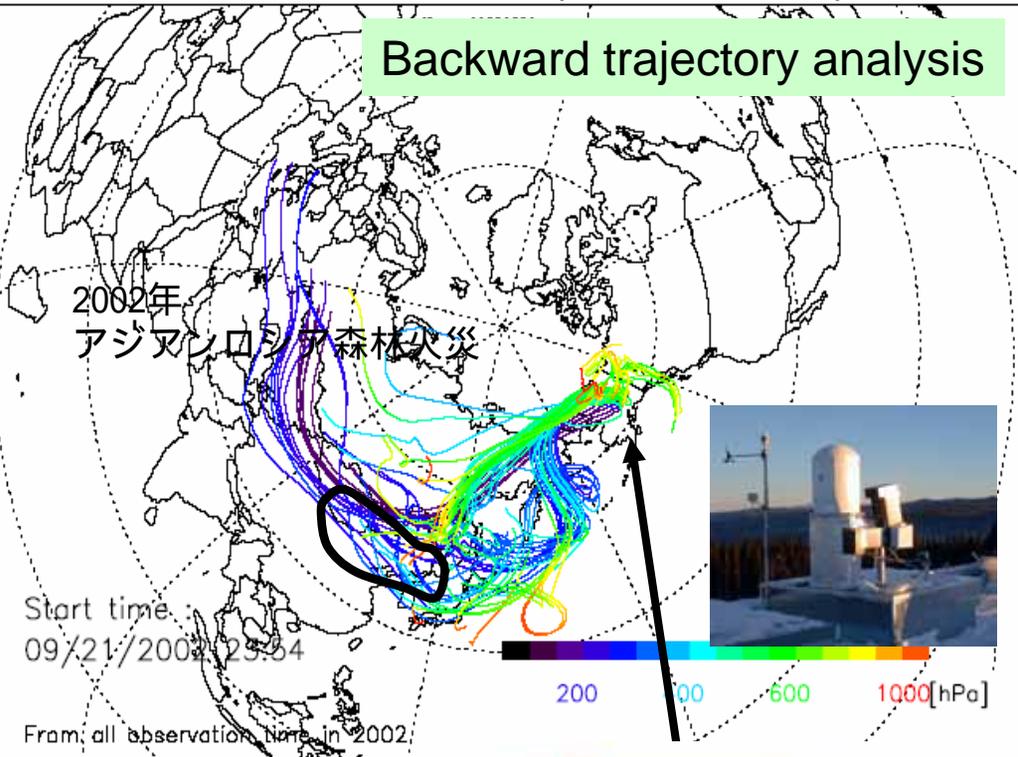


Image of EarthCARE measurement

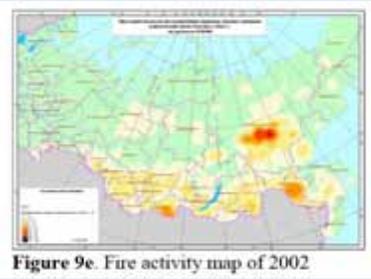
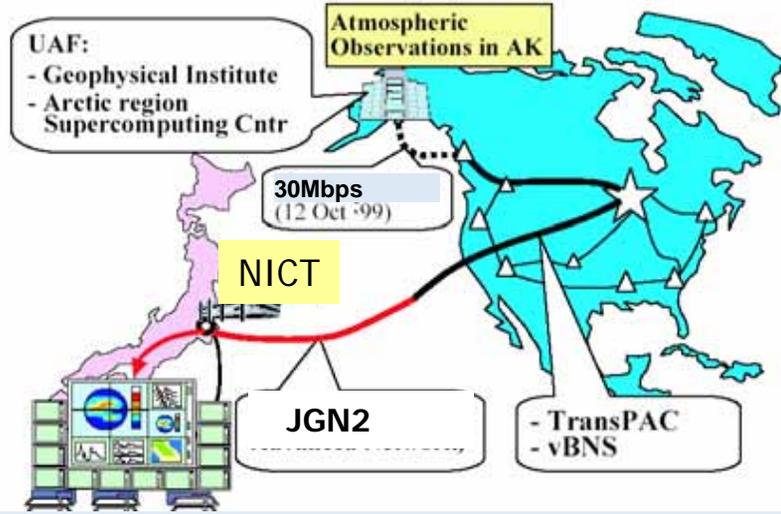
A joint study of arctic atmosphere measurement for global change (NICT- Univ. Alaska): Real time data access available in Japan

ECMWF + NIPR Backward Traj. from PF for 7 day

Backward trajectory analysis



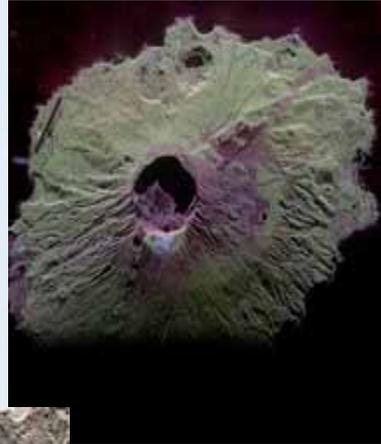
International Network for SALMON (System for Alaska Middle Atmosphere Observation data Network)



Remote sensor technology developed in NICT for the disaster damage reduction



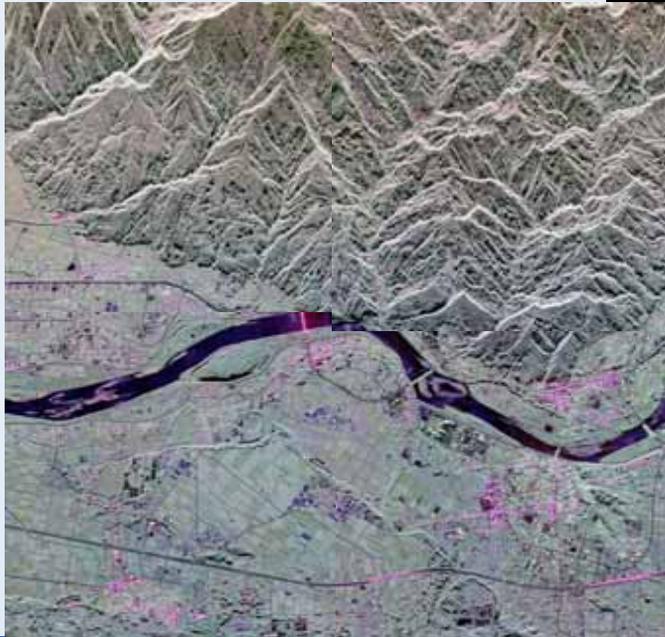
Airborne SAR (Synthetic Aperture Radar) system developed in NICT



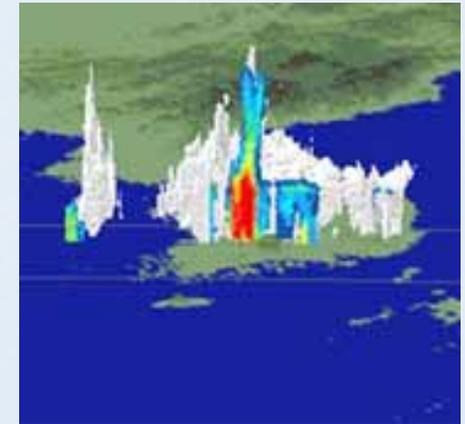
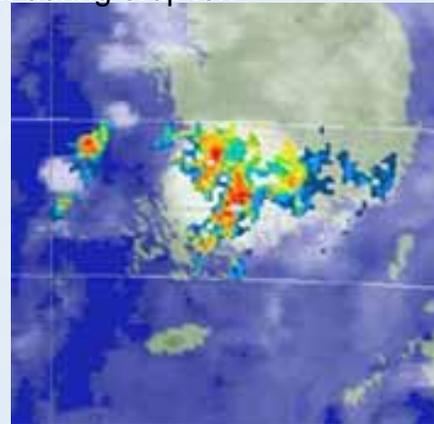
SAR image of crater of Miyake Isl. during eruption



Tropical Rainfall Measuring Mission (TRMM) satellite equipped with world first rain radar developed by NICT/JAXA

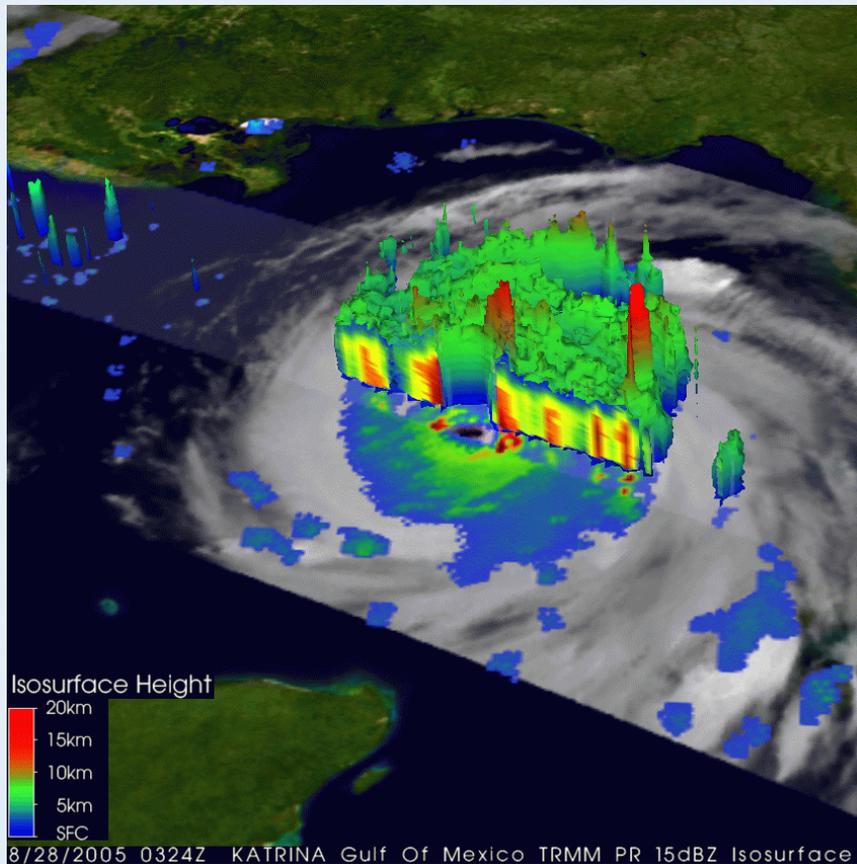


SAR image of disaster area of Chuetsu Earthquake (Niigata Pref.)

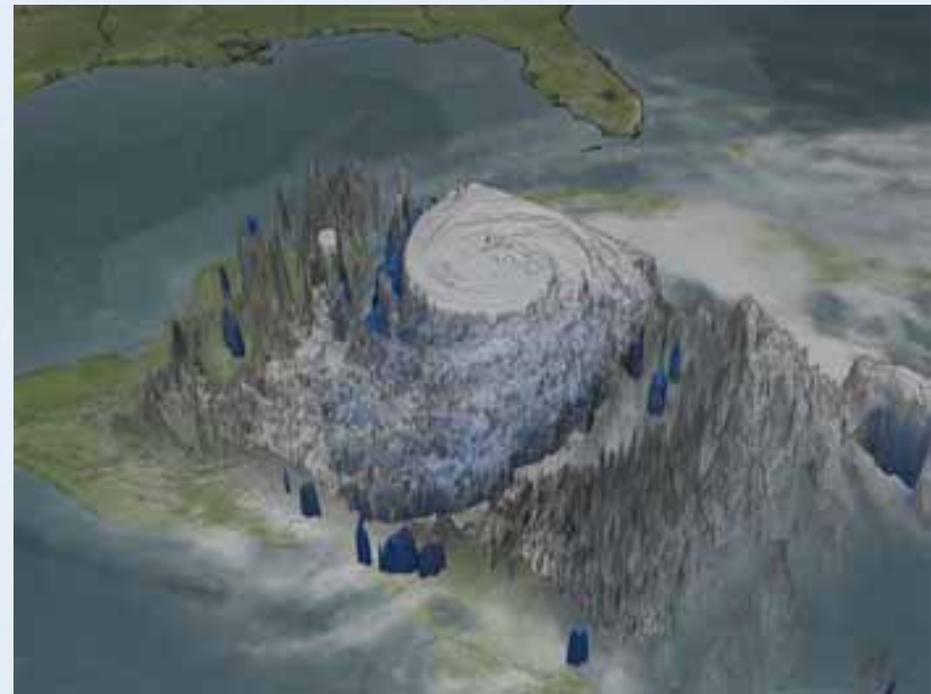


Heavy rain event in Korea seen by TRMM radar; horizontal rain distribution (left) and vertical distribution (right)

Recent results by TRMM radar applied to Hurricane monitoring and forecasts in USA



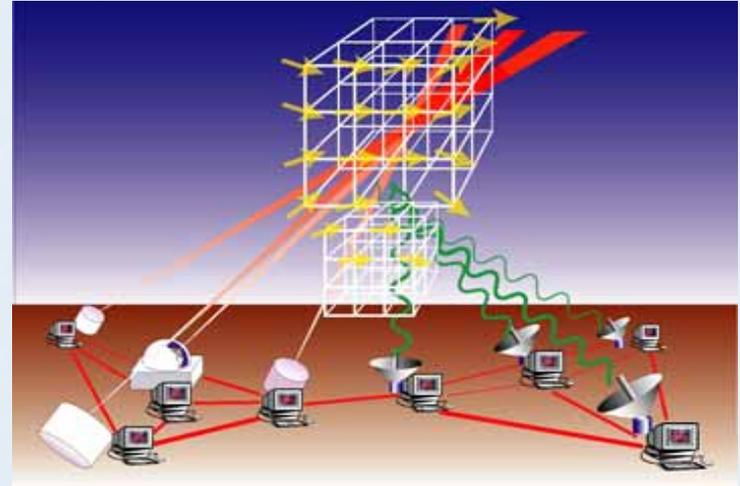
Hurricane Katrina (NASA HP)



Hurricane Wilma (NASA HP)

5. Approach to the ubiquitous sensor networks for environment monitoring

- **Concept of sensing network:** huge number of simple/cheap sensors are connected with cutting-edge network technology
- **Multiple sensor network:** a few number of high-quality sensors are connected with usual network



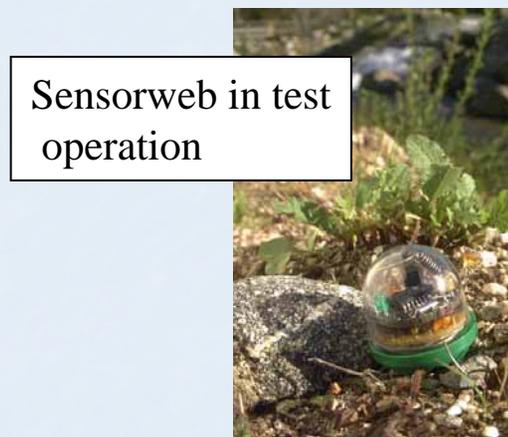
Small scale vector-wind measurement system with multiple sensor network

Sensing network for monitoring regional environments

- Sensing network for monitoring regional environments becomes attractive as an application of ubiquitous network system.
- adaptive network system via adhoc/multihop communication
- Integration with remote sensing is a new challenge;
- Application areas
 - Micro climate
 - Agriculture
 - Ecology
 - Disaster monitoring



Sensor Box

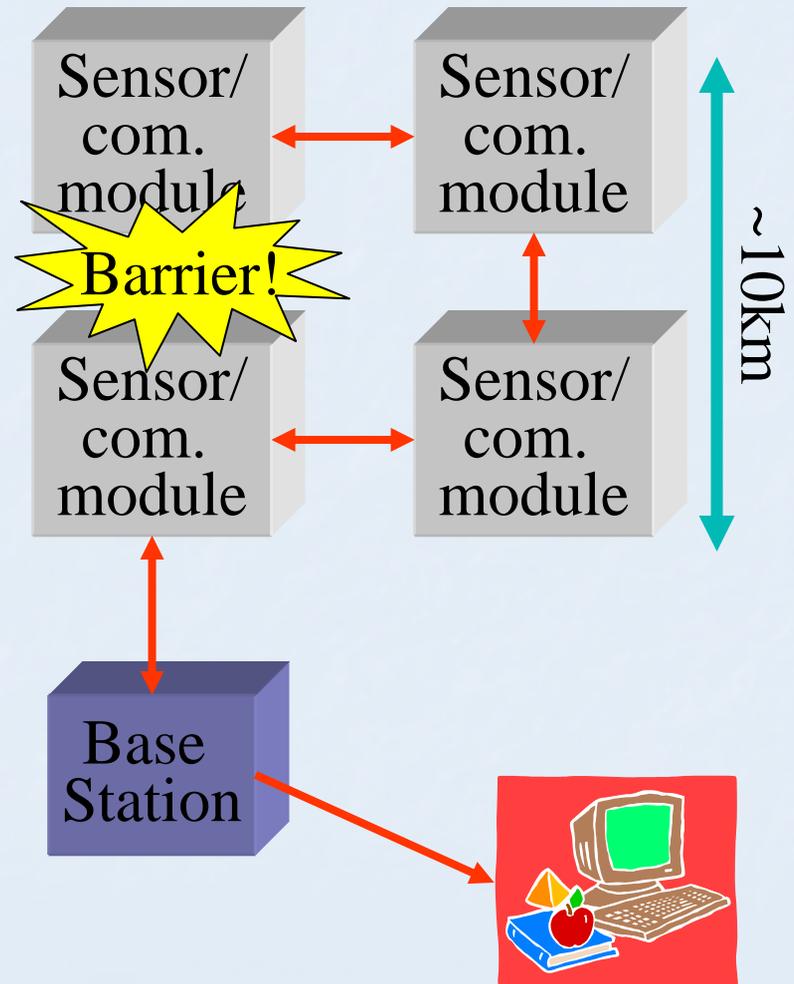


Sensorweb in test operation

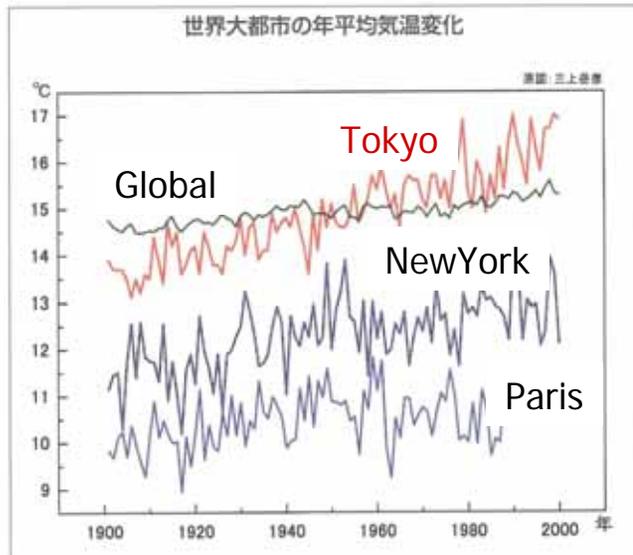
photo:NASA/JPL

Adhoc/multihop communications

- Each terminal sends data to the nearest relay station, by which the total electric power consumption is small.
- Adaptive network: movable module and flexible routing

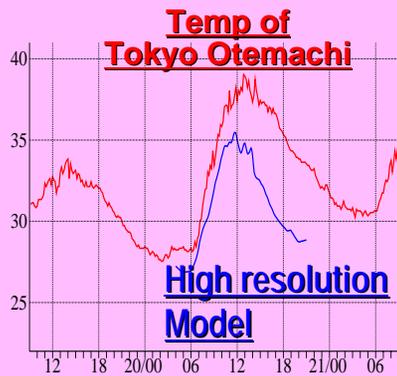
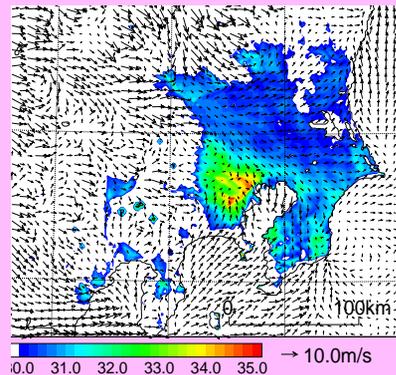


A potential application area: Monitoring Mega-city environment

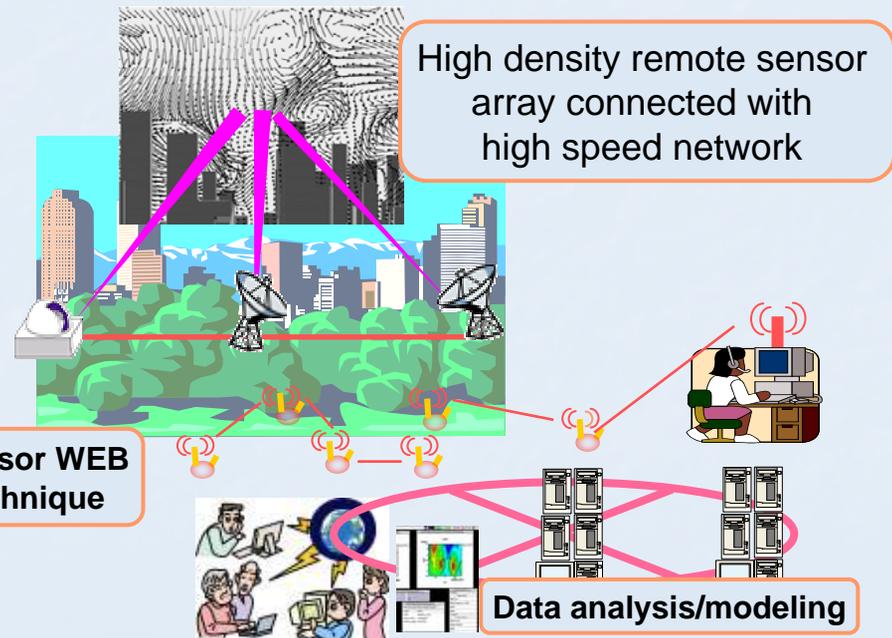


Trend in Temperature change

- Concerns have been raised in Mega-city on
 - recent weather events/ disasters
 - air pollution
- Current monitor system not working enough
- High density measurement in small area needed



Numerical model (high resolution) can not predict summer heat in Tokyo down town (MRI).



Conclusion

1. **NICT was established in 2004 and working as a core research center for advancing ICT R&D under MIC, Japan;**
2. **The Ubiquitous Network Society (UNS) Research Programs were established as the national ICT initiative by MIC, Japan in July 2005;**
3. **Topics given are regarding to the ICT applied to the societal safety and security;**
4. **NICT has contributed to develop remote sensing technology for the global change study and disaster damage mitigation.**
5. **Significance in the ubiquitous sensing technology, in which the sensing and network techniques are integrated, was pointed out;**
6. **One of potential application areas of this technology is the environment monitoring of city areas; New ICT approach of ubiquitous sensing copes with present issues and helps realize societal safety and security;**