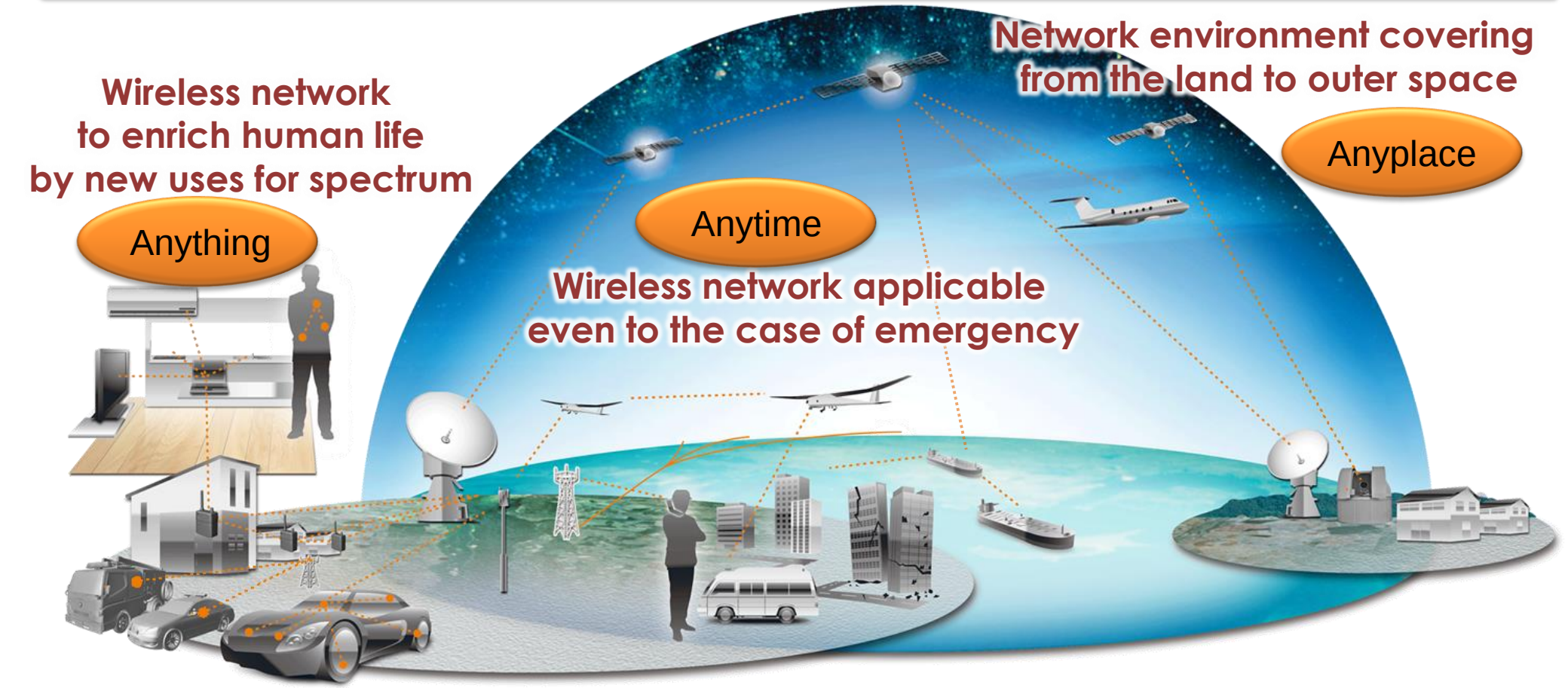
情報通信研究機構
National Institute of Information and Communications Technology

Overview of NICT Wireless Network Research Institute

Hiroyuki YANO
Director General
Wireless Network Research Institute, NICT

R&D Vision

Wireless Network Research Institute conducts R&D on wireless network that secures flexible connection of people and things in mobile environment, in time of disaster/emergency or in the area with difficulty of deploying wired networks while realizing the efficient use of frequency and energy resources.



Overview of Laboratories and R&D Locations

Wireless Network Research Institute

Research and Development

Smart Wireless Laboratory

- TV White Space Communication Technology
- Wireless Smart Utility Network (Wi-SUN)
- Wireless Regional/Metropolitan Area Network
- Wireless Ultra-broadband Communication Technology, etc.

Dependable Wireless Laboratory

- Resilient Multi-hop Wireless Mesh Networks
- Short-Range Body Area Networks (BAN) and Two-Dimensional Communication
- Application of UWB technology, Low-Power Architecture for Video Coding, etc.

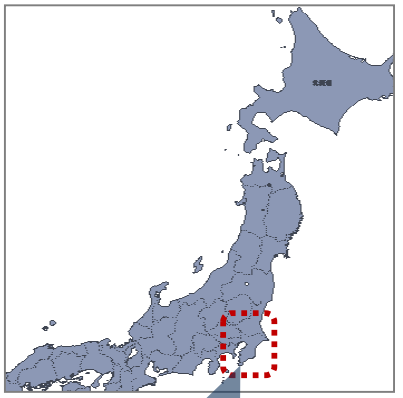
Space Communication Systems Laboratory

- Broadband Mobile Satellite Communication System
- Broadband Optical Satellite Communication/ Terrestrial Free Space Optical Communication
- High-Precision Orbit Technology, etc.

Support and Promotion of R&D

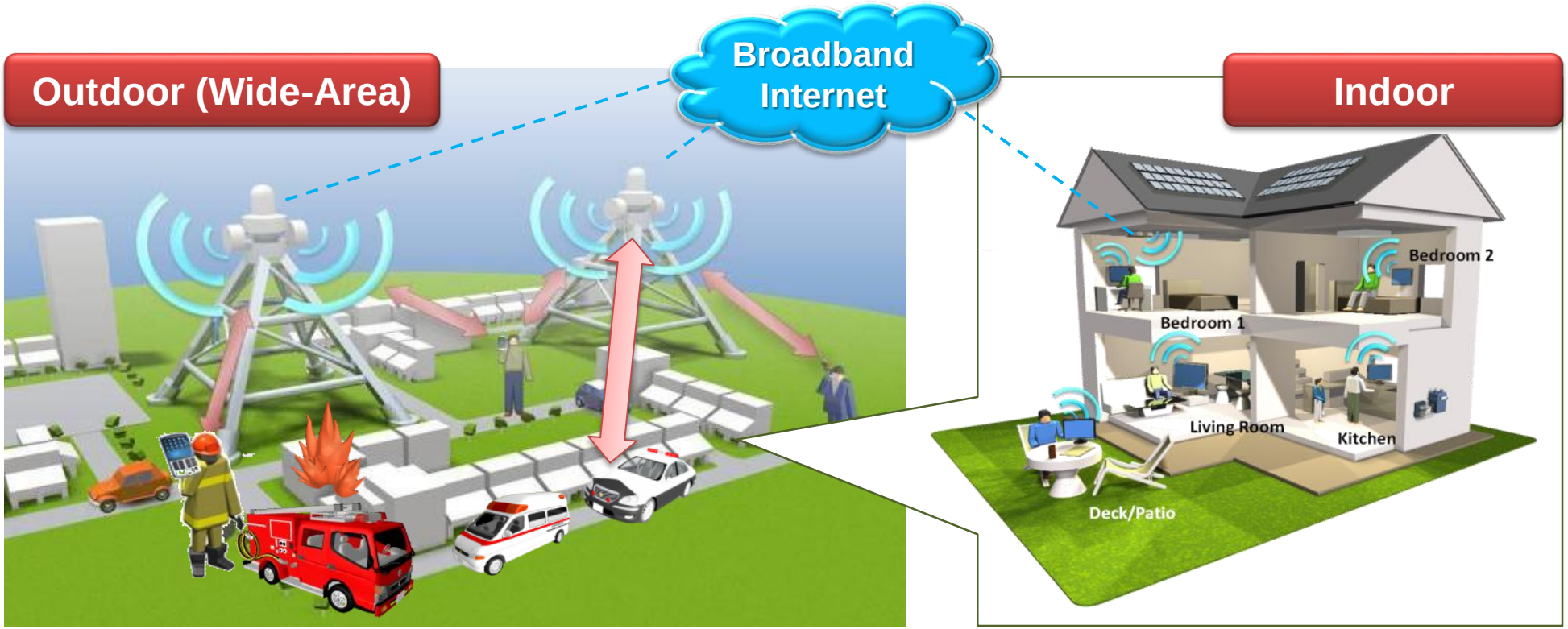
Planning Office

- Public Relations
- Administration and Outcome Management
- Management of Research Environment



Wireless network to enrich human life by new uses for spectrum

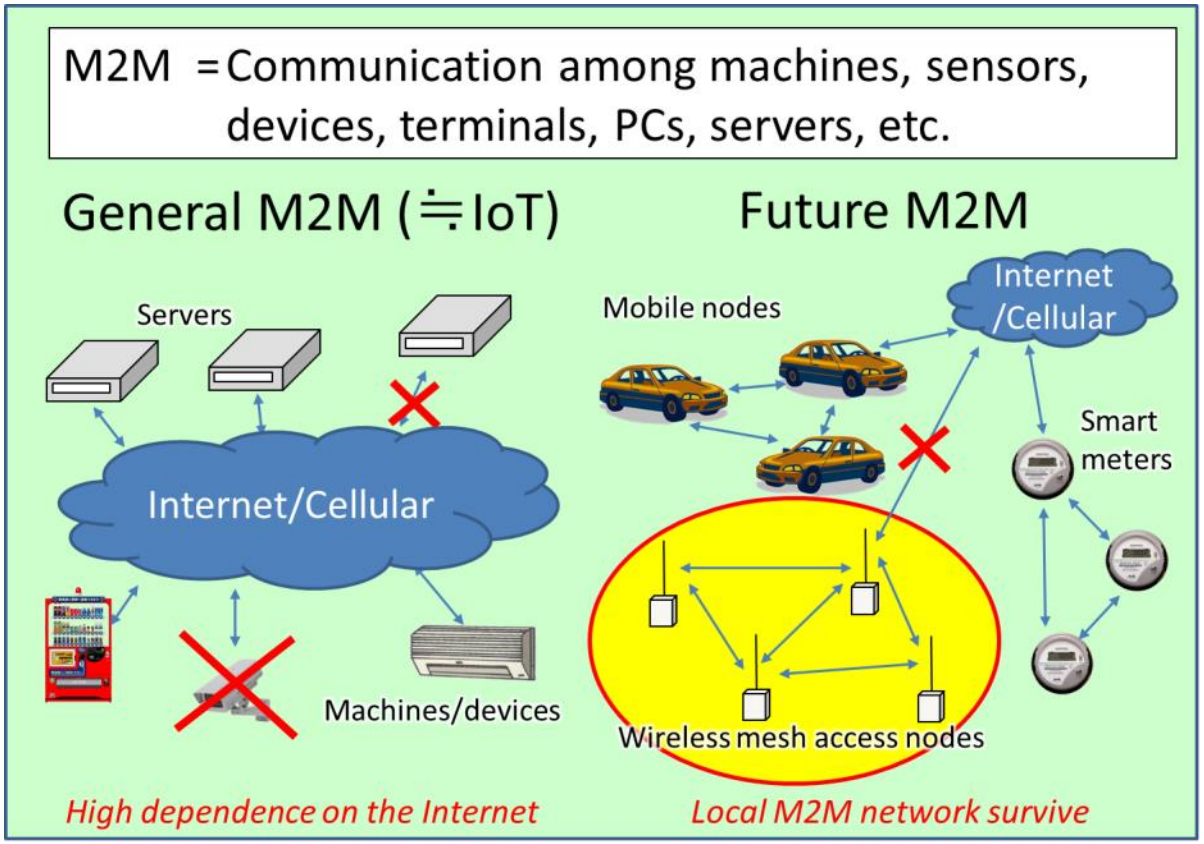
- Establish basic technology for the system that can realize several 10km wide coverage area with a base station using VHF and UHF band after the termination of analog broadcasting, and that can be used for public communication system to support living.
- Establish the technology for the Wireless Personal Area Network (WPAN) using Millimeter, Submillimeter or Terahertz-wave achieving the rate greater than 10Gbps that is adequate for the image transmission such as 4K and 8K movie images.

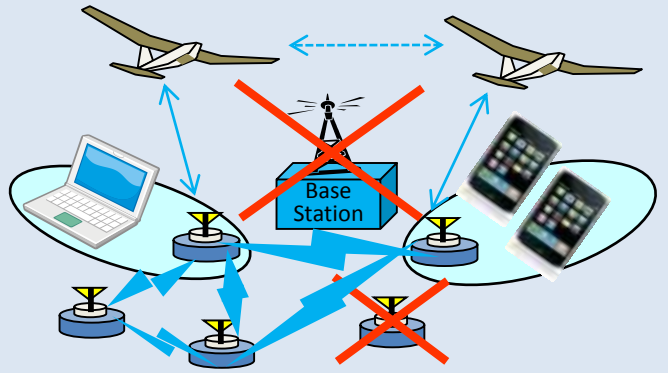


Smart Wireless Laboratory

Wireless network applicable even to the case of emergency

- Establish robust and disaster resistant wireless multi-hop networking technology that allows existing distributed mobile nodes in the atmosphere or on the ground to flexibly connect each other in over tens meters to hundreds kilometers wide area
- Establish reliable short-range communication technology such as body area network with wearable/implant sensors and as device-to-device or machine-to-machine communications



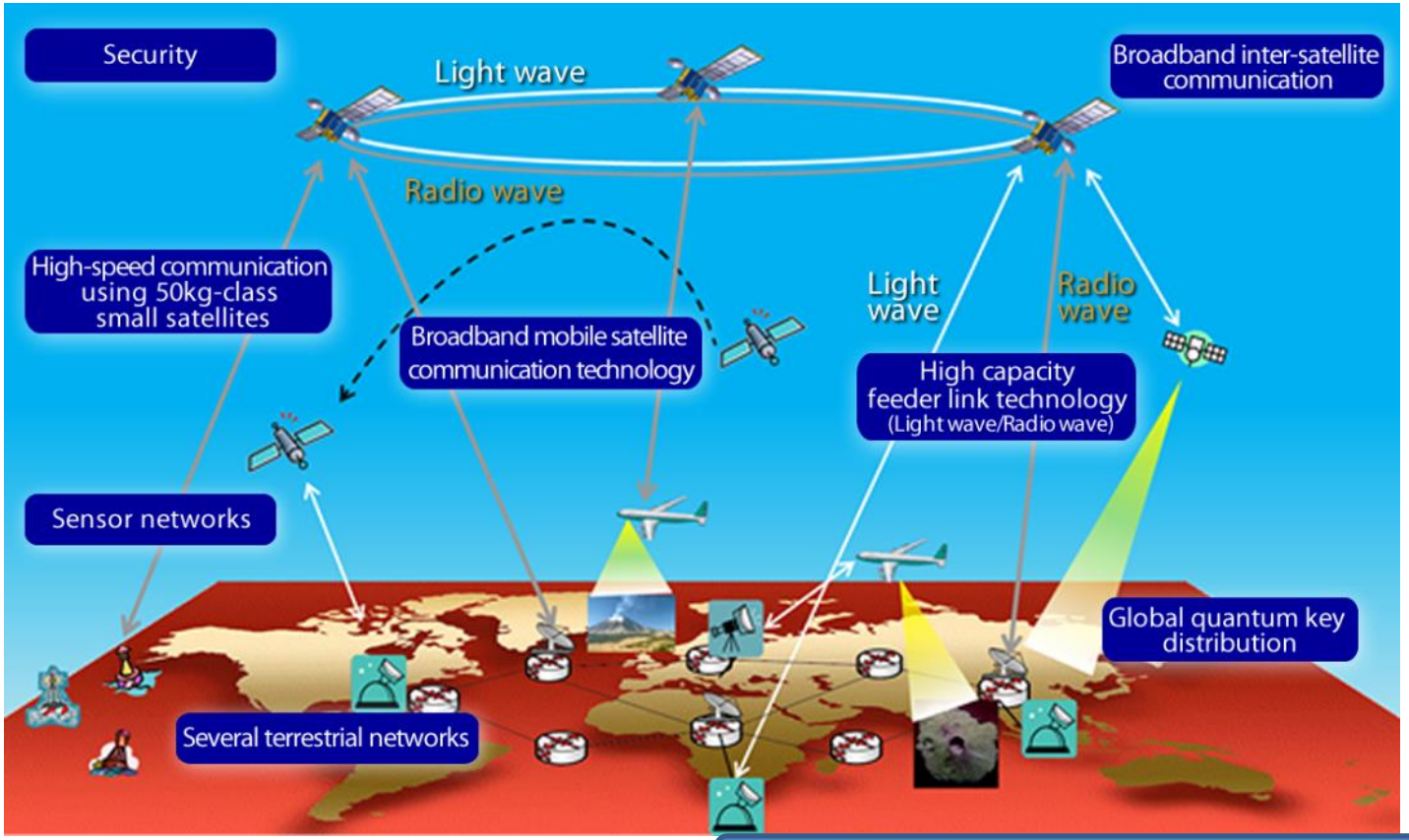


Autonomous decentralized wireless network with disaster-resistant robustness that maintains its operation to the extent possible no matter how seriously the wired/wireless infrastructure is damaged.

Dependable Wireless Laboratory

Network environment covering from the land to outer space

- Establish a broadband mobile satellite communication system deployable in times of emergency or disaster, covering from the land to the outer space
- Establish an optical satellite communication technology with high security and build the technology for super high-speed radio/laser data relay and for super high-speed feeder link so as to support the transmission of mass data sent from earth observation satellites

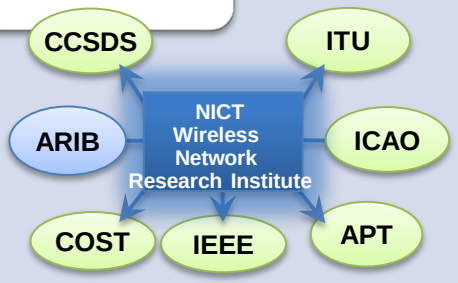


Space Communication Systems Laboratory

R&D Strategy

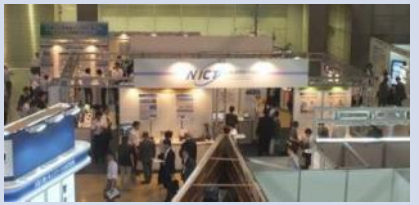
1. Promotion of Standardization

- Submission of contributions and recommendation in ITU-R (SG1,3,4,5)
- “Selection and concentration” of proposals in IEEE (802,1900)
- Participation in ARIB and ITS Info-communications Forum
- Human resource development for taking the leadership in standardization activities



2. Promotion of Collaborations with Industries, Academia, and International Organizations

- Fully utilize the geographical condition of YRP, the Japan’s center of excellence of the R&D on wireless communications, then promote;
  1) Collaboration with universities
  2) Outcome-focused R&D in collaboration with manufacturers and carriers from the planning phase



Wireless Technology Park (WTP)

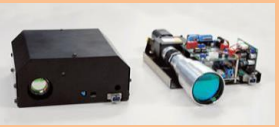
3. Establishment of R&D Platform

- Accelerate the practical use of research results by establishing the wireless testbed which takes advantage of YRP’s geographical feature (closed space for radio wave).
- Actively promote collaborative researches in cooperation with YRP R&D Promotion Committee.

Wi-SUN Research and Demonstration Platform

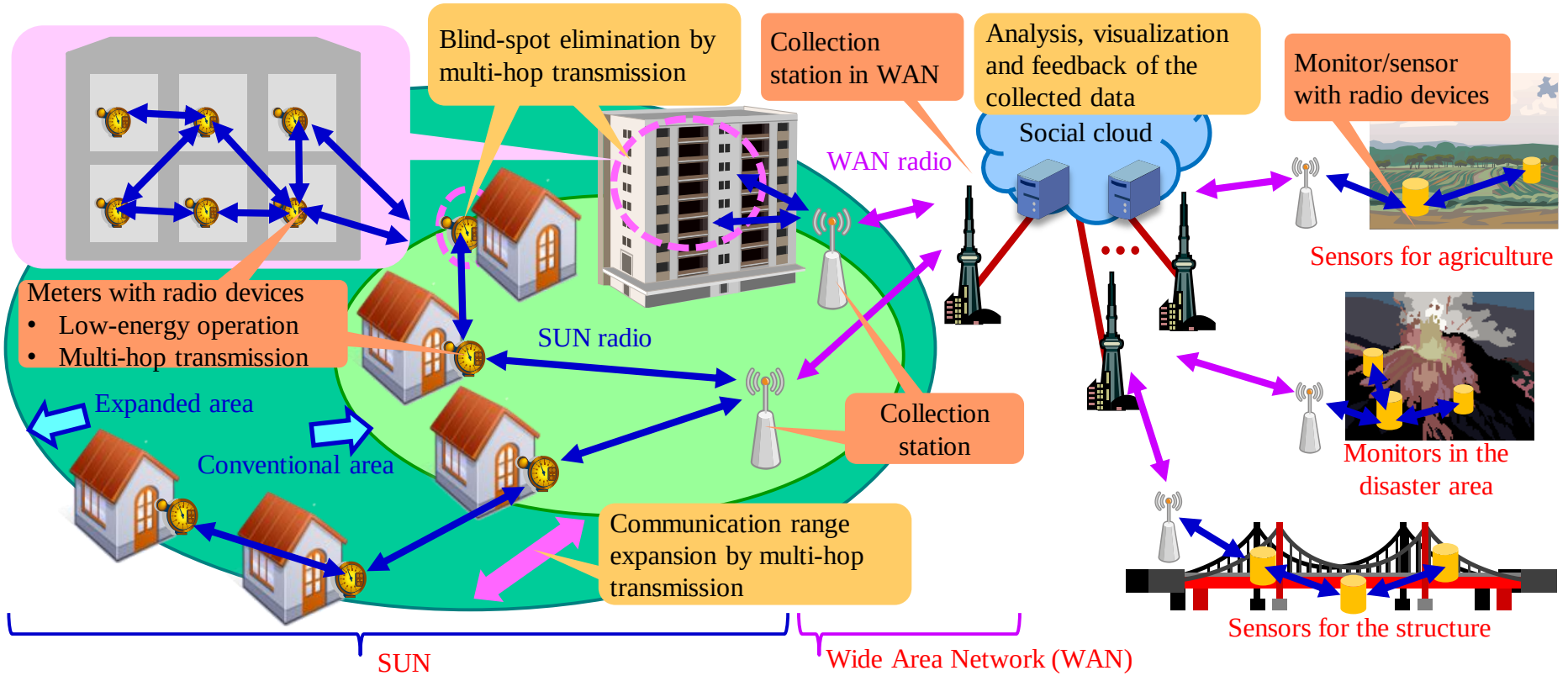
In order to solve various social issues

4. Technology Transfer/ Development to Society



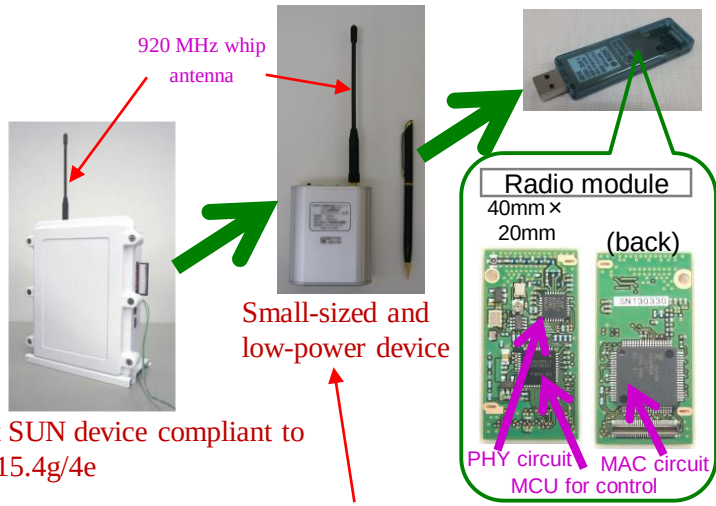
Typical use image of SUN

- SUN (Smart Utility Networks) means a network constructed by Electricity/Gas/Water meters equipping radio devices that can effectively and automatically relay data frames to the collection station, which is expected to further support large amount of monitoring/sensing applications
- SUN's technical requirements:
  - Low-energy performance
  - Multi-hop transmission capability



Wi-SUN developed in NICT

- SUN radio devices
  - Basic low-power operation capability
  - Compliance to IEEE802.15.4g/4e standards
  - Connectivity to the assumed meters/sensors



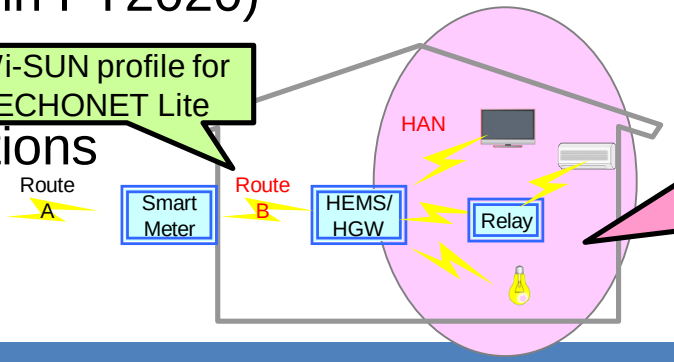
World first SUN device compliant to IEEE 802.15.4g/4e

- Standardizations
  - IEEE 802.15.4g(PHY)
  - IEEE 802.15.4e(MAC)

→ Wi-SUN Alliance
(NICT is the Wi-SUN promotor member)

Size	85mm×70mm×35mm (excluding antenna)
Weight	165g
Frequency	920 MHz~92 8MHz
Tx power	20mW
Modulation scheme	2GFSK
Data rate	50kbps, 100kbps, 200kbps
Maximum data length	2047octets
Communication range	500m
Power source	AA-battery×3, AC
Consumption current	50 mA and 2 mA for Active and Sleep states
Interface	RS-232C, RS-485, U-LINE, and others (expandable)

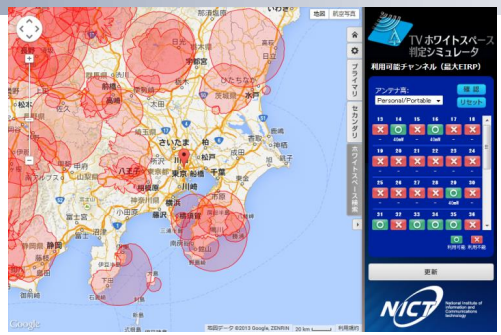
- Field trials and deployment
  - ECHONET Lite (27 mil. houses in FY2020)
  - Home Area Network (HAN)
  - Coping with the various applications



Wi-SUN profile for Home Area Network supporting multiple appliances and relay transmission among them

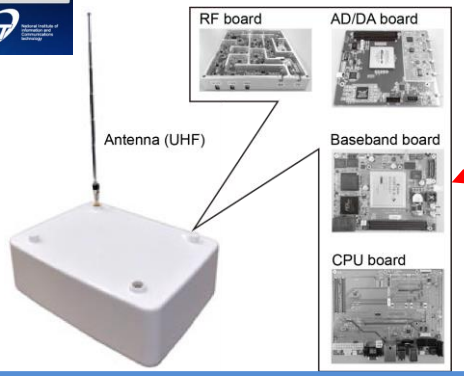
TV White Space in NICT's R&D

- System developments
  - White Space Database
    - Find available TV channels
  - White Space Devices
    - Satisfy strict spectrum mask requirements
- Standardizations
  - IEEE 802.11af / 802.15.4m / 802.19.1 / 802.22b
  - IEEE DySPAN-SC / 1900.4 / 1900.6
  - ITU-R WP5A
- Field trials



Following regulations of FCC/ Ofcom/ Japan

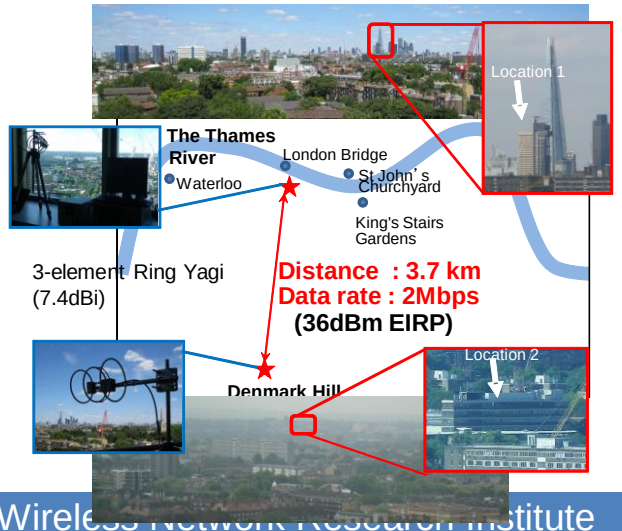
White space LTE System
470-710MHz, 1920-1980MHz(↑), 2110-2170Mz(↓),
BW: 5 / 10 / 20MHz, PW: ～20dBm, TDD/FDD

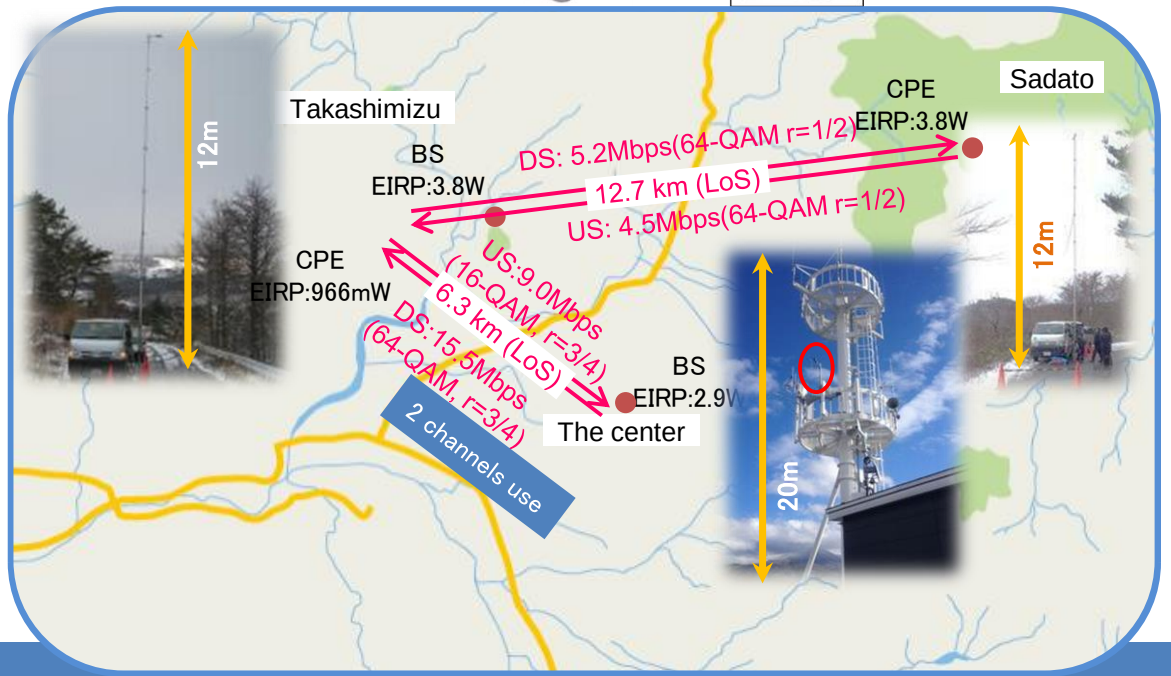


Comply with FCC/ETSI requirements on spectrum mask

IEEE 802.11af
470-710MHz, 6MHz,
10mW, OFDM

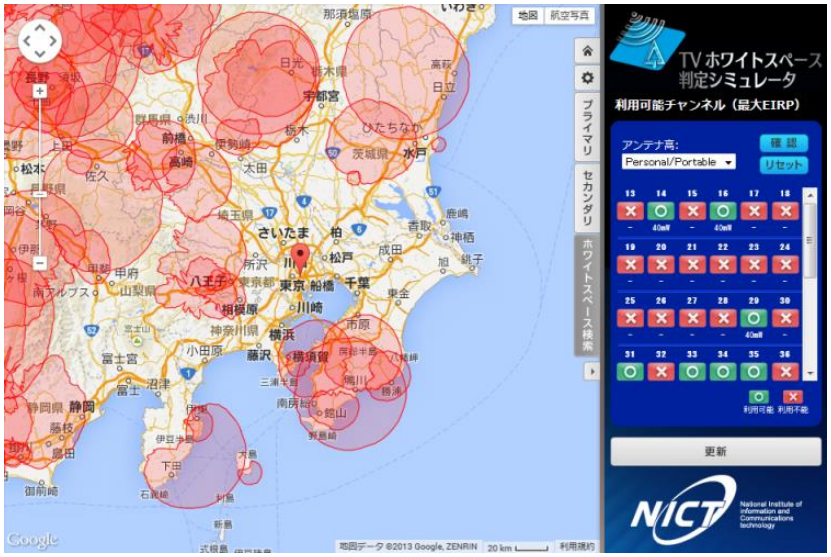
No interference to TV broadcastings in the center of London





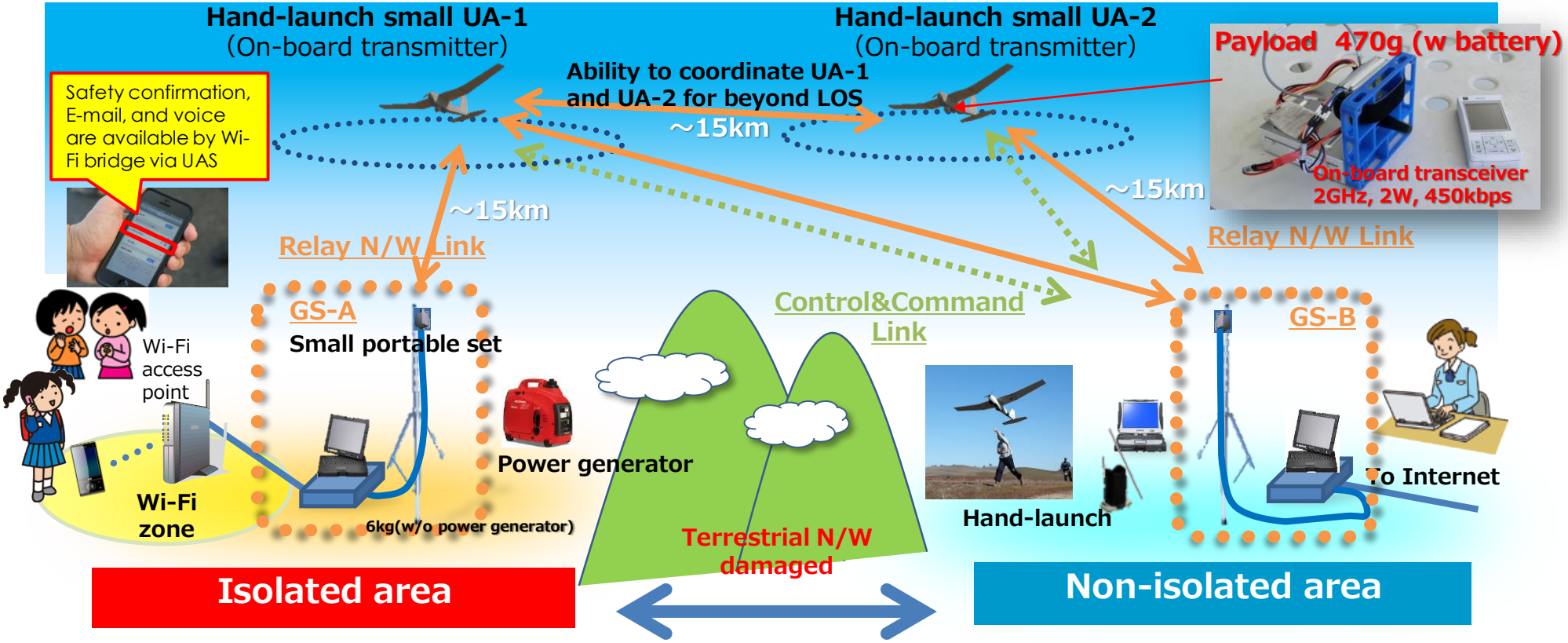
Structures of NICT's TV White Space System

NICT's White Space Database was **qualified by U.K. Ofcom** for the TV White Spaces Pilot



Wireless Relay Network using UAV

- Under devastating damage, recovery of communication network usually takes 2-3 weeks
- To rapidly provide temporary communications to isolated and remote areas in disasters, unmanned aircraft (UA) scrambles to achieve the wireless relay network between isolated and remote area.
- Advantages: Rapid deployment, Low operation cost, No runways needed



Innovative ICTs help realize the better and safer world.