Aplicaciones TICs para Nuevos Negocios

Hideyuki Iwata

NIPPON TELEGRAPH AND TELEPHONE CORPORATION

June 2018

About NTT Group

NTT

NTT carries out basic research and development activities at three laboratory groups in a wide range of fields, including some of the most advanced ICT research in the world.

Innovative R&D by NTT

Total Assets : ¥ 21,250.4 billion
Consolidated Operating Revenues : ¥11,391.0 billion
Consolidated Operating Income : ¥1,539.8 billion
Number of Employees : 274,844
Consolidated Subsidiaries : 944 (Consolidated subsidiary in Japan : 446)

100%※1	100%※1	66.7%※1	54.2%※1	
NTT EAST, NTT WEST	NTT Communications, dimension data	docomo	NTT DATA	Other Group Companies
Regional Communications Business ※2	Long Distance & International Communications Business ※2	Mobile Communication Business ※2	Data Communication Business ※2	Other Business ※2

※1 Voting rights to major subsidiaries (As of March 31,2017)
※2 including R&D department

Innovative R&D by NTT

Overview of NTT R&D

NTT R&D numbers at a glance

16,000+
patents granted

2,300
researchers working

$2B / year
invested in R&D
(total of group companies*)

1,300
technical papers annually

3 times
awarded IEEE Milestones

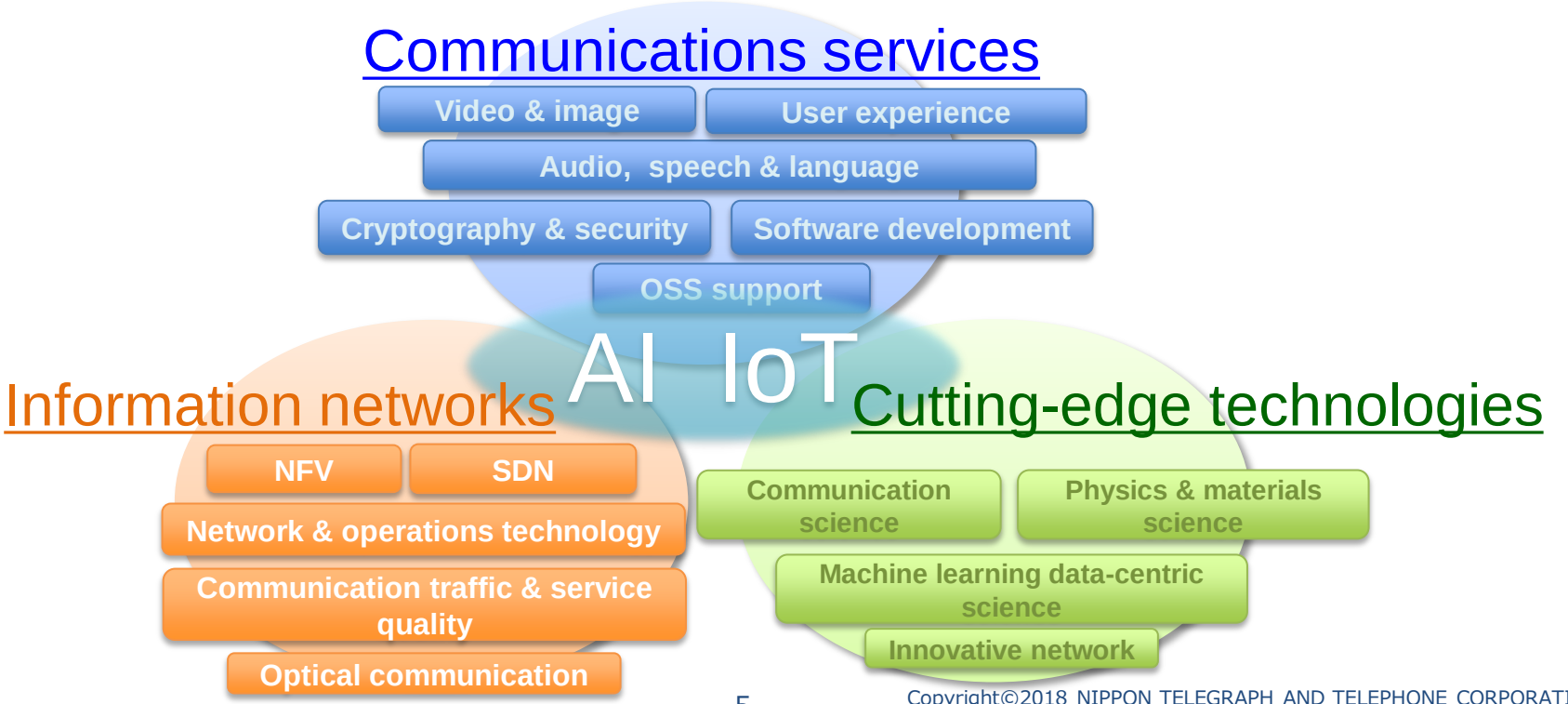
40 persons
IEEE Fellows
(including former colleagues)

Top 100 Global Innovators
by Clarivate Analytics

*) Note that $1B/year was invested by the R&D Labs. of NTT holdings and the remainder by the operating companies.

Overview of NTT R&D

Undertaking research and development in a wide range of fields, including media, security, networks and physics, **NTT R&D has great potential to create new values in society worldwide**.



Innovative R&D by NTT

NTT R&D organization

Tsukuba ⟨T⟩

Silicon Valley ⟨V⟩

Musashino/Tokyo ⟨M⟩

Otemachi/Tokyo ⟨O⟩

Kyoto ⟨K⟩

Shinagawa/Tokyo ⟨S⟩

Atsugi ⟨A⟩

Yokosuka ⟨Y⟩

- President & Vice President
  - R&D Planning Department ⟨O⟩
  - Service Innovation Laboratory Group ⟨Y⟩
    - Communication services
      - Service Evolution Laboratories ⟨Y·M⟩
      - Media Intelligence Laboratories ⟨Y·M⟩
      - Software Innovation Center ⟨M·S⟩
      - Secure Platform Laboratories ⟨M⟩
  - Information Network Laboratory Group ⟨M⟩
    - Information networks
      - Network Technology Laboratories ⟨M⟩
      - Network Service Systems Laboratories ⟨M⟩
      - Access Network Service Systems Laboratories ⟨T·Y·M⟩
  - Science and Core Technology Laboratory Group ⟨A⟩
    - Cutting-edge technologies
      - Network Innovation Laboratories ⟨Y·M⟩
      - Device Innovation Center ⟨A⟩
      - Device Technology Laboratories ⟨A⟩
      - Communication Science Laboratories ⟨K·A⟩
      - Basic Research Laboratories ⟨A⟩
  - NTT Innovation Institute Inc. ⟨V⟩
    - Cloud development

2,300 researchers working

Innovative R&D by NTT

Technical papers and awards

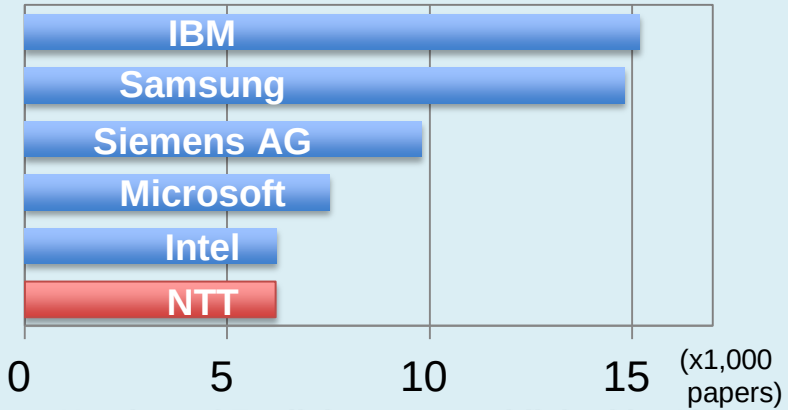
NTT R&D has been publicizing its research results in many technical papers that have been **highly rated** overseas and received **various awards**.

Technical Papers

NTT is ranked 13th in the number of technical papers published by corporations, and in the

Top 6

for ICT companies.



Number of English papers published by ICT companies (2006-2015)

Source: Clarivate Analytics

Awards

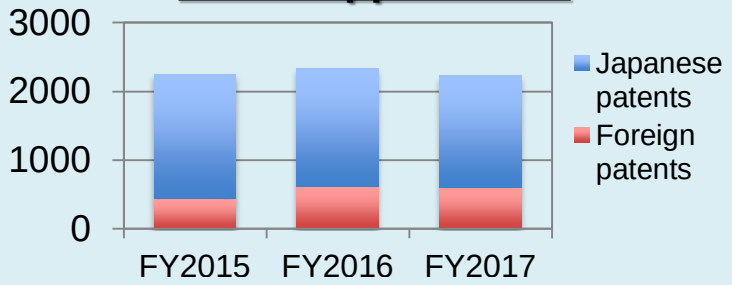
3 NTT developments are recognized in IEEE Milestones*. Among its present and former researchers are 40 IEEE Fellows.
In 2017, it received 21 overseas awards in a variety of fields.

*IEEE milestones recognize the technological innovation and excellence for the benefit of humanity found in unique products, services, seminal papers and patents that occurred at least twenty-five years ago in an area of technology represented in IEEE and having at least regional impact.

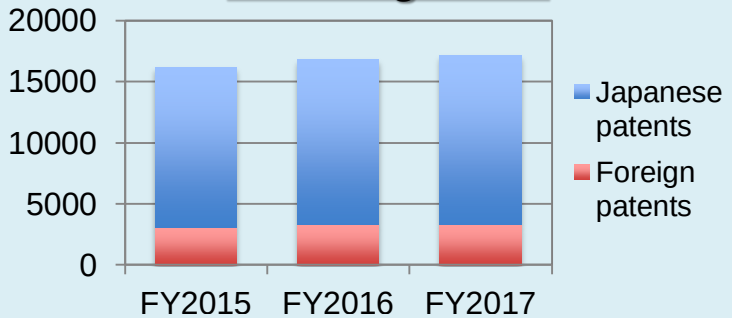
Patents

NTT files thousands of patent applications every year and owns more than 16,000 patents.

Patent applications



Patents granted



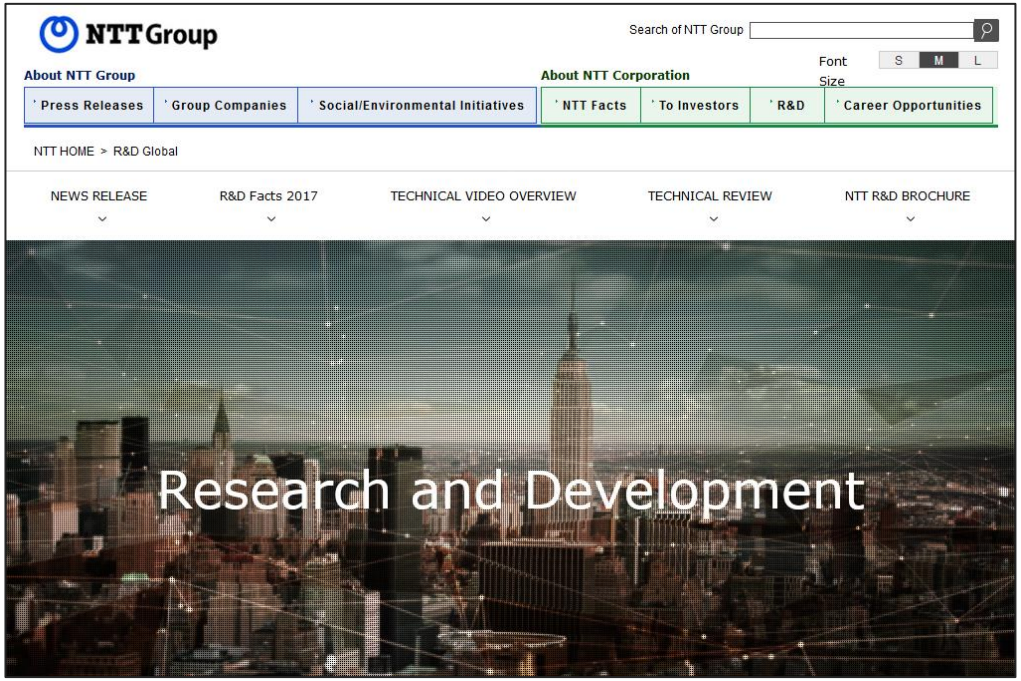
Award

Clarivate Analytics has included NTT among its Top 100 Global Innovators for 7 consecutive years.

Clarivate Analytics presents this award to 100 companies selected from firms across the globe as “innovative companies and institutions vigorously engaged in protecting intellectual property rights and creating innovations with global impact,” by evaluating, from an objective viewpoint, four principal criteria: 1. Volume (of patents); 2. Success (grant rate of patent application); 3. Globalization, and 4. Influence.

This award is clear evidence that the NTT Group’s R&D activities are making highly valuable and groundbreaking contributions to the global market.

NTT R&D Website



Visit our website for updated information on NTT R&D

http://www.ntt.co.jp/globalRD/

Innovative R&D by NTT

ICT cases in Japan by NTT East

challenges facing our community

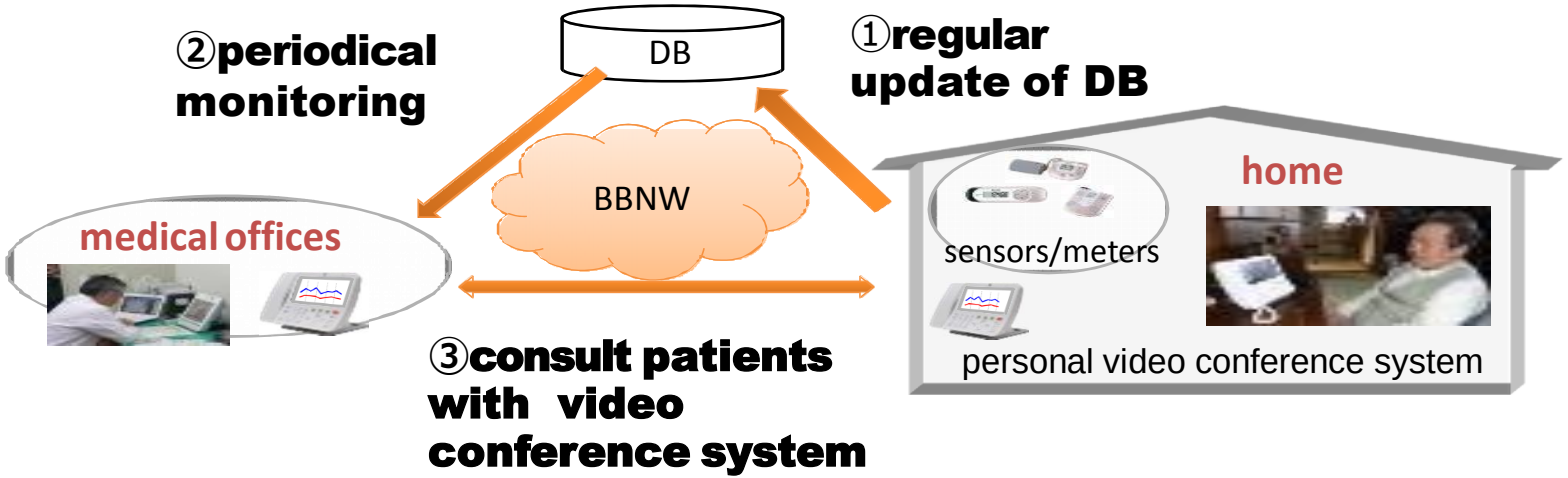
- Rural-to-urban migration
- Aging of society
- Depopulation

Agenda

- cases
  - remote medical care
  - distance education
  - disaster control
  - business development
- insights

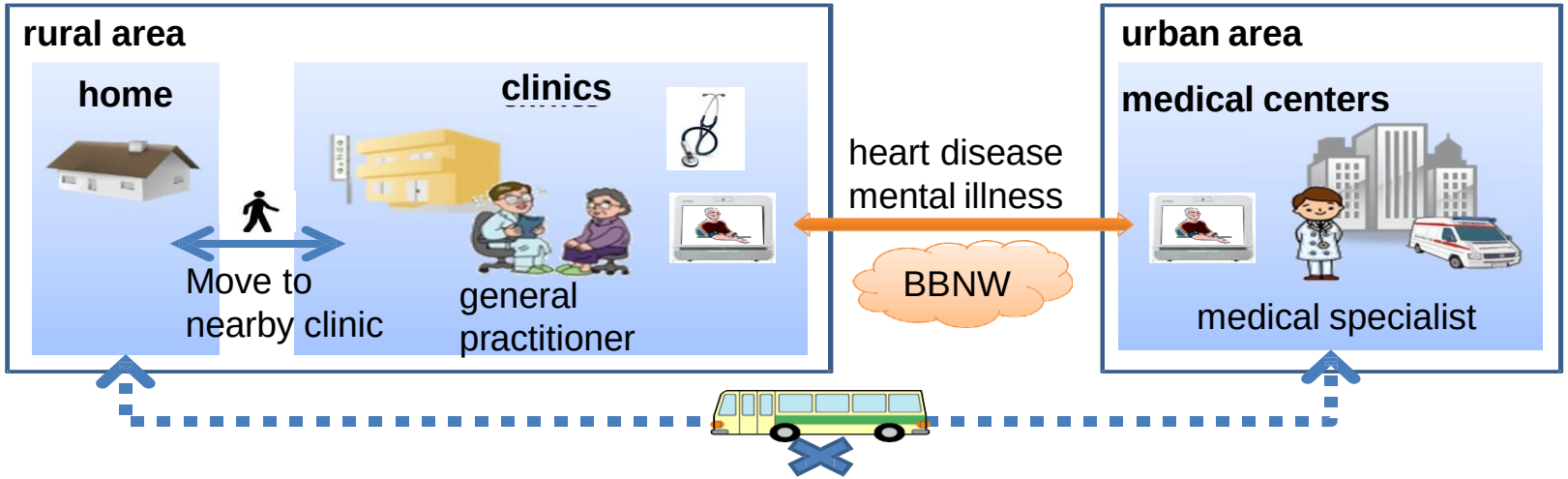
Case 1: remote medical care

- BBNW connect Villagers' homes and medical offices
- Sensors/meters regularly update health database
- Doctors periodically monitor the database and consult patients using personal video conference system.



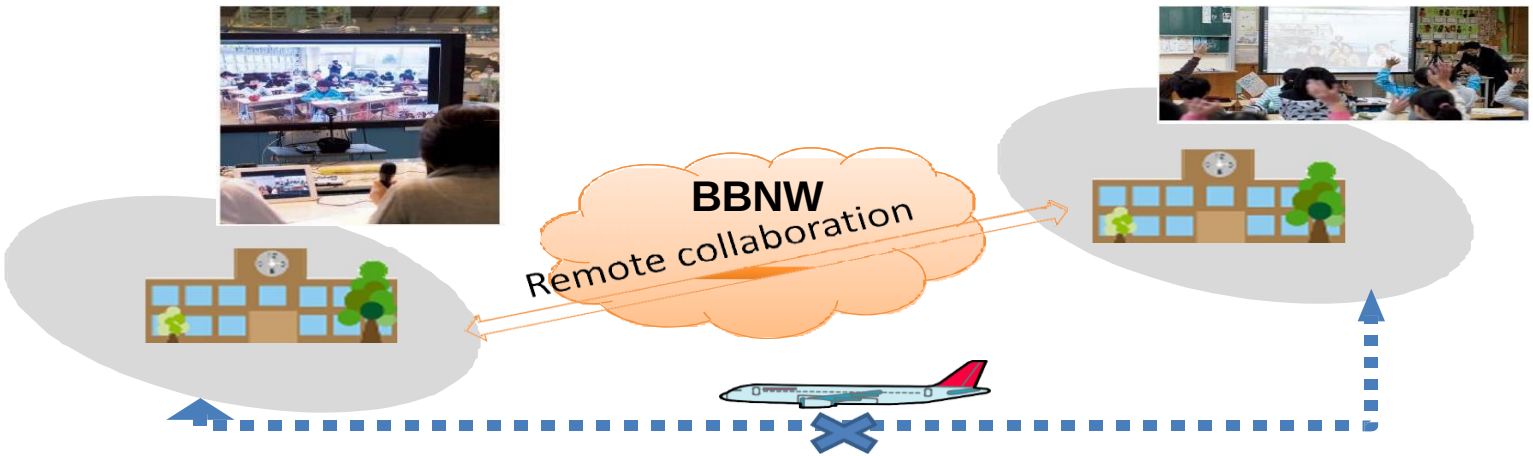
Case 2: remote medical examination

- **BBNW connect rural clinics and medical centers in urban area**
- **Patients in rural area can receive medical care by specialists**



Case 3: remote collaboration

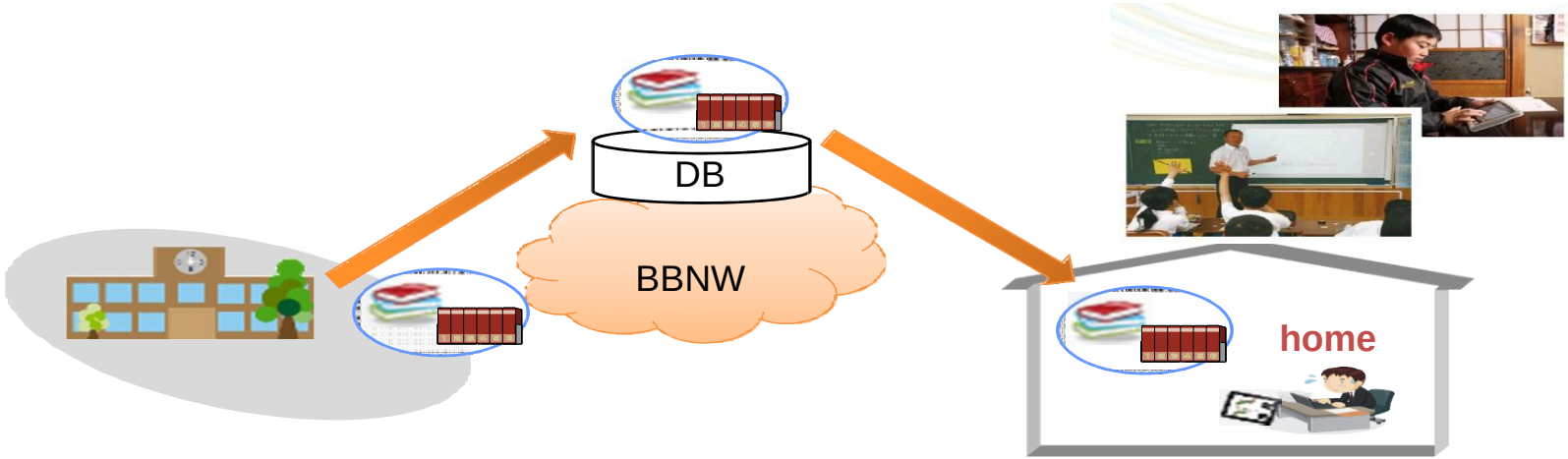
- **BBNW connect schools in a remote location.**
- **Students in rural area can collaborate with students in urban area or overseas**



Innovative R&D by NTT

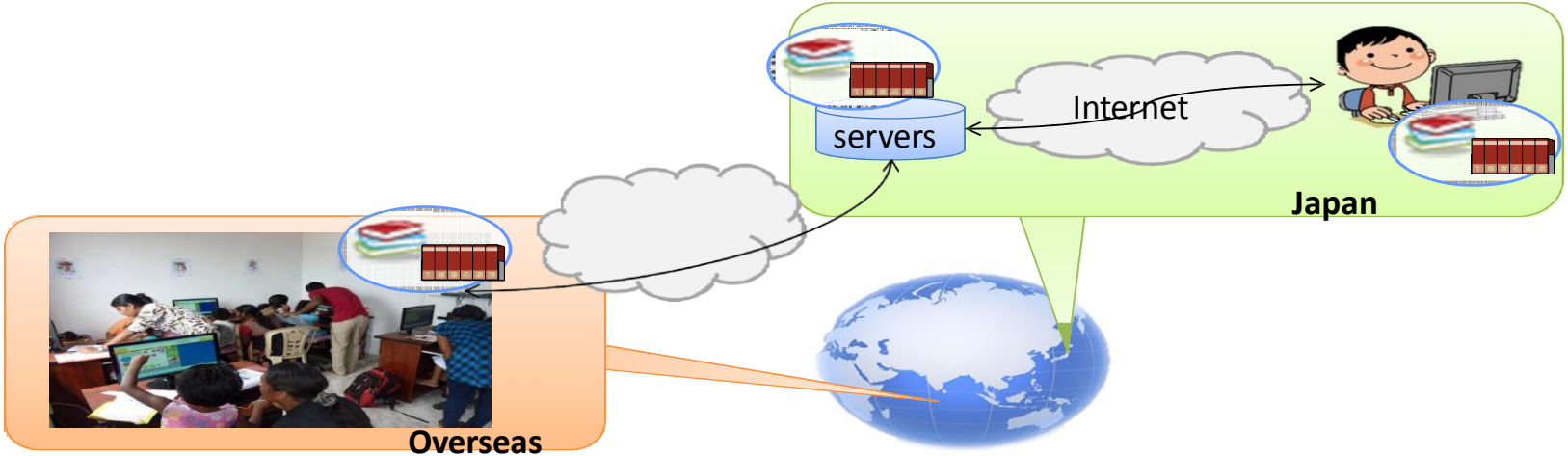
Case 4: home schooling

- **Students can use their schools' education material on servers located on BBNW**
- **Students carry their tablets home and can access these education material at home**



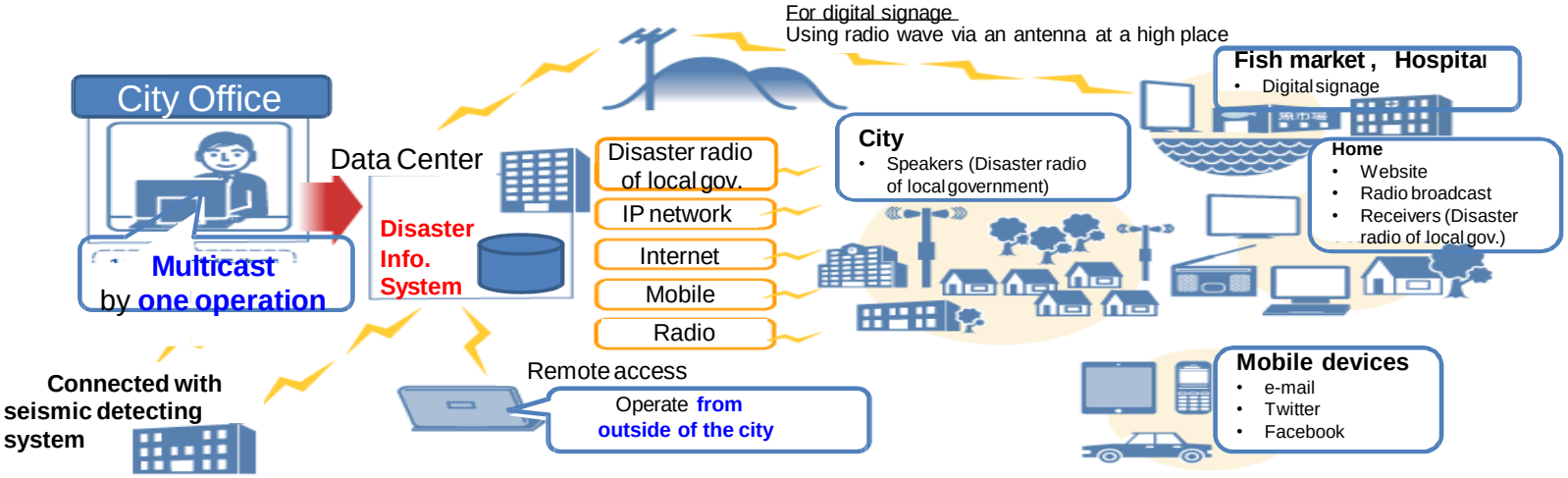
Case 5: cloud based learning

- **Students can use education material on servers located on BBNW**
- **Students can get their education at the same level even if they live in any part of the world.**



Case 6: disaster information

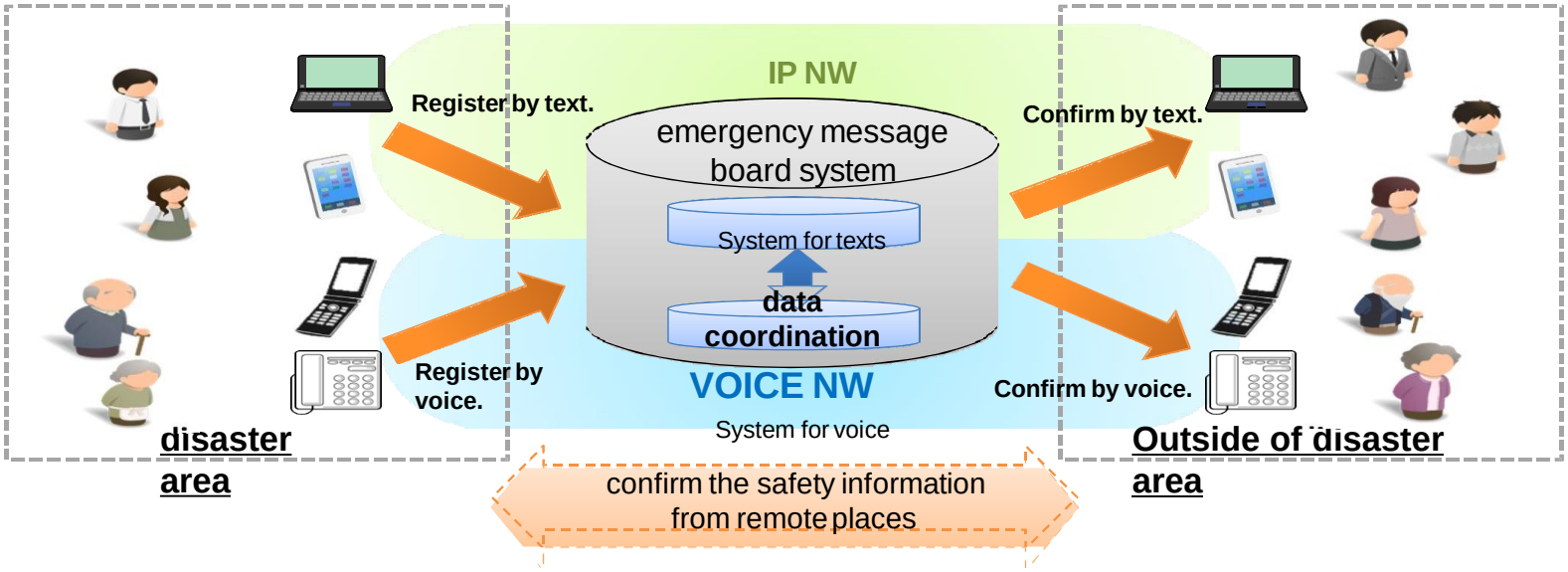
- **One operation triggers delivery through every types of media.**
- **Fast delivery of disaster information leads to quick evacuation**



Innovative R&D by NTT

Case 7: emergency message

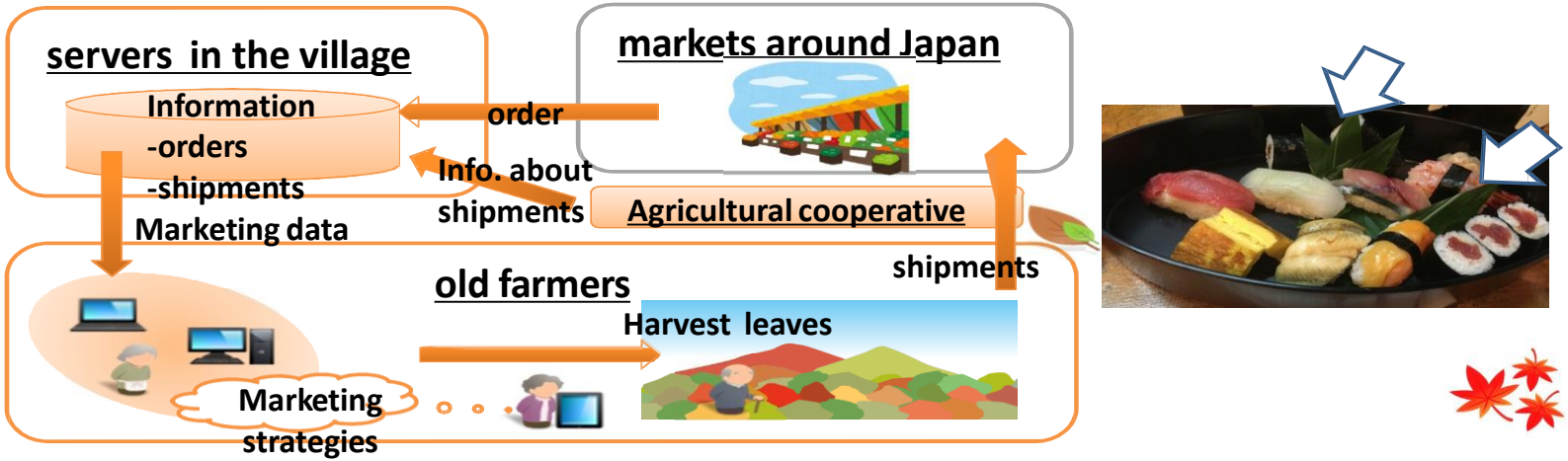
- **Safety confirmation system using voice and text.**
- **In times of disasters, confirm safety of residents quickly.**



Case 8:Green leaves change into 2 mil. USD/y

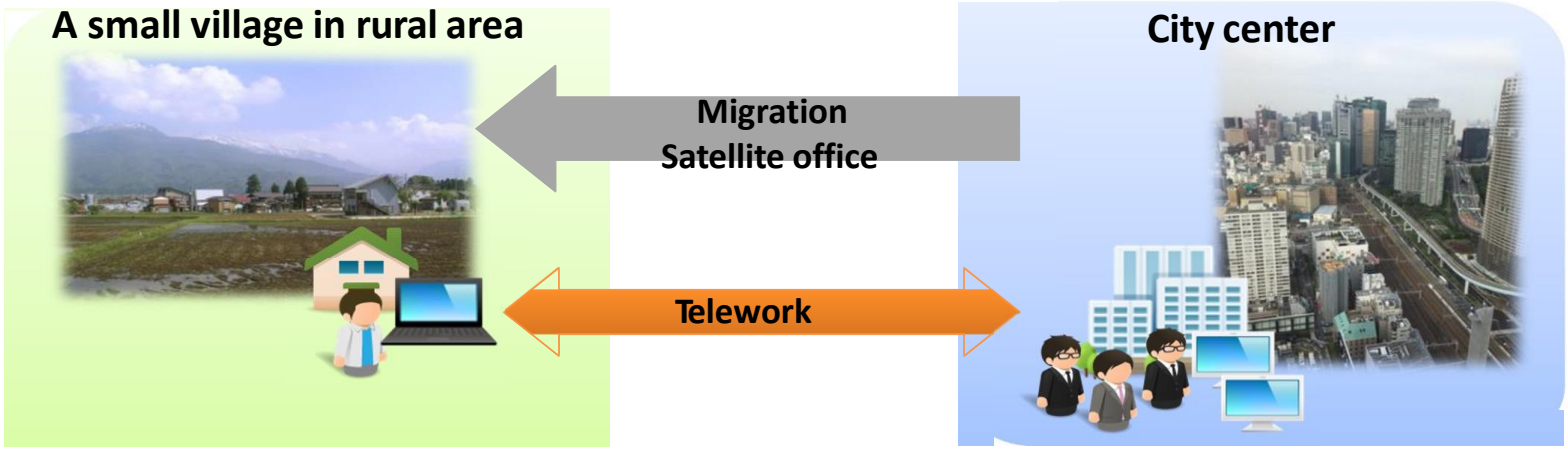
- **Mountainous, depopulated, and aging village**
- **New business created employment among older people**

- Business Model



Case 9: Green valley, artists' and IT startups' nest

- **Mountainous, depopulated, and aging village**
- **FTTH network fully covers the whole village and is connected to the center of the city.**



Insights drawn from experience in Japan

- **FTTH broadband network offer good opportunity for residents in rural area to enrich their quality of life and solutions to problems.**
- **In the beginning, government subsidy for initial investment works well. However, sustainable service requires sharing some of running cost with end users, residents.**
  - **Financial aid of running cost is key.**
- **FTTH broadband network also accelerate business development in rural area.**
  - **Entrepreneurship is key.**

NTT EAST

Innovative R&D by NTT

Immersive Telepresence

NTT Service Evolution Laboratories

NTT

Feeling as if they are experiencing the atmosphere of the sporting venue, wherever they are

Transporting entire sporting space to remote locations in real time

Kirari!

Kirari! – Background and motivation

- On 2020, people will enjoy sharing their excitement by watching sports on TV or large public screen at anywhere, with high picture quality and resolution(4K/8K).
- NTT has been contributing to “sharing the excitement” via R&D for high quality audio/video compression technology

- For more ultra-realistic presence technology,

  “transmit entire sporting space to remote location in real-time”

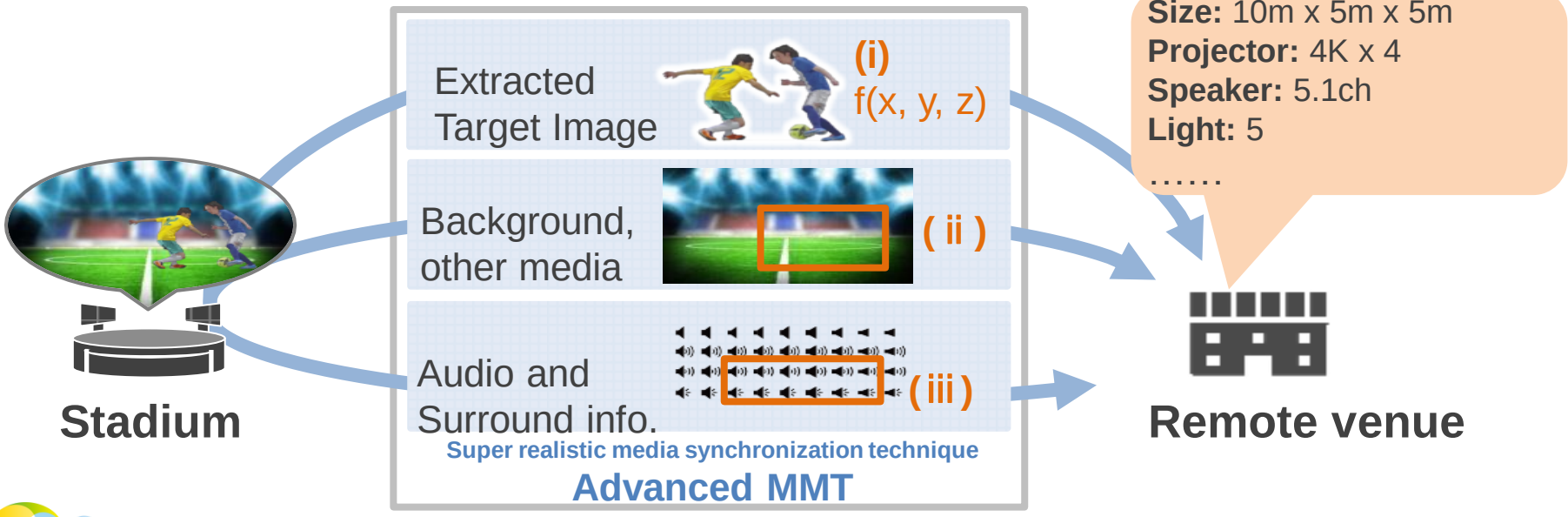
NTT had Started R&D for more realistic sensations.

Started R&D for Immersive Telepresence technology “Kirari!”

Innovative R&D by NTT

Challenges for Live video transmission by Kirari!

- Precision improvement in real time image and target audio extraction technology
- Transmission technology, that enable synchronize extracted audio/video and other media such as large background images, and reproduction (display) technology at remote space are required



Innovative R&D by NTT

Latest R&D achievement in Kirari!

From 2015(*),

NTT started R&D for Immersive telepresence technology “Kirari!!”. (* press released 2015/2/18)

Feburary 2016,

NTT developed a technique that enable “Pesudo-3D” realtime video transmission for individual sport competitition,

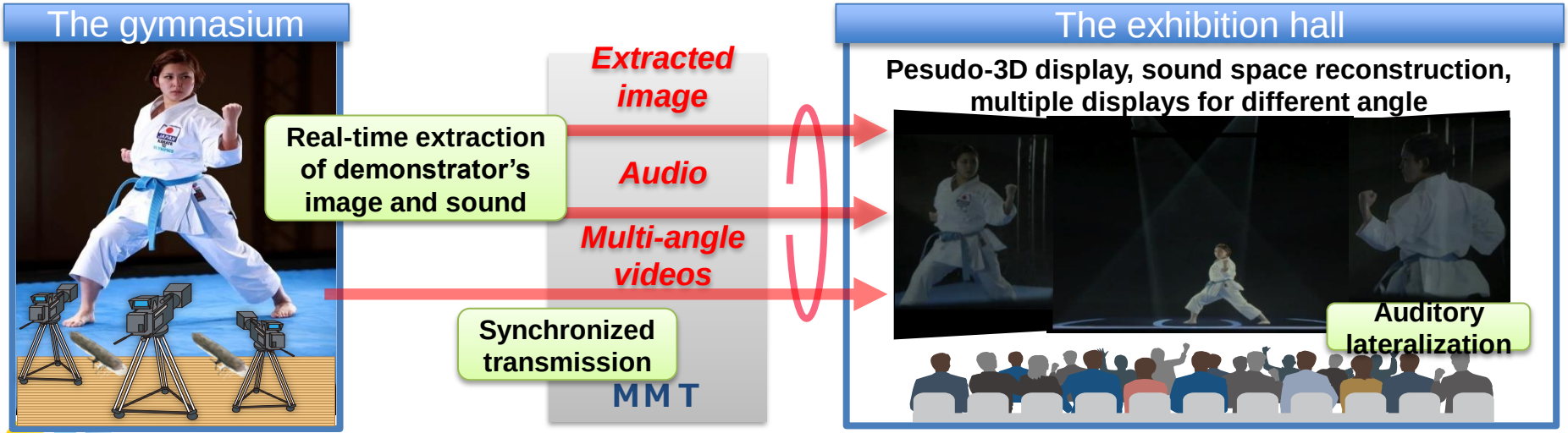
and successfully demonstrated with ultra-realistic user experience. (Press released 2016/2/16)

Innovative R&D by NTT

Live Demonstration at NTT R&D Forum 2016

We have demonstrated real-time aerial video transmission and sound field reconstruction for powerful Karate solo demonstration, in cooperation with Japan Karatedo Federation.

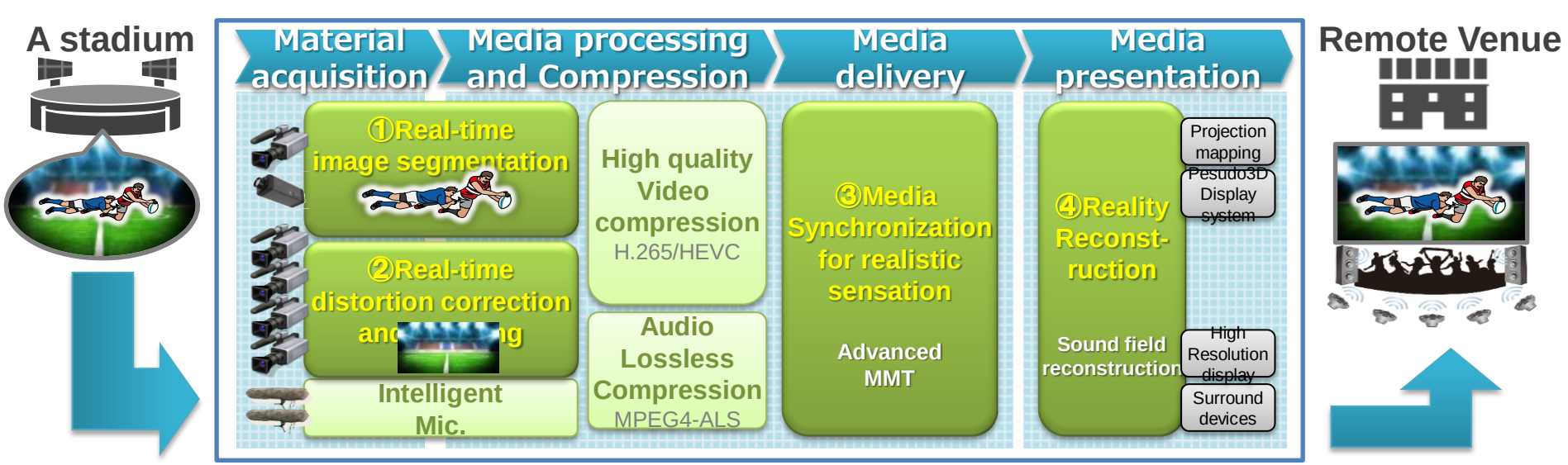
⇒ **Real-time target image/audio extraction, synchronized live transmission and sound image reproduction by virtual speaker are proofed in this demonstration.**



Youtube NTT Official Channel https://www.youtube.com/watch?v=HQfwt0I374E (Japanese version only)

Innovative R&D by NTT

Individual technology and current progress



NTT Developed:

① Real-time image extraction technology **for simple background and for a few target images,**

② Real-time distortion correction and stitching technology **for video captured by multiple 4K cameras,**

③ Synchronized transmission technology for spatial information (such as size of target image, positional relationship, and direction of sounds, etc) , as well as audio/video**,**

④ High-realistic sound field reconstruction technology**, that enables to virtually reconstruct the origin of sound for wide area by using a small number of speakers.**

Innovative R&D by NTT

More use case for Kirari!

NTT

Sports

Sport viewing in public screens

Stage Performance

Traditional stage performance in an event hall

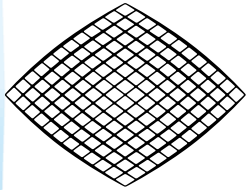
music

Live concert in music hall
Virtual / Real

Speech

Remote lecture, speech

Innovative R&D by NTT

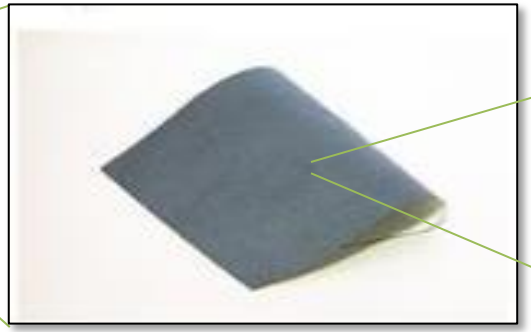


hitoe

Sensing fabric “hitoe”

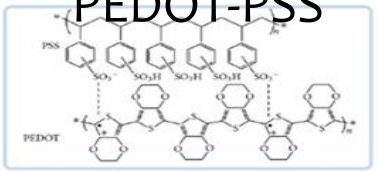
- **“hitoe” is an electro-conductive textile for vital sensing.**
- **Conductive polymer is densely filled into nanofibers.**
- **It has been created by the collaboration of NTT & Toray.**

NTT & TORAY Innovation by Chemistry



hitoe®

PEDOT-PSS



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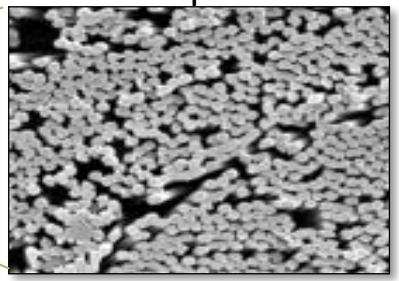
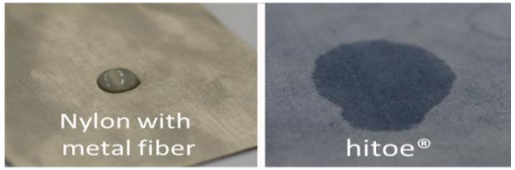


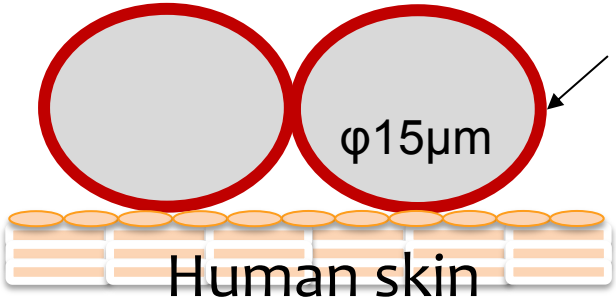
nanofibers

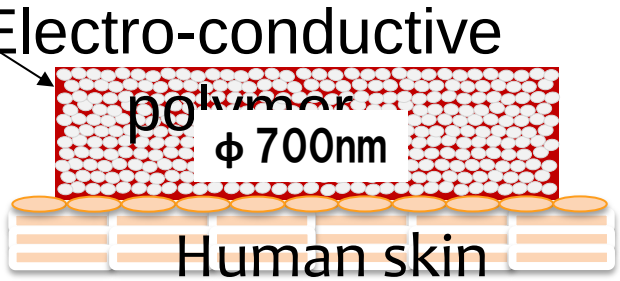
Innovative R&D by NTT

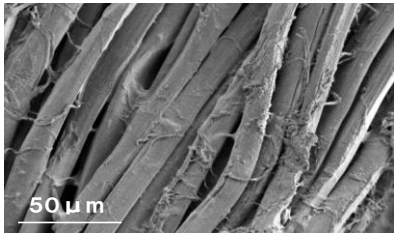
Features of hitoe

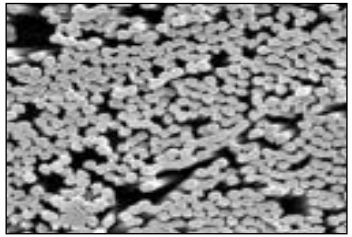
- **<u>Less stimulation to skin</u> by not using metal.**
- **<u>Stable measurement</u> even at sweat condition.**
- **<u>High durability</u> to withstand repeated washing.**







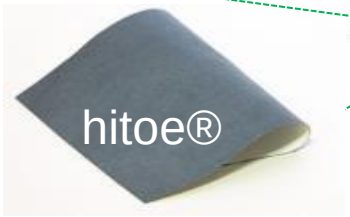


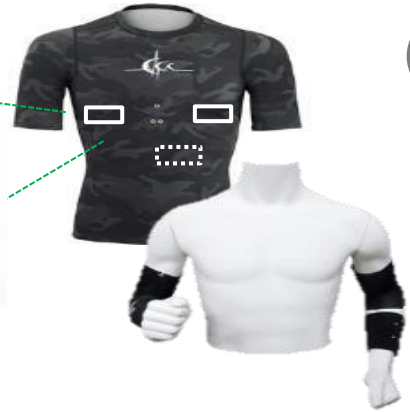


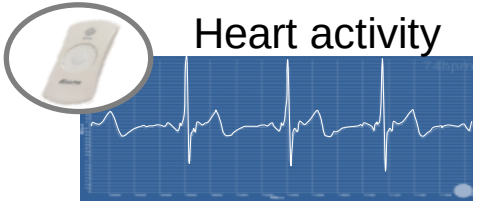
Innovative R&D by NTT

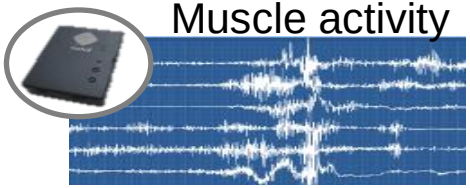
Sensing fabric “hitoe”

- **“hitoe” is integrated in various kinds of wears**
- **Monitoring of heart and muscle activities enables various services**

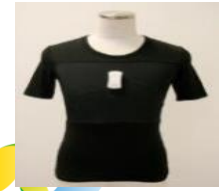








Health care



Sports

Medical

Innovative R&D by NTT

Target fields and Use cases

Innovative R&D by NTT

Worker safety: health condition monitoring

- **Prevent an accident at working sites by monitoring health condition of workers.**

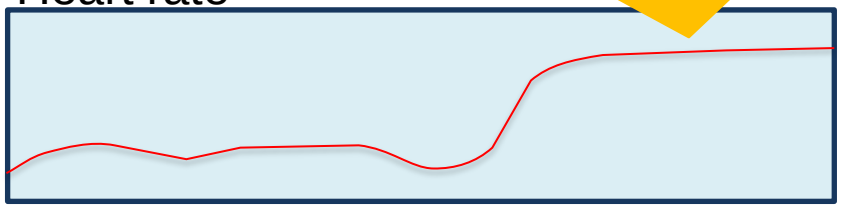
Factory

Construction site

“hitoe” clothes for workers

heart rate is rising.
Possibility of heat stroke.

Heart rate



fall detection

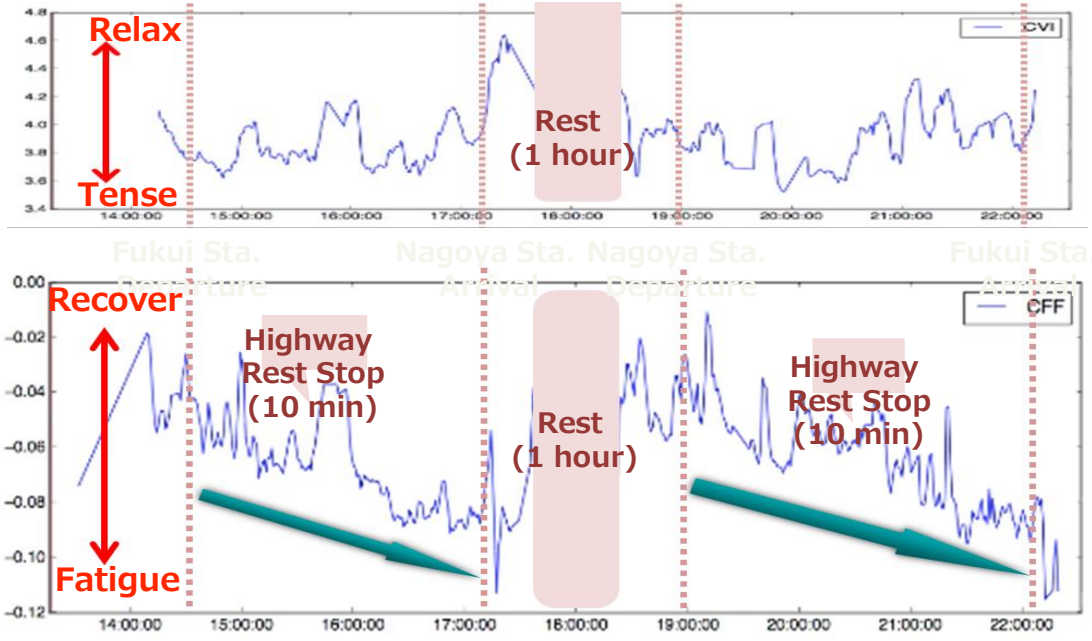
He may be need a help.

Manager can monitor at remote

Innovative R&D by NTT

Worker safety: Transportation management

Nervousness and mental fatigue is estimated from heart rate variability to support fleet operation.



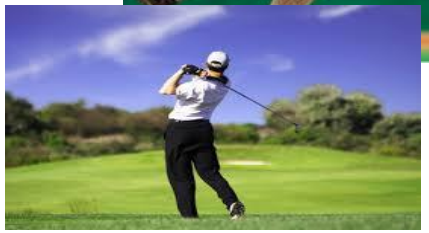
Innovative R&D by NTT

Sports: Visualization of sports training

- **“hitoe” can visualize training effect utilizing heart rate and electromyogram.**
- **Comparing usage of muscle of top-player can help athlete to do higher training.**

Training with “hitoe”

“hitoe” sports wear
(heart rate)

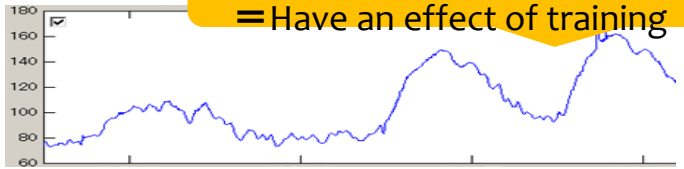


Prototype “hitoe” sports supporter
(electromyogram)

Visualization of sports training

Heart rate

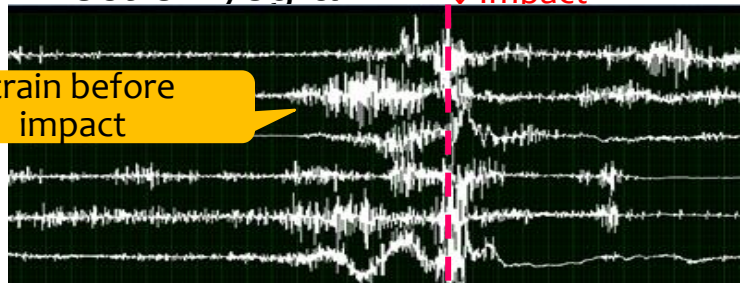
A rise in heart rate is slower than last month
＝Have an effect of training



Electromyogram

↓ Impact

Strain before impact

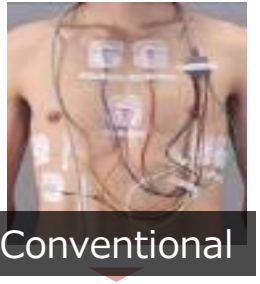


Innovative R&D by NTT

Medical : Monitoring of heart disease patient

- **“hitoe” can easily acquire ECG for a long term.**
- **The system will warn if abnormal ECG data are found.**

In-home patient



Conventional

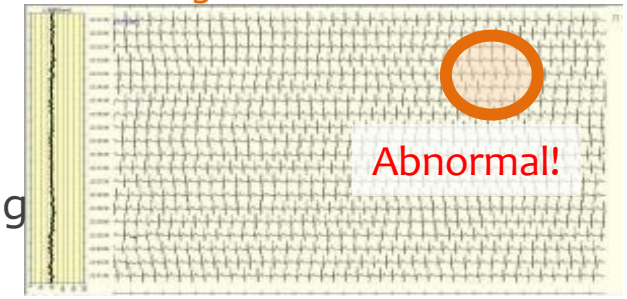
change

“hitoe” medical clothes

Long-term ECG monitoring

Doctor in hospital

Warning! Alarm!



Innovative R&D by NTT

Spread the usage with Collaboration Partner

NTT

Training support service

runtastic for docomo

For Sports

Sportswear

GOLDWIN

Rehabilitation support (Demonstration)

For Health Care

Fujita Academy Incorporated Educational Institution
FUJITA HEALTH UNIVERSITY

Medical equipment registration (in Japan)

For Medical

Airline PJ : Can babies be stopped crying!? (Demonstration)

For Baby

hitoe

Worker support service

TORAY

For Worker

OBAYASHI

Worker safety management system Envital®

SAP

NTT Communications

Safe driving support

For Driver

Drowsiness detection

docomo

For Extreme

SUPER FORMULA/IndyCar Series Biometric data measurement (Demonstration)

docomo

NTT DATA

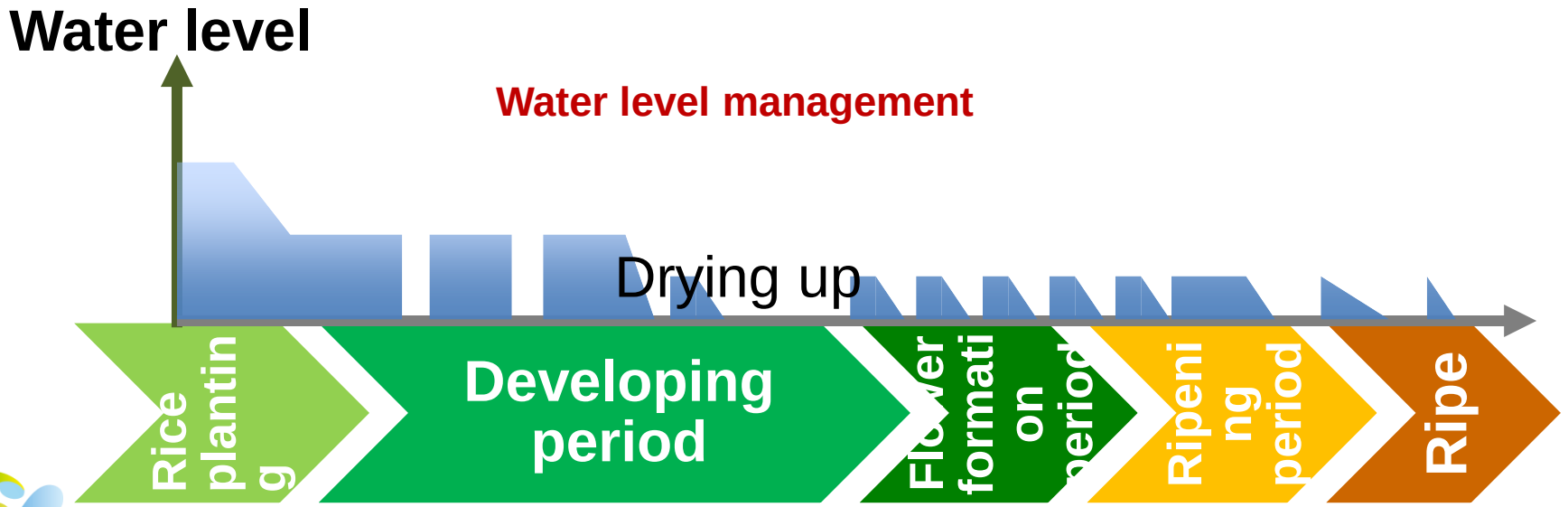
Innovative R&D by NTT

Introduce of IoT solutions and related promotion for agriculture by NTT Docomo

Expected benefits of Paddy Watch

About35%reduction of labor for inspecting paddy

Improved rice quality & taste through analysis of sensor-collected data



Innovative R&D by NTT

Collaboration with Niigata city

Paddy Watch trialed in Niigata area
— One of Japan's major rice-producing regions —

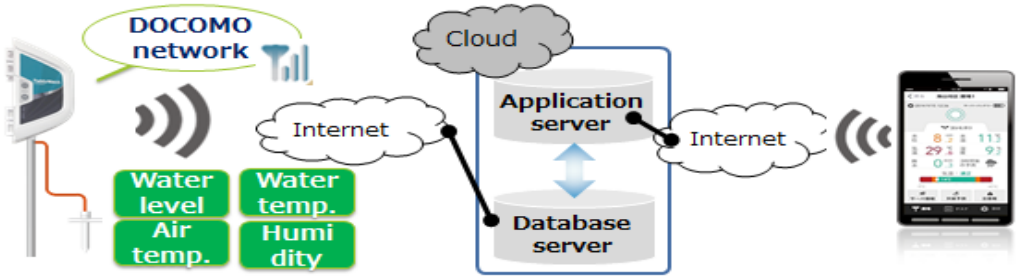
Niigata is designated as a strategic district for developing more competitive agro-business to help stimulate rural Japan.

460 hectares of rice paddies and
300 sensors installed in paddies.

Initiative #1: “PaddyWatch”

- Monitoring of rice fields
- Works without a power supply (battery)
- docomo×Vegetalia×Akita Prefecture×Kubota

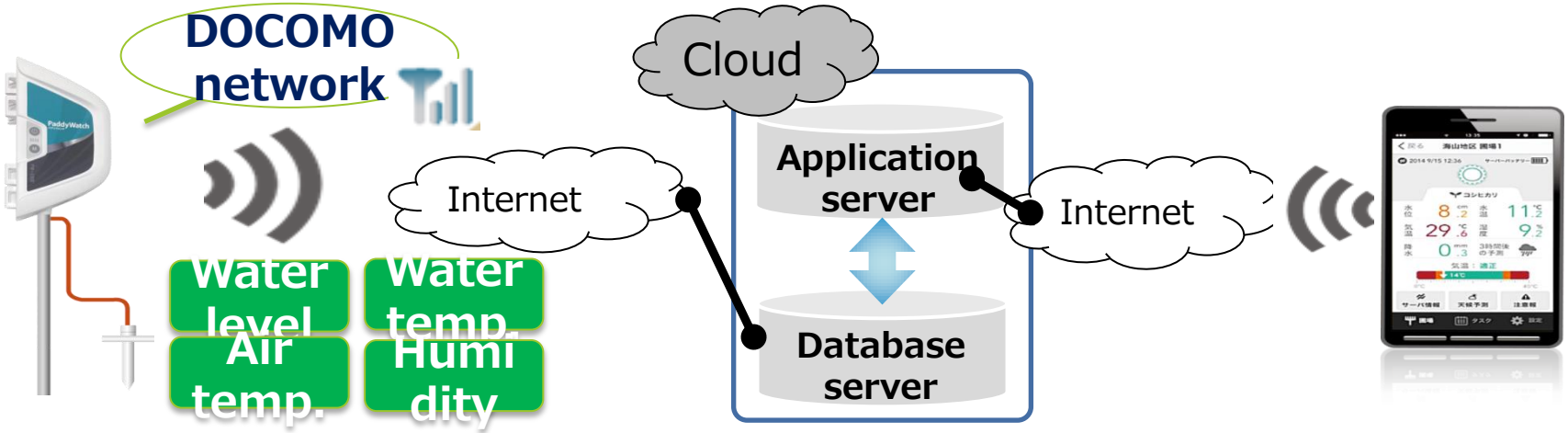
<System image>



<Meeting with the representatives from nine regions throughout Japan>

System for rice-paddy water management

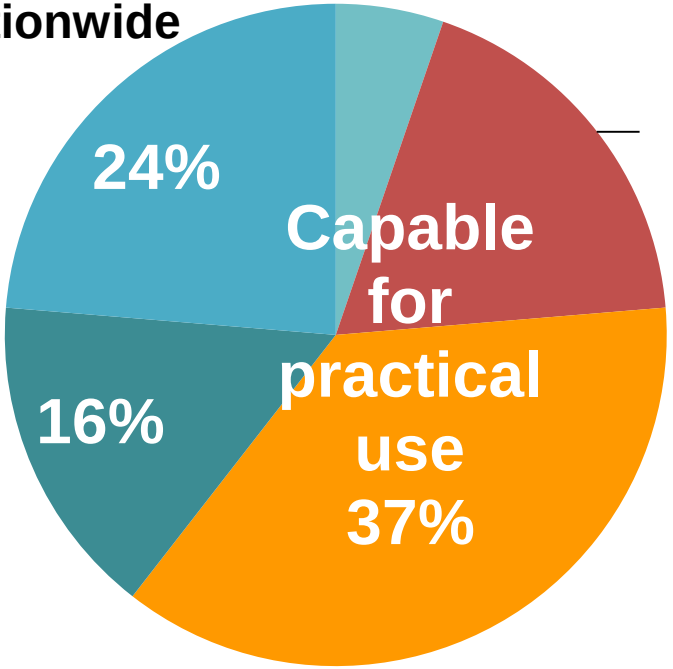
Remote monitoring via sensors
Sensors in paddies collect data on water level, atertemperature, etc.
to enable anytime, anywhere monitoring



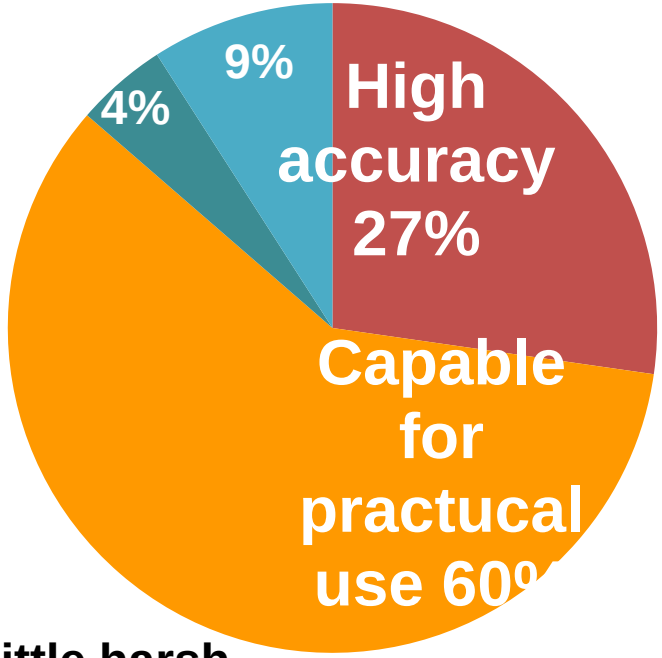
Innovative R&D by NTT

Measurement Accuracy

Technology dissemination organizations in 36 prefectures nationwide



22 Agriculture corporations and private farmers in Niigata City



Evaluation of technical experts is a little harsh
Satisfaction of producers is high

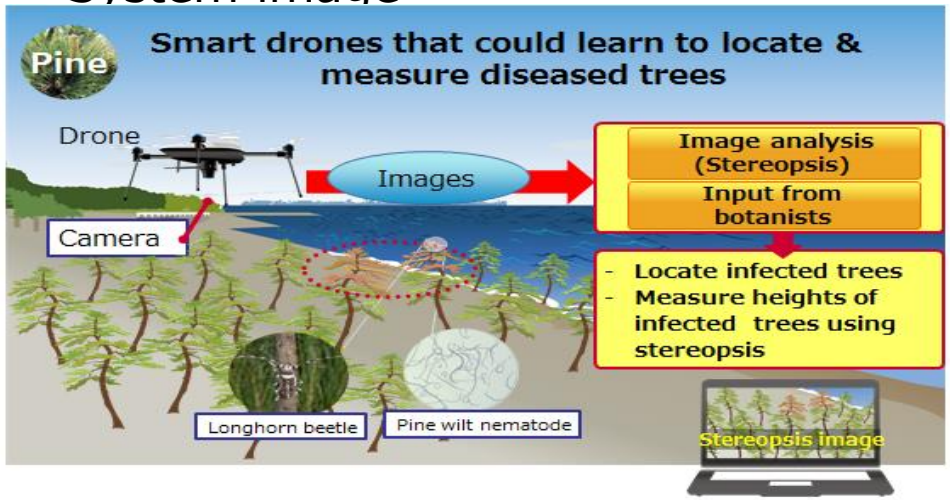
Innovative R&D by NTT

Initiative #2: Drones

- **Discovers and locates pine weevils***
- **Measures material volume**
- **docomo×Nigata-city×Aerosense**

*Destructive pest insects which attack and destroy pine trees

<System image>



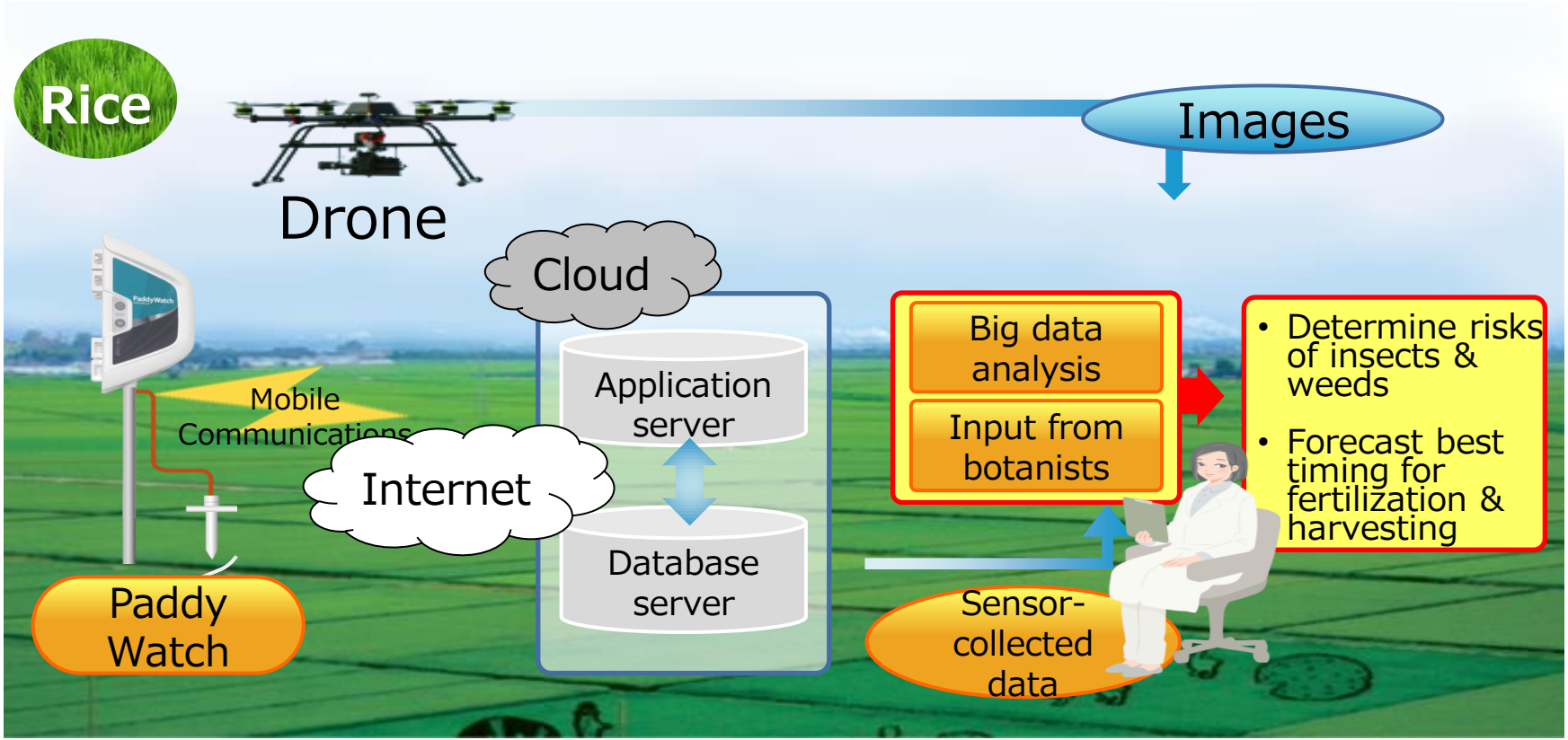
<Expected benefits>

Pine

Locate infected trees ⇒ Quick, precise removal
Calculate height of infected trees ⇒ Less costly logging

More efficient countermeasures for pine wilt disease

Sensor data+drone-captured images



More economical rice farming

Determine risks of insects & weeds

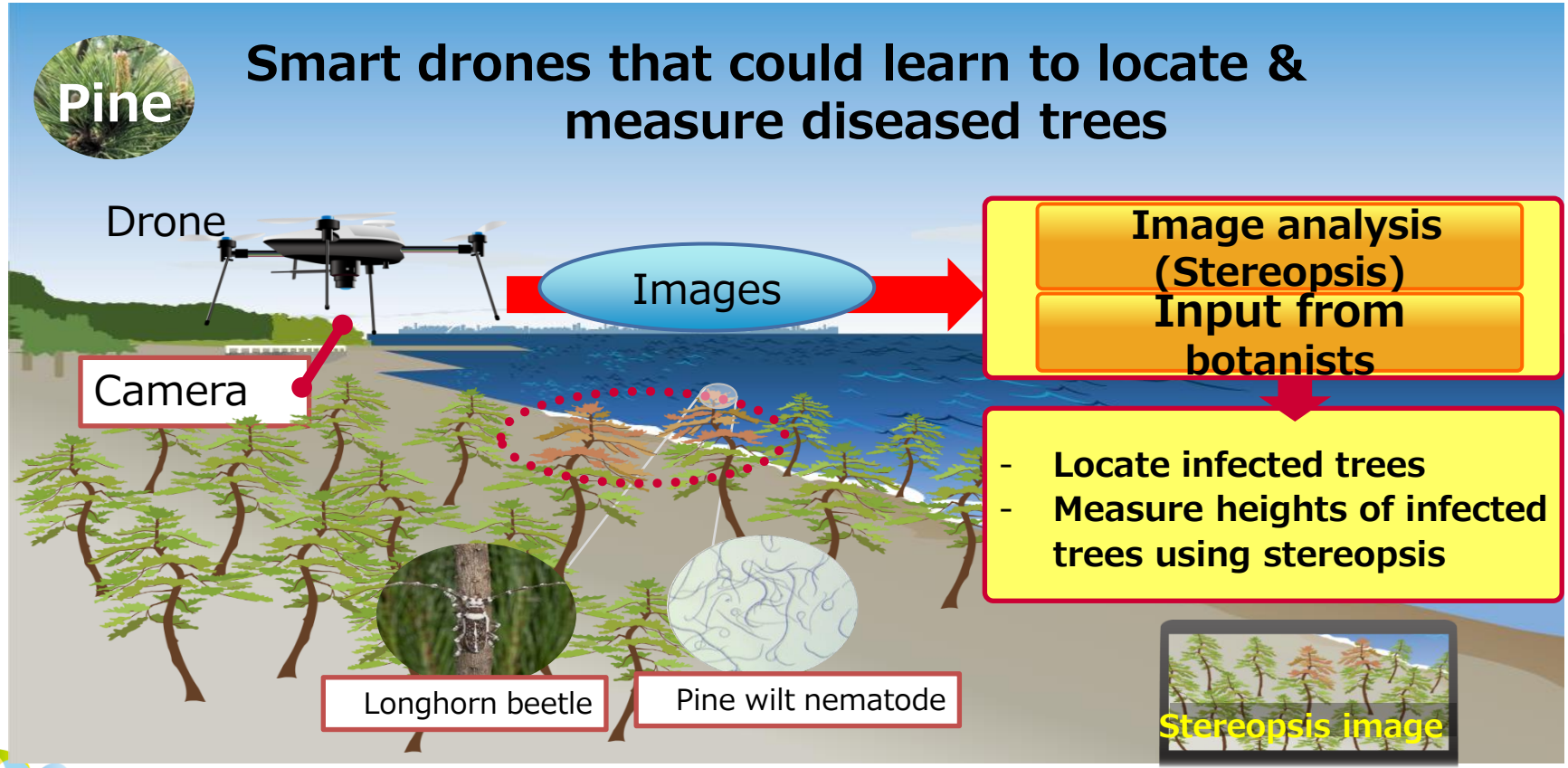
Forecast best timing for fertilization & harvesting

Higher quality, bigger yields

and lower costs

Innovative R&D by NTT

Remote sensing with drones



Innovative R&D by NTT

Expected benefits

Locate infected trees ⇒ Quick, precise removal

Calculate height of infected trees ⇒ Less costly logging

More efficient countermeasures

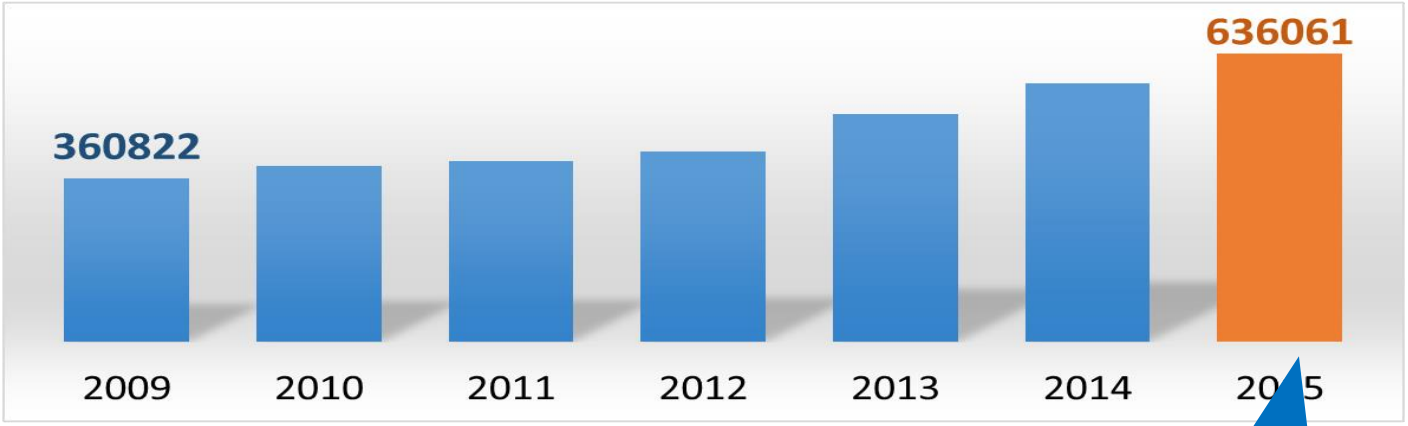
for pine wilt disease

Innovative R&D by NTT

Activities in the field of cattle raising:

Detection of childbirth sign of the cow

The calf price is soaring



Wagyu, the Japanese cattle, is very vulnerable

- Many delivery accidents (Accident rate: 5%)
- Often the actual delivery date shifts one week from the expected date

The number of those who abandon the agriculture is increasing

Initiative #3: “Mobile Gyu-On-kei*”

*Calving Monitor

- **Monitoring of the delivery timing of the mother cow**
- **Tied up with Japan Agricultural Cooperatives (JA)**
- **docomo × JA × Remote, Inc.**

<System image>

Using a temperature sensor

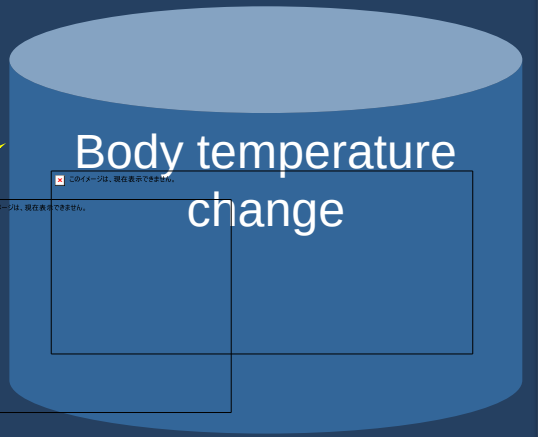
<Temperature change graph>

Mobile Gyu-On-Kei

(Cow Temperature Measurement with Benefit)

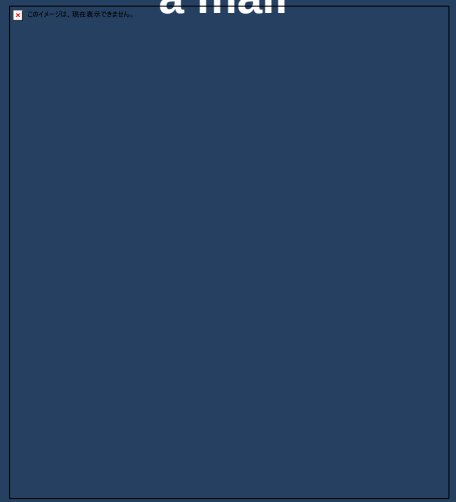
To measure the deep part reaction in every 5 second

To detect the 24 hours before delivery from a slight change in the body temperature



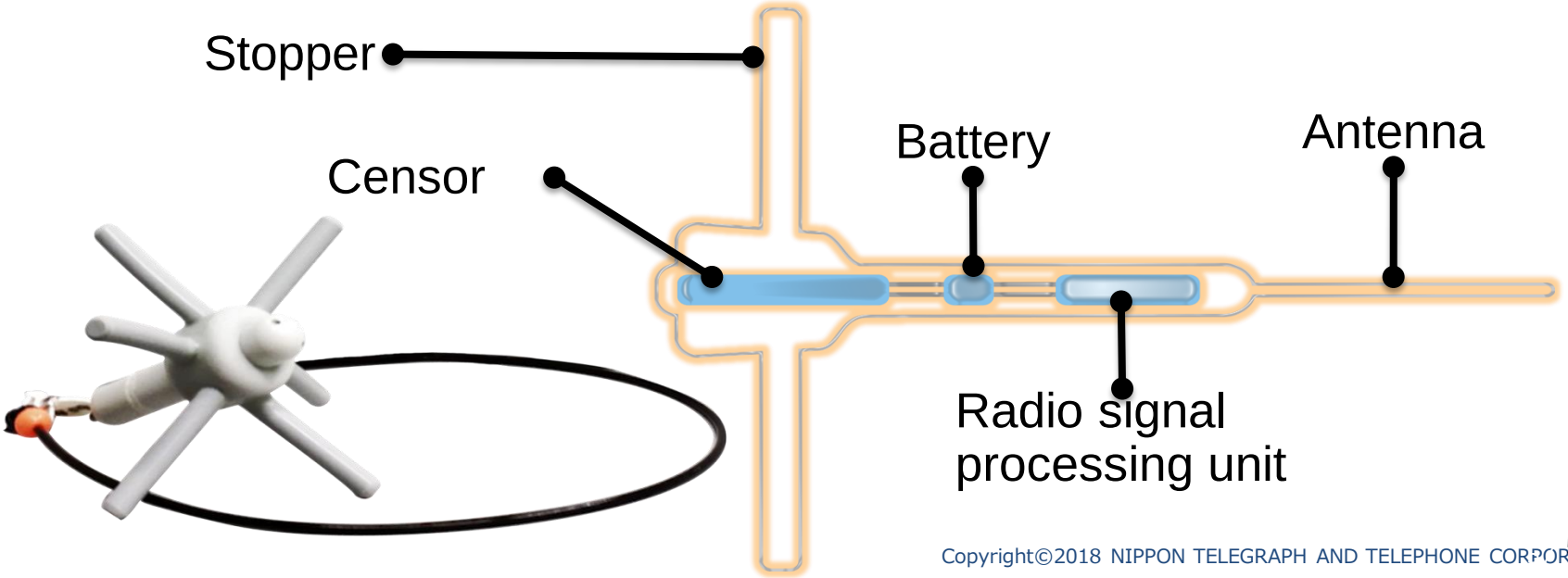
Notice by mail

A typical sample of a mail



It is a simple censor but various knowledge from the field is condensed into it

Stopper	• Preventing probable dropping at the first water breaking
Battery	• A battery for 5 years (no need to change)
Antenna	• Winding the antenna to the tail



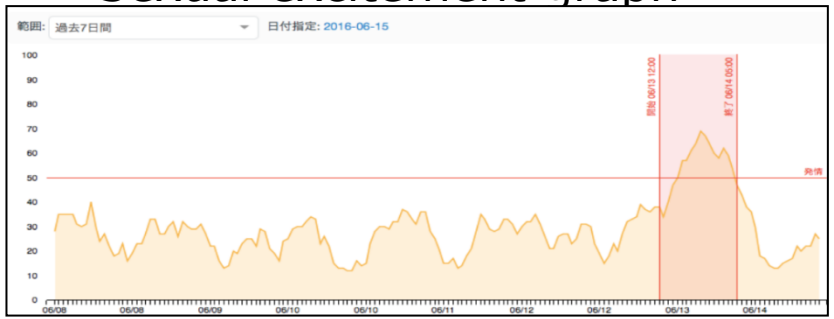
Initiative #4: “Farmnote Color”

- Monitors the sexual excitement of female cows
- Commercially distributed by the JA group
- docomo ×JA group × Farmnote

<Sensor image>

Using a motion sensor

<Sexual excitement graph>



Estrus Level, Activity Level

To support the wagyu production nationwide

Demonstration test for evaluating the performance
(by National Agriculture and Food Research Organization)

Number of delivery: 167	Notice on 24 hours before: 142 (Notice in the night: 99)
	Notice at the time of water breaking: 25

Sales Figure

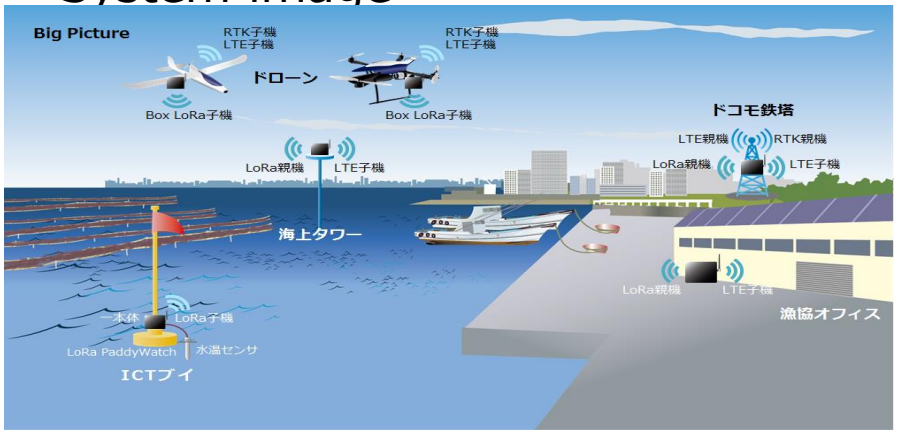
About 900 sets

About JPY 400,000,000
(From June 2014 to MARCH 2017)

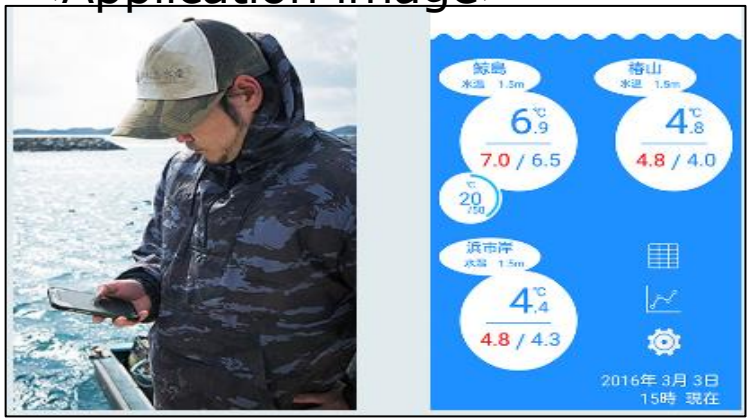
Initiative #5: ICT Buoys & Drones

- Understands the environment for seaweed and oyster farming
- Measures sea water temperature and salinity
- docomo×Saga-Prefecture×Optim ×fishermen's association

<System image>



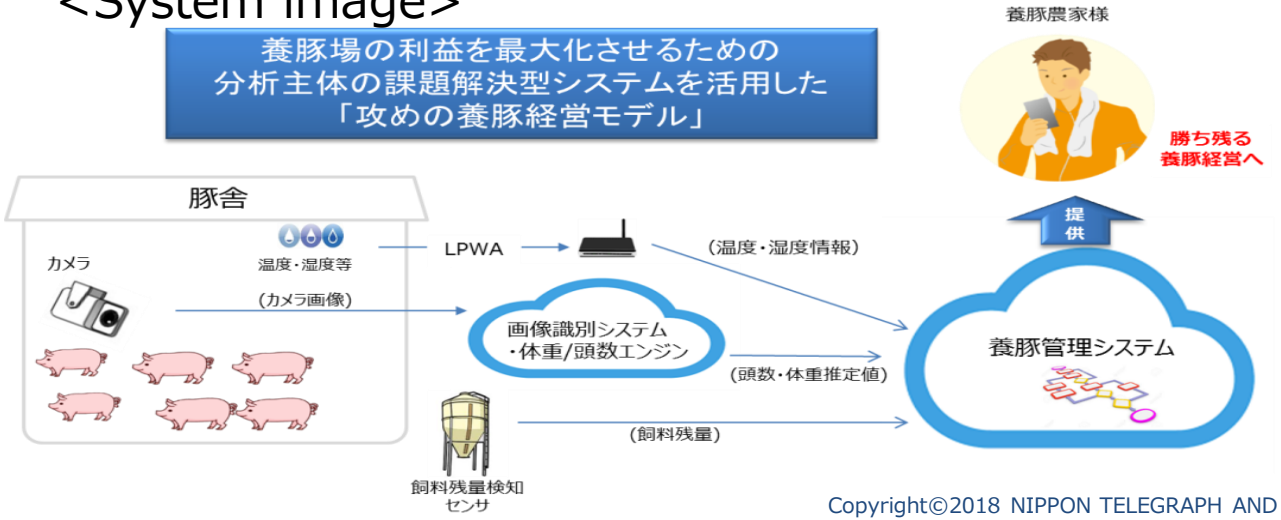
<Application image>



Initiative #6: Hog Raising（Test）

- Measures the weight of a pig by using image recognition
- Reduces production control cost
- docomo×Data-Horizon×Canon×Hirata ranch

<System image>



Next Value Partner

for

Transformation

of Business models and Lifestyle

by

Trusted Solutions

of Global, Secure, End-to-end,
and Full-line ICT services