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shaping tomorrow with you

ICT paradigm shift and communication technology trends

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Fellow

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Contents

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Condolences

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NTT courtesy

Networks are a social infrastructure

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Communication services are necessary in the midst of a disaster or emergency

(Expectations)

1. To provide convenient and comfortable services in normal situations
2. To provide basic communication services even in disaster situations
3. Cloud type secure information storage and management to maintain basic services even in disaster situations

(Reality)

Progress in telecommunication technologies and the increased variety of access methods will naturally realize expectation 1 and 3, but special actions are needed to realize expectation 2.

New paradigm “Human-Centric Intelligent Society” supports these expectations.

ICT paradigm shift

- Toward a Human-Centric Intelligent Society-

ICT paradigm shift

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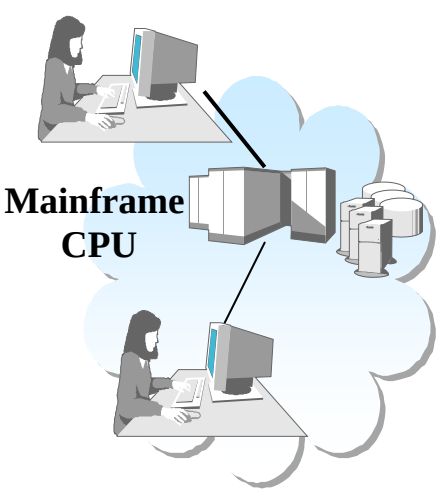
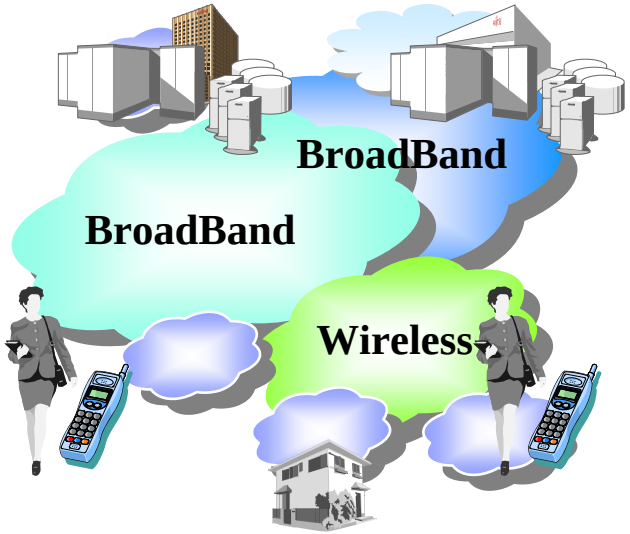
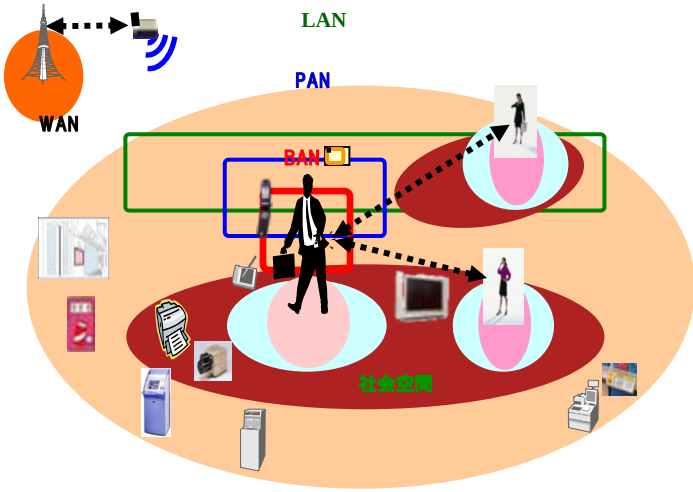
Toward a human centric system

Computer centric → Network centric → Human centric







For experts → For everyone → Dependable

Data processing → Information collection → Knowledge creation

What is human centric?

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Human centric system:

- User is supported in an unconscious manner
- Service is adapted to user's environment
- User can connect to every thing

Dependable system:

- System operates on a non-stop basis
- System provides high security
- System serves the user comfortably
- System supports sustainable growth

Knowledge creation

- Create useful knowledge from abundant information

Human centric system means more

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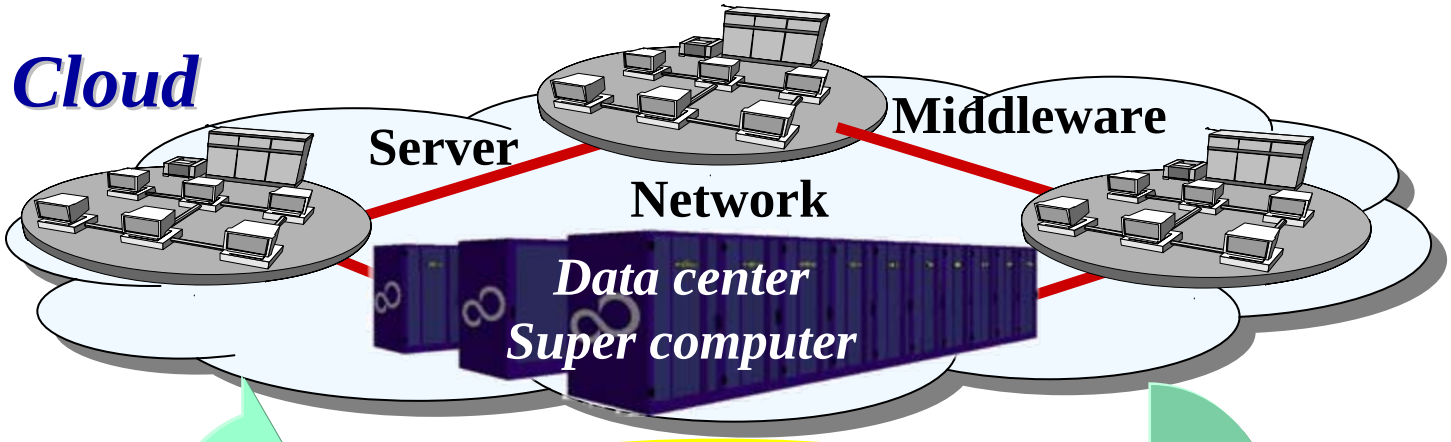
- **Care for people, with ICT to support problem solving in our lives**
- **Changes in ICT provision, to a more user friendly, fun and enjoyable experience**

Creating a human centric intelligent society

New value creation through a human centric system



Human centric computing

- Real time context capturing
- Autonomous service provision

Data collection

Dynamic service

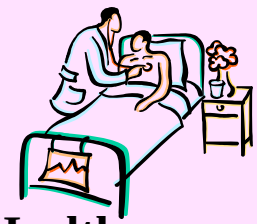
Real world

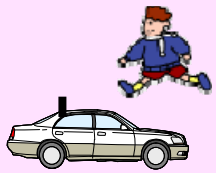
Mobile terminals

Sensors


Agriculture


Power management


Health care


ITS


Office

Social concerns

- Aging society, healthcare
- Environmental issues
- Food (Production, Safety)
- Safe and secure society
- Efficient investment & operation

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Healthcare service using mobile phone and cloud

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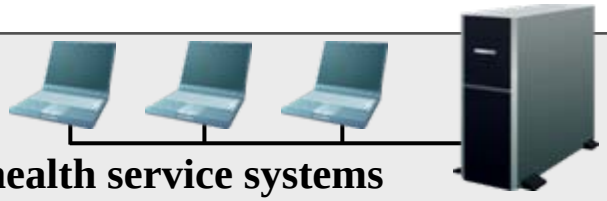
Metabolic diagnostic system using mobile phone e-mail

Healthcare insurance staff



Existing health service systems

Sends approval to user for service use

Referral

Report

User

Dietary log

Exercise log

Dietary/Exercise Report

Insurance system for customized support

Effective advice

Nurse/Dietician

Healthcare center

Telecommuting (Home office)

Dietary diagnostic function

Energy management solution

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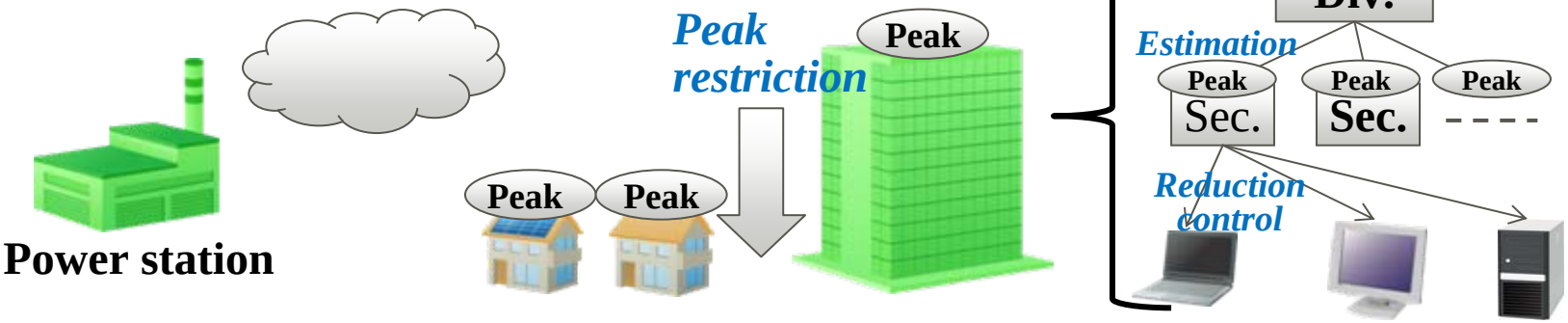
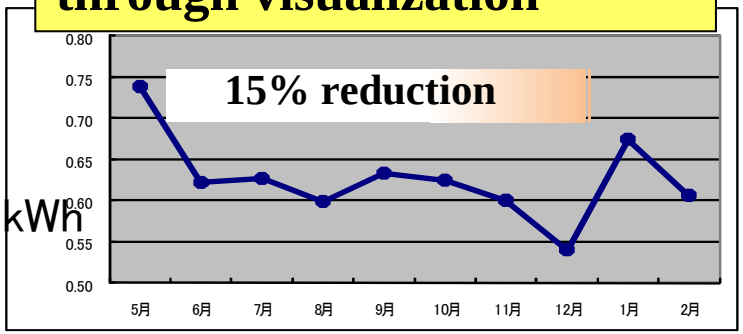
Demand response system

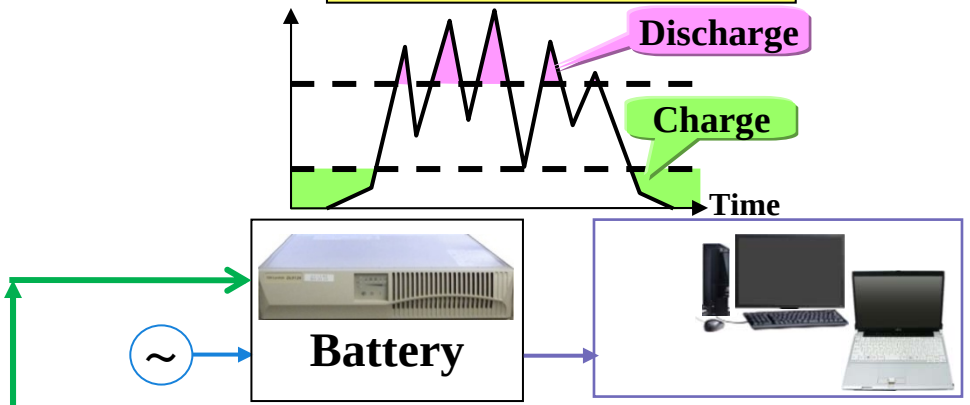


Reduction in demand through visualization

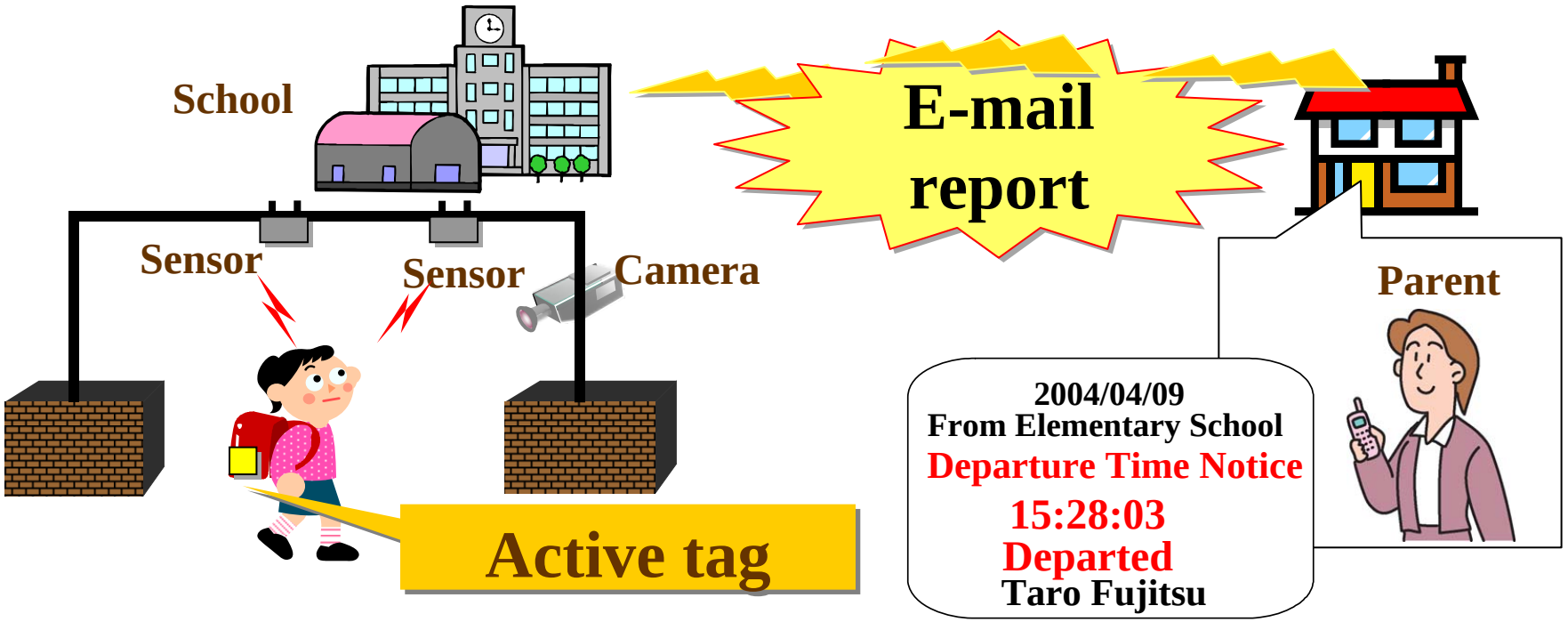


Smart power outlet

Peak suppression



Managing school attendance records



Active tags used for 720 children
Read rate= 99.99%
Teachers don't have to search for students
Parents receive real-time school attendance information

Enablers

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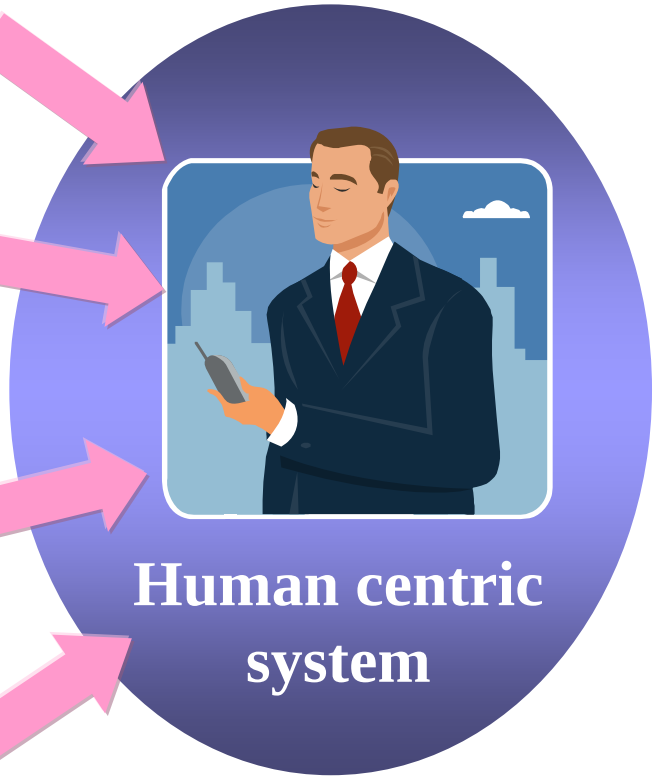
Cloud computing

Wireless network
LTE, Ad-Hoc network

Mobile terminal (Smart phone)

Knowledge management



Service/Resource on demand

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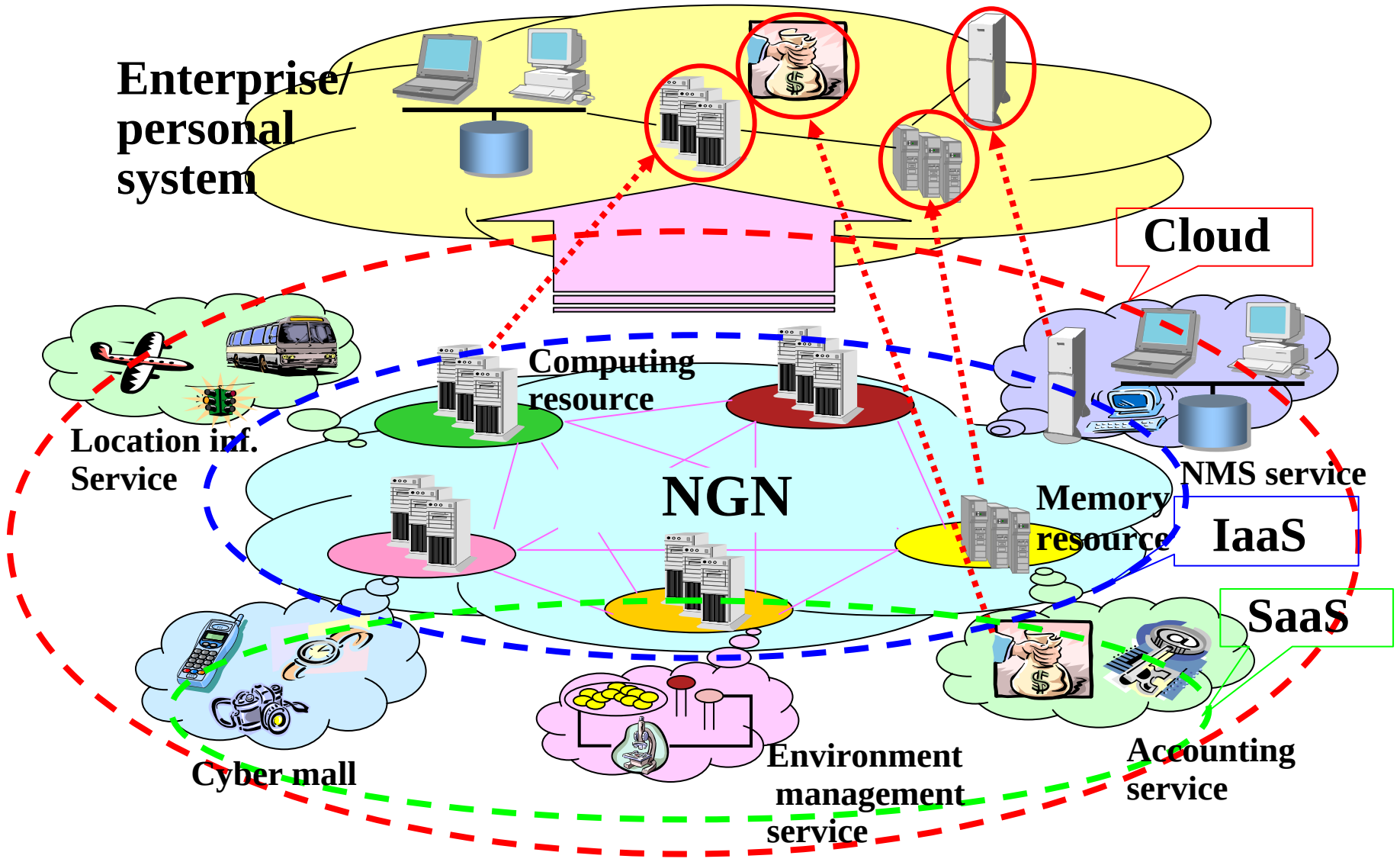

Evolution of cloud computing

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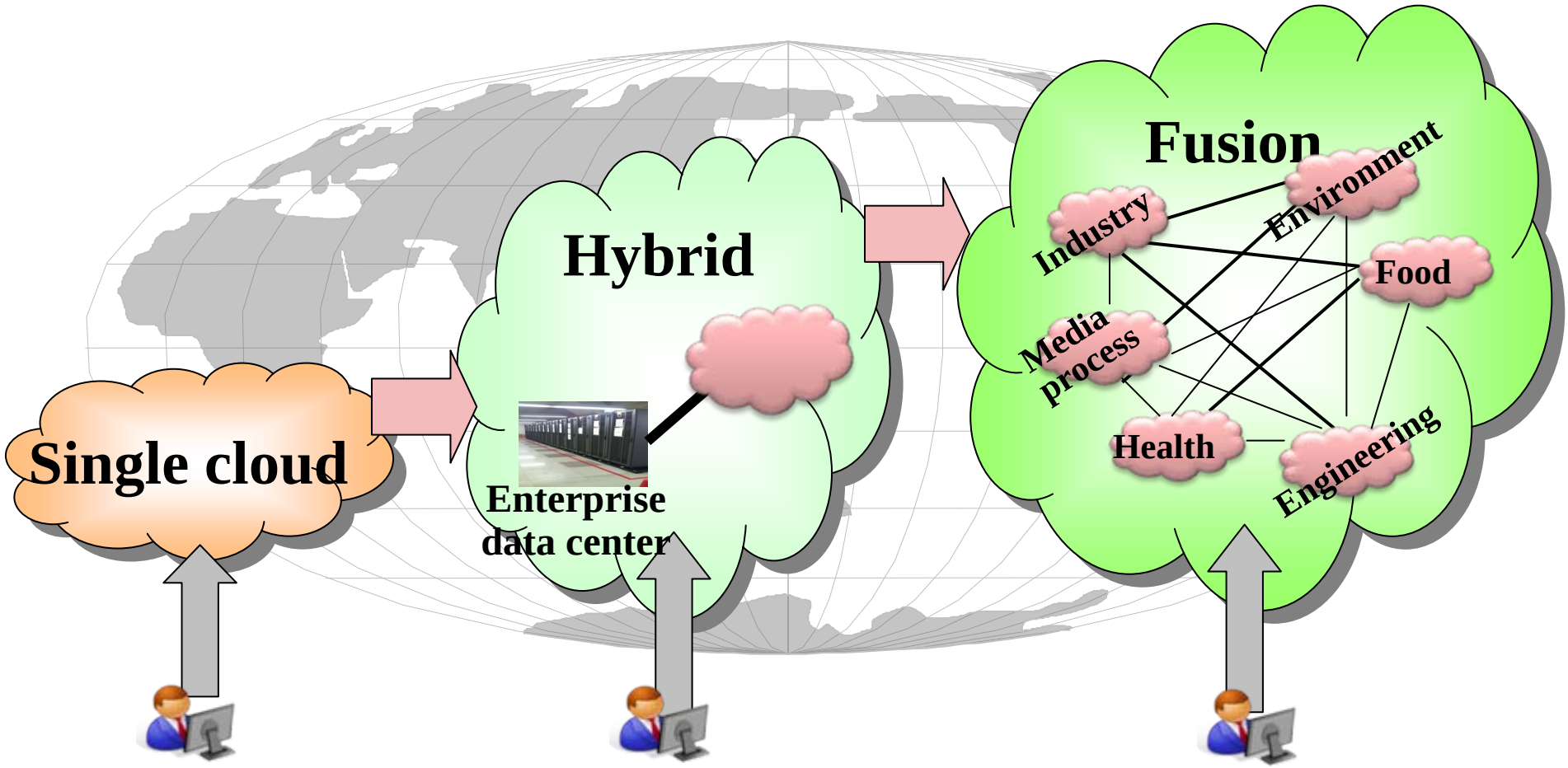
From single cloud to hybrid, to cloud fusion



Next generation super computer

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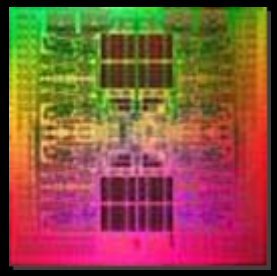
Processor



SPARC64™ VIIIfx

- 8 processor cores, Cash memory, Memory Control Unit on 1 chip
- High performance with low power consumption

System board

High efficiency cooling

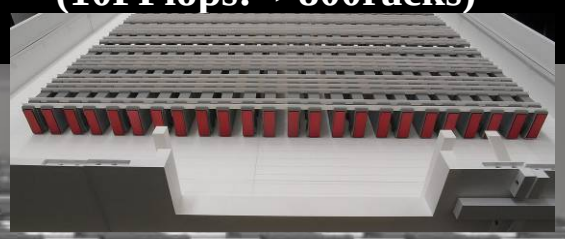
- Water cooling

Rack

High density mounting

- About 100 processors in a rack

(10PFlops: >800racks)



System

- 10PFlops
- More than 80,000 processors

System image

Enablers

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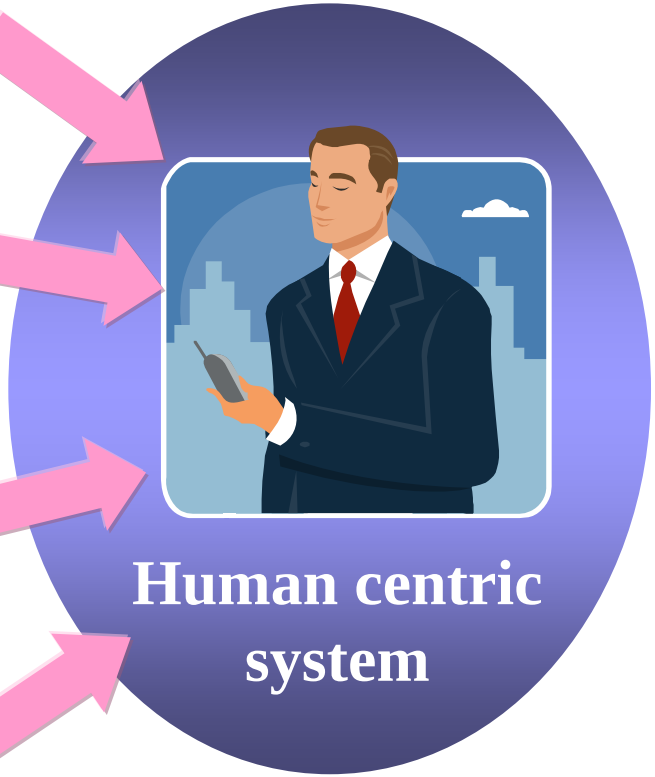
Cloud computing

Wireless network
LTE, Ad-Hoc network

Mobile terminal
(Smart phone)

Knowledge management



LTE field experiment

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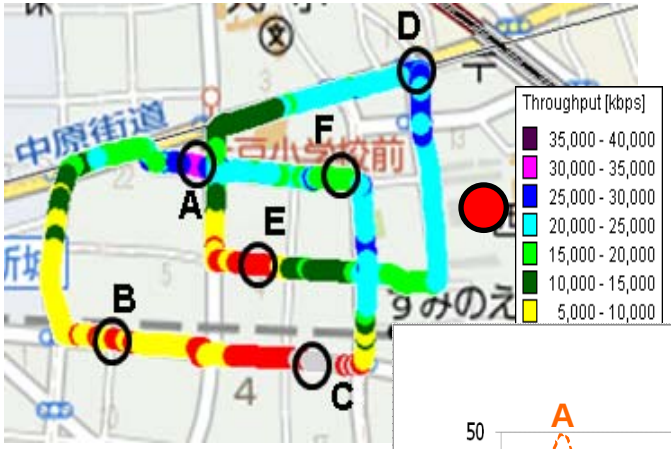
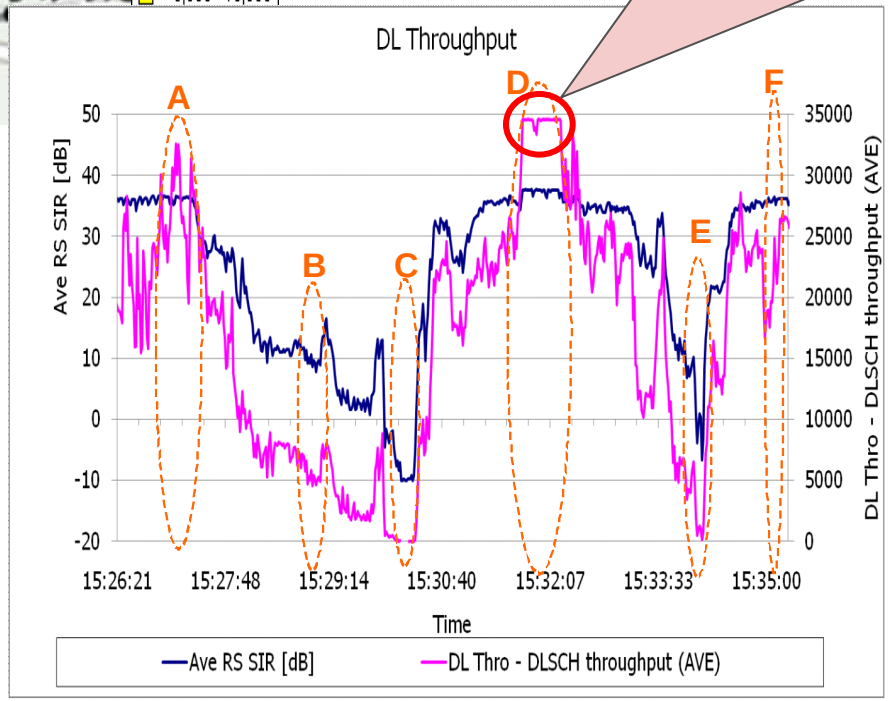
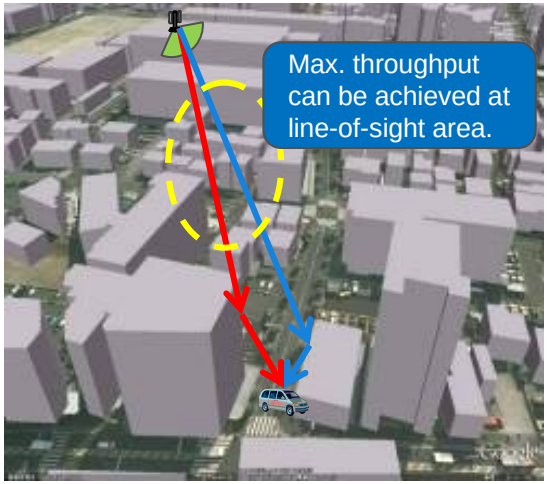
Throughput maximization

- MIMO performance optimization under multi cells



Maximum throughput: 34.6Mbps (2x2 MIMO, 5MHz bandwidth)





Smart meter system using ad-hoc network

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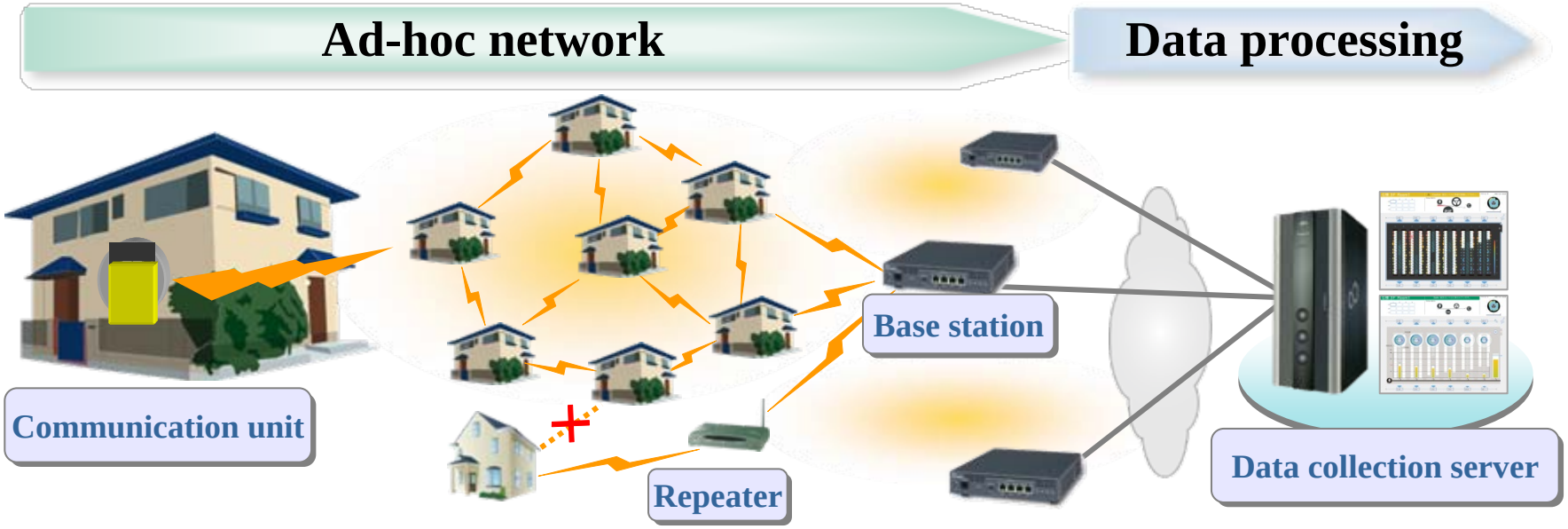
WisReed: Fujitsu's Ad-hoc network technology

- **High scalability:** Accommodates up to 1,000 nodes by one gateway. Further scalable by increasing gateways.
- **High speed restoration:** Autonomic restoration by each node.
- **Applicable to both fixed and wireless**



UHF RFID Technologies

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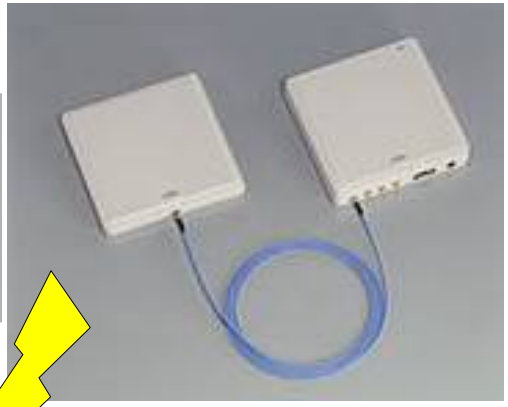
Reader/Writers

Long range type

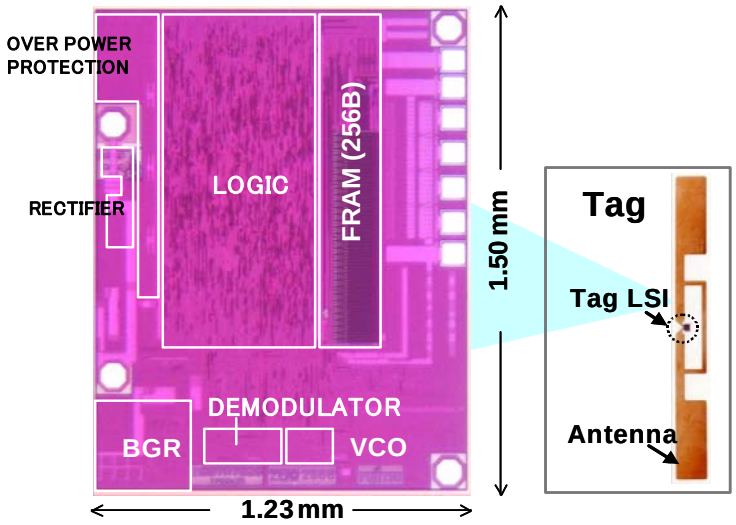


Handheld terminal

FRAM based tag LSI

Low power, High speed memory access

64kByte memory

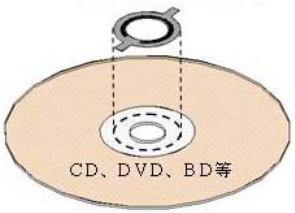


Sample picture (256B Tag LSI)

Tags corresponding to applications

For stacked documents

CD/DVD



For metal surface

Enablers

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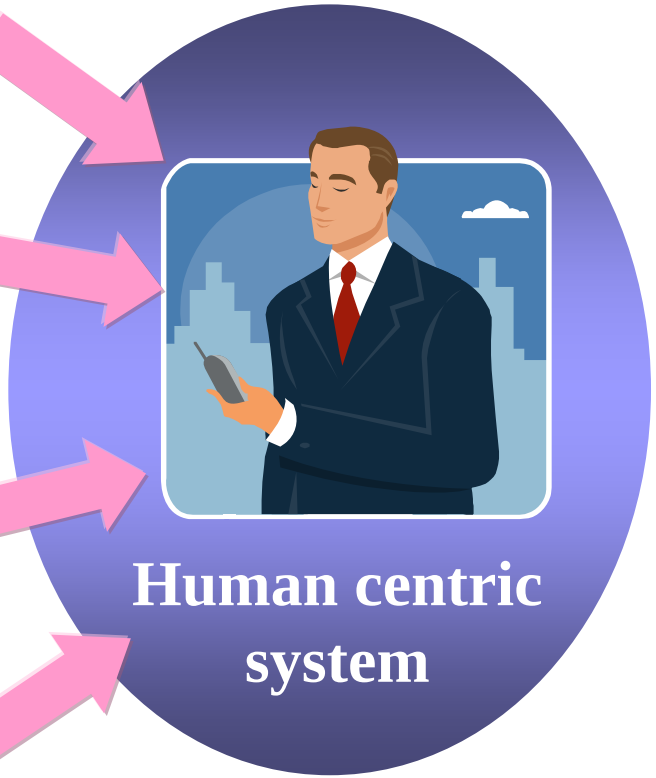
Cloud computing

Wireless network
LTE, Ad-Hoc network

Mobile terminal (Smart phone)

Knowledge management



Mobile terminal as a personal gateway

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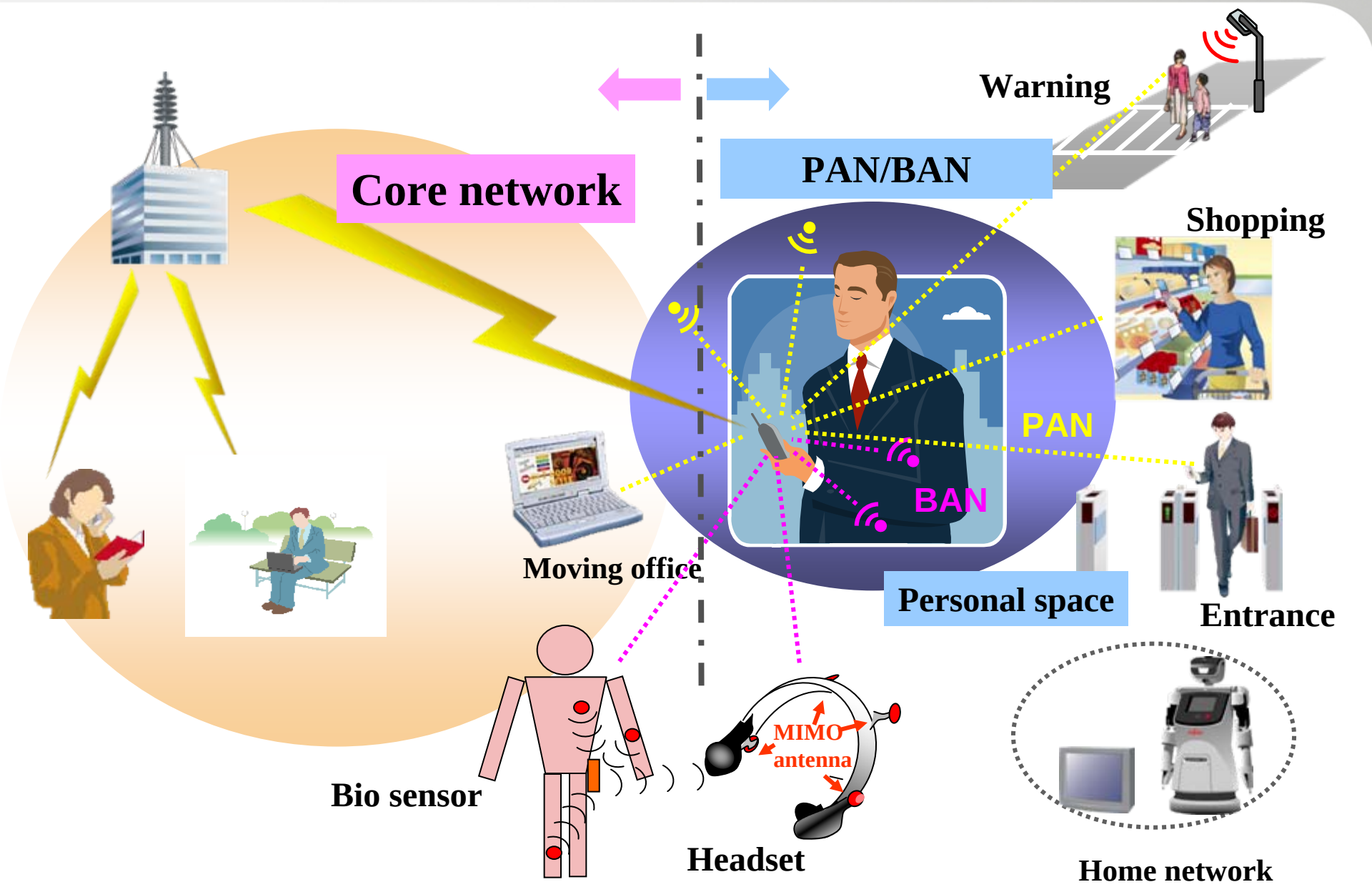

Motion sensing using mobile phone

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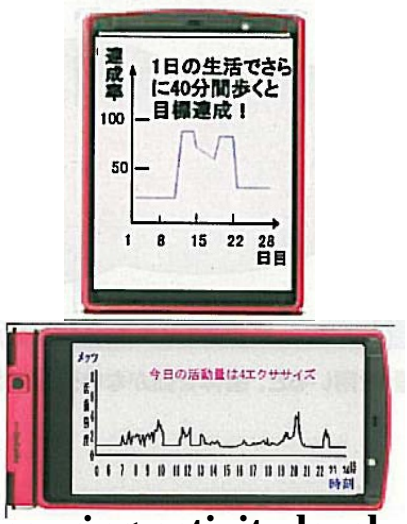
- **Detecting human motion through acceleration sensors embedded in mobile phones**
  - **Pedometers and other devices for measuring activity level (built into all Fujitsu mobile phones except those for children)**
  - **Estimates type of physical activity (technologies to detect walking, running, jumping, bowing, etc.)**

Golf swing diagnostic application, demonstration events held in Tokyo

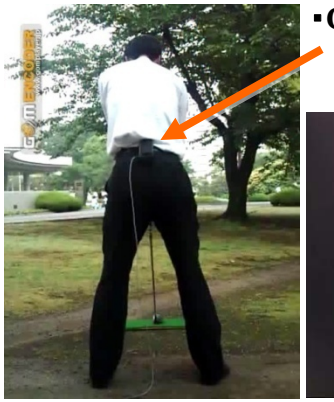


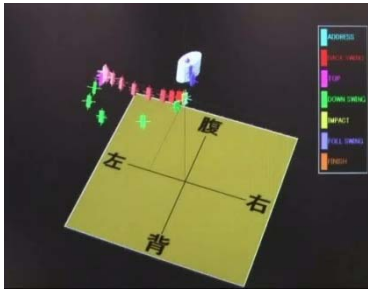
Measuring activity level

Movement sample for experimental event

Experimental event poster

- **Acceleration sensor**
- **Gyro sensor (magnetic sensor)**





Measuring waist rotation for a golf swing diagnostic app.

Enablers

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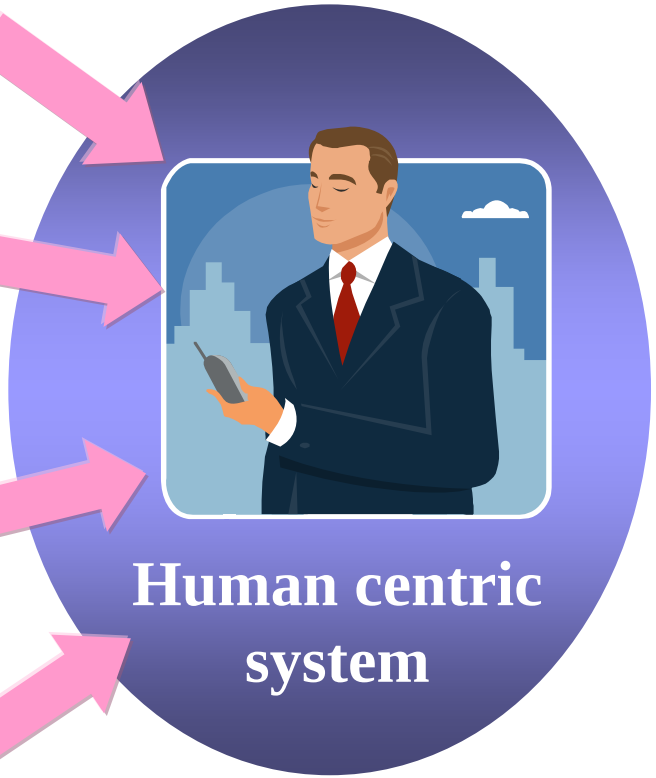
Cloud computing

Wireless network
LTE, Ad-Hoc network

Mobile terminal
(Smart phone)

Knowledge management



Crime prevention mapping using social media analysis

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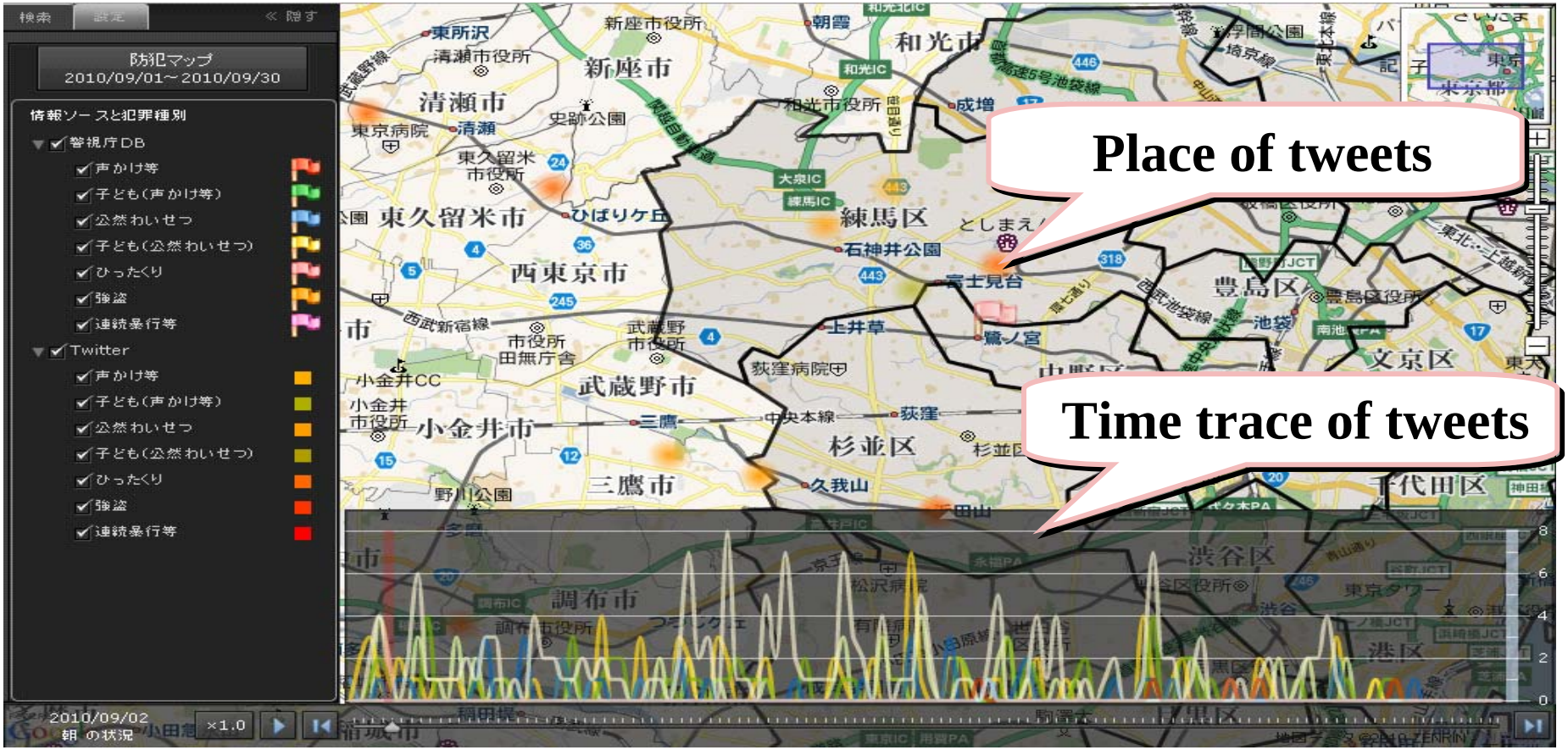
- **Analyze and map dangerous zones from Twitter's tweet data**



Prevent crimes by properly locating policemen

Impact on networks

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- Continuous requirement of bandwidth increase
- Possible increase in power consumption
- Drastic change of traffic mix
  - Bulky video signals, huge data files for cloud computing, and small but large number of sensor data
- Dynamic and flexible operations
- End to end QoS requirement
- Network edge may be a front processing node of computer cloud

Photonic network trends

Requirements for photonic networks

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- **Continuous bandwidth increase**
  - **New coding and multiplex technology**
- **Greener network**
  - **Full use of photonic network capability**
  - **Self optimizing network((F)SON)**
  - **Optical integrated circuits and new device**
  - **Efficient power and cooling**

Optical modulation/multiplexing trend

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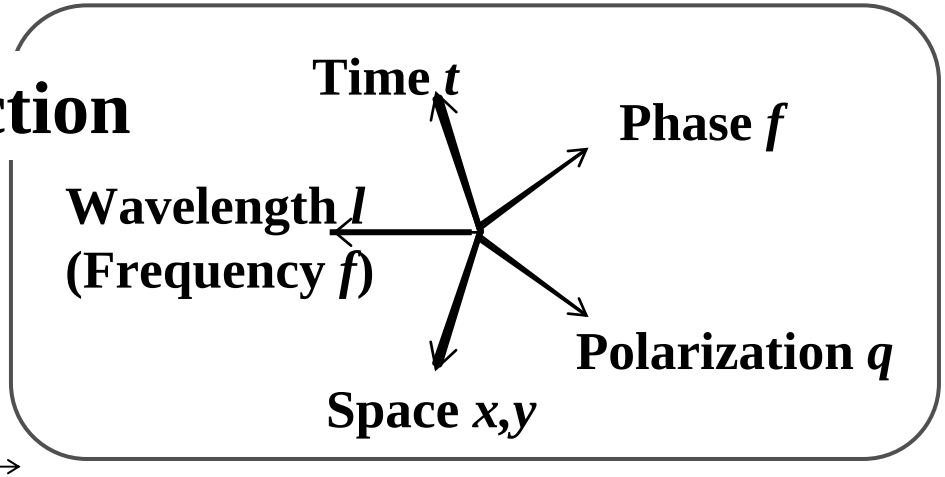
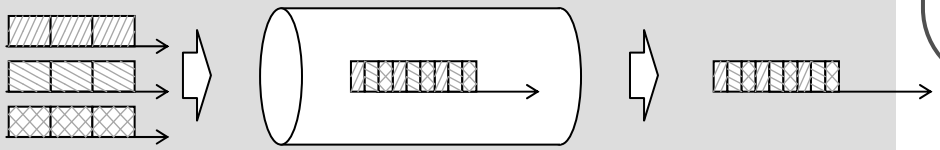
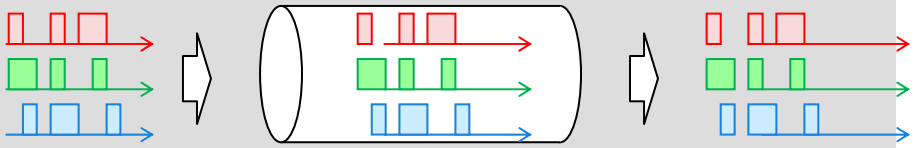
Technology direction



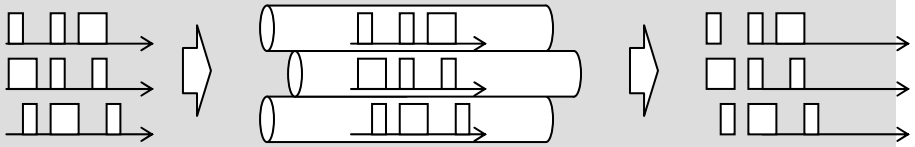
- **Time domain**
  TDM



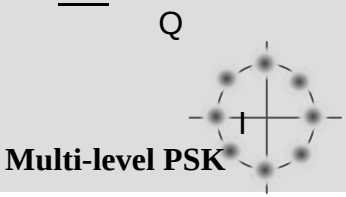
- **Wavelength (Frequency) domain**
  WDM, OFDM



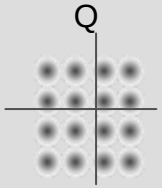
- **Space domain**
  Multi-core, Multi-mode



- **Phase domain**
  Multi-level modulation with DSP

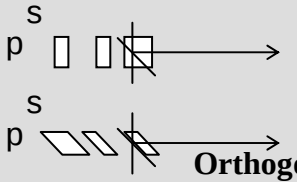


Multi-level PSK



QAM

- **Polarization domain**
  Pol.-mux with DSP

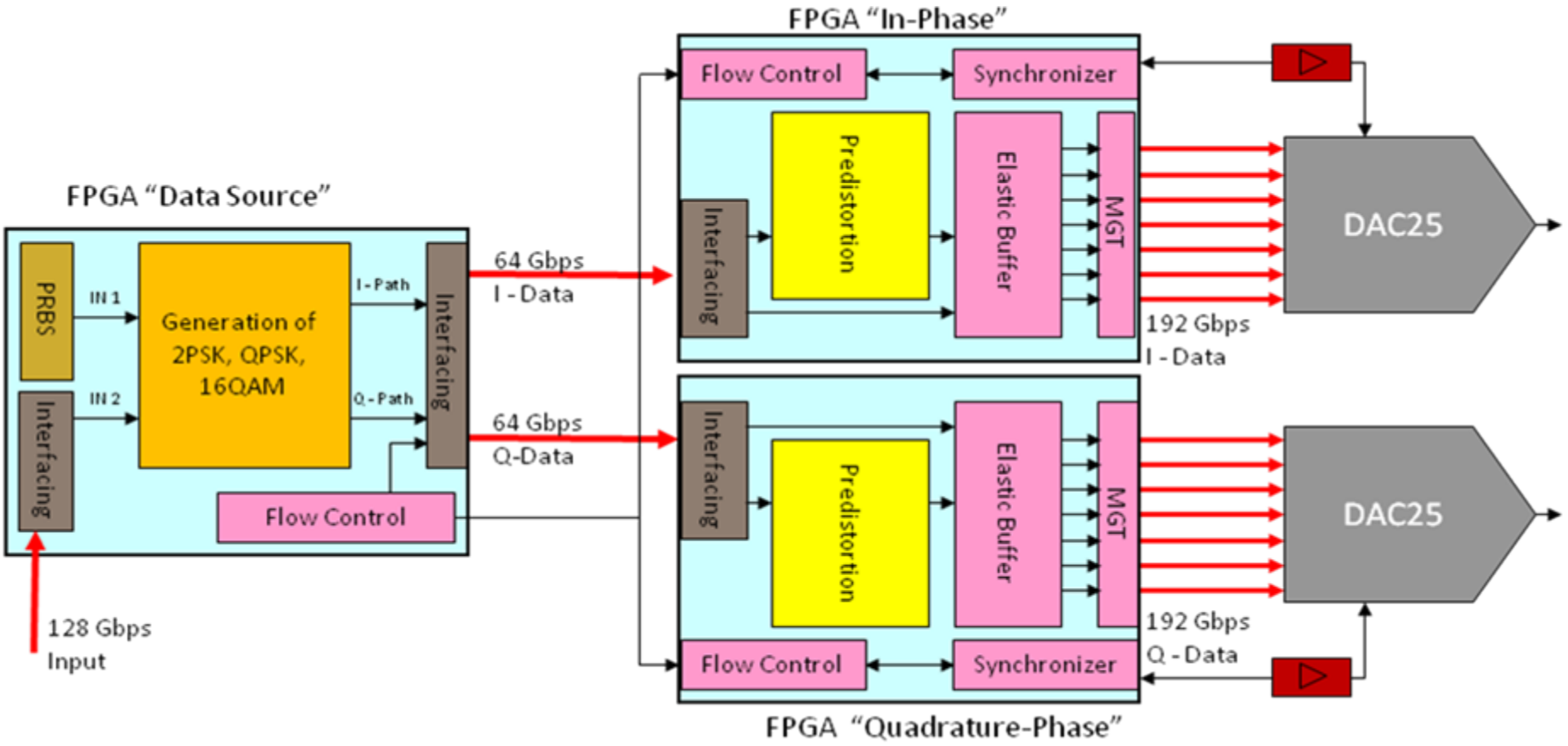


Orthogonal pol.

Mapping on Poincaré sphere

Fujitsu research beyond 100G

- Collaboration with Heinrich-Hertz Institute (HHI)
- Multi-format FPGA based digital signal processing platform



Multi-format BER performance

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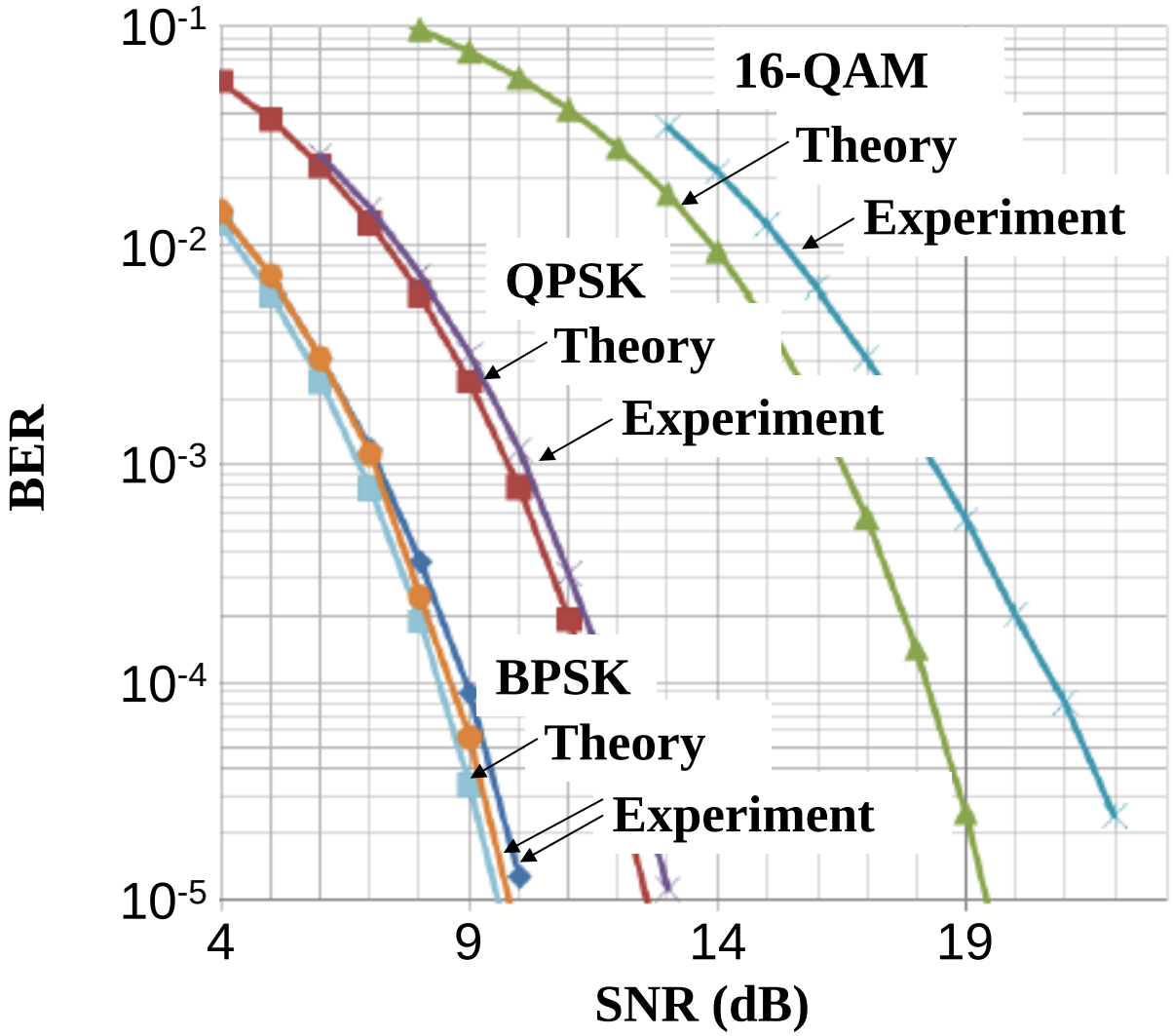

Requirements for the future network

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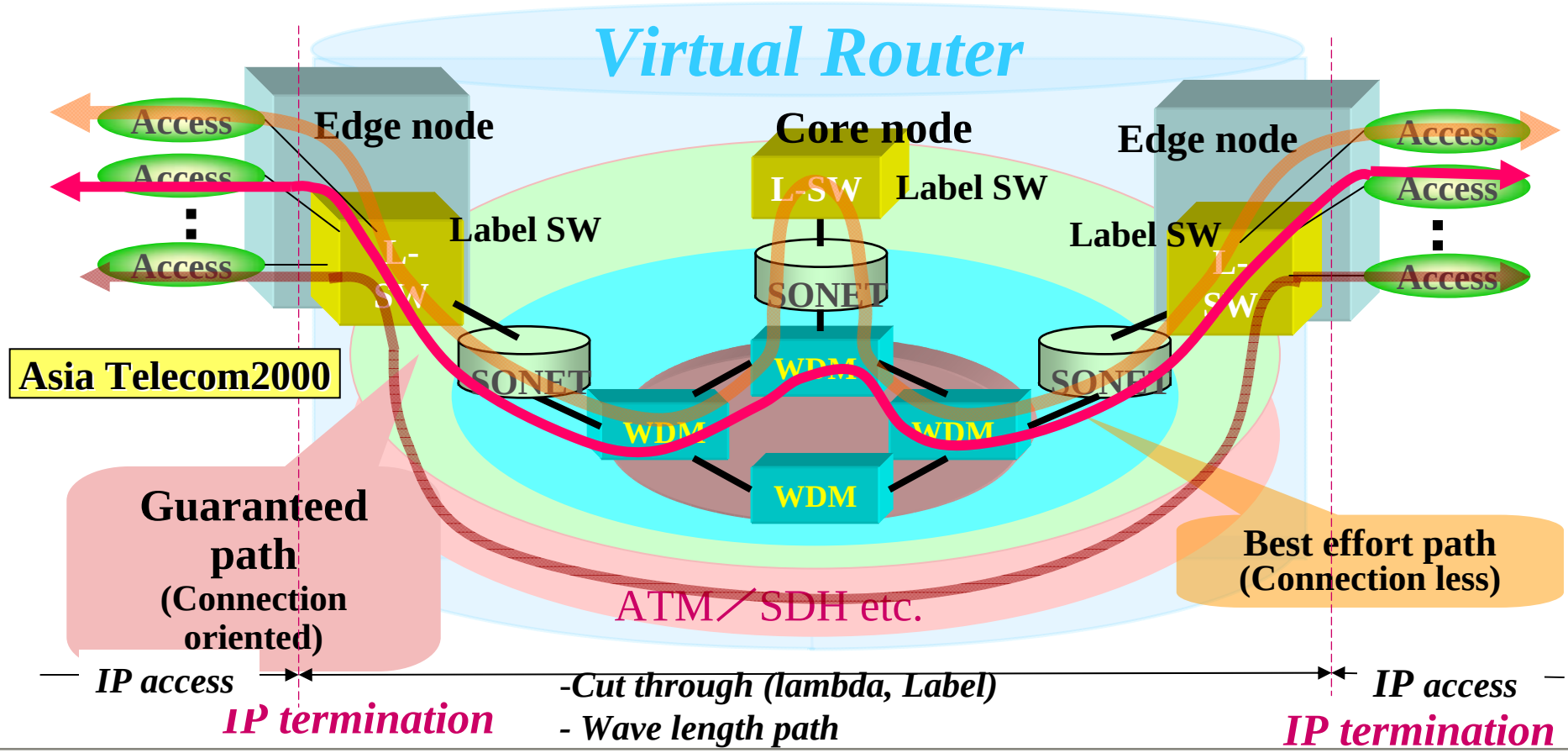
- Continuous bandwidth increase
  - New coding and multiplex technology
- **Greener network**
  - **Full use of photonic network capability**
  - **Self organizing/optimizing network((F)SON)**
  - Optical integrated circuits and new device
  - Efficient power and cooling

Virtual router network

- Create total network as a router
- Simple core and intelligent edge
- Use of photonic network to reduce power consumption



Prototype of 8×8 SOA switch unit

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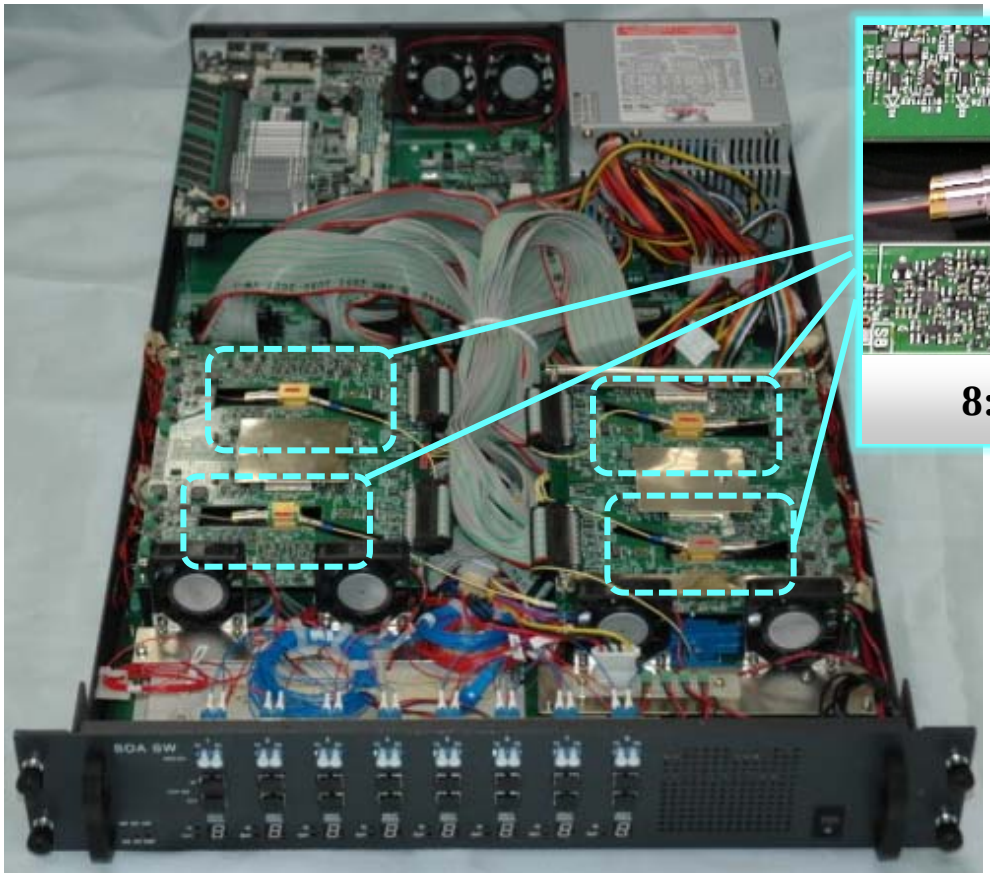
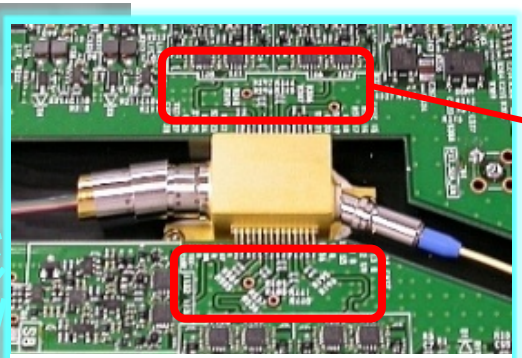
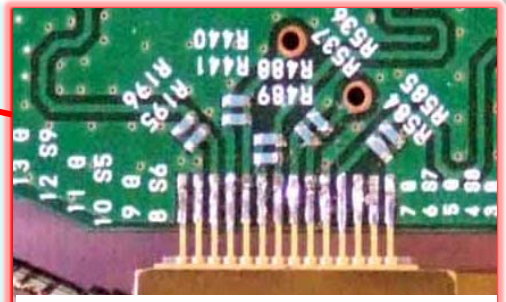




8:1 SOA module



Delay lines for skew correction

Items	Specifications
Wavelength	Signal: 1520 - 1561 nm
Switching capacity	800 Gbps (10 Gbps ×10ch.×8 port)
Gain	0 −5 dB
Size	19-inch 2U sized rack
Functions	・Digital PID TEC control ・Power monitoring

1) Y. Kai et al., ECOC2008, We.2.D.4
2) S. Yoshida et al., OECC2008, P-95

Switching characteristics

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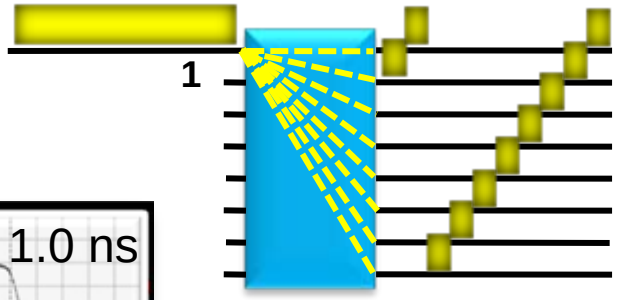
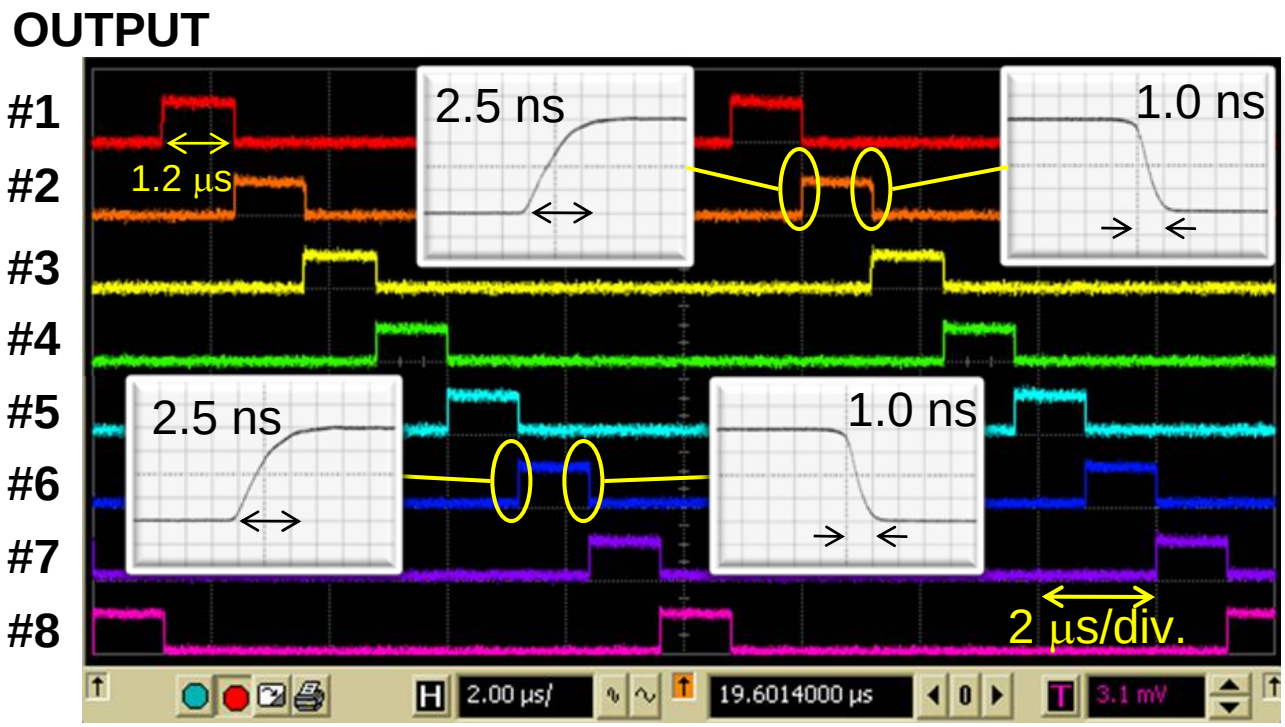
■**Periodically switched to output port #1→#2→・・・7→#8→#1→ ・・・every 1.2 ms**





Less than 2.5 ns for all switching

Why SON

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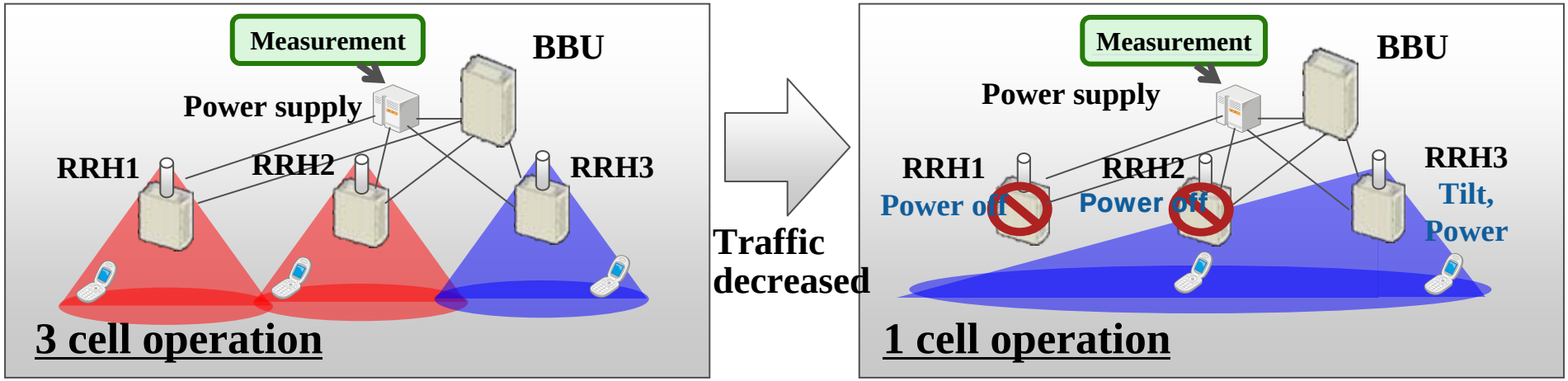
- **In cloud computing, due to the dynamic nature of processing, a demand based dynamic setting in path, bandwidth, and QoS is required of the network.**
- **Mobility support is essential, and leads to a dynamic network configuration**
- **Efficient usage of existing resource is necessary to reduce both CAPEX and OPEX, and also make the networks disaster resilient**

SON field experiment

SON applied for energy reduction of LTE access network
- **Energy saving of 56% is achieved**

5 MHz bandwidth



	3 cell operation	1 cell operation
Relative power consumption	100	44
Area cover ratio	99.5 %	97.4 %
DL area throughput	29.2 Mbps	18.9 Mbps
UL area throughput	12.6 Mbps	6.4 Mbps

Concept of FSON

Flexibly adjust spectrum/bandwidth, data rate and reach to match traffic demands – thereby maximizes overall resource usage, reduces CAPEX, and makes networks disaster resilient

Design Parameters

- Spectrum slot – 12.5/25/50 GHz, contiguous
- Data rate – n x 25/50/100Gb/s
- Grooming/Aggregation – OTN, Optical layer

ROADM

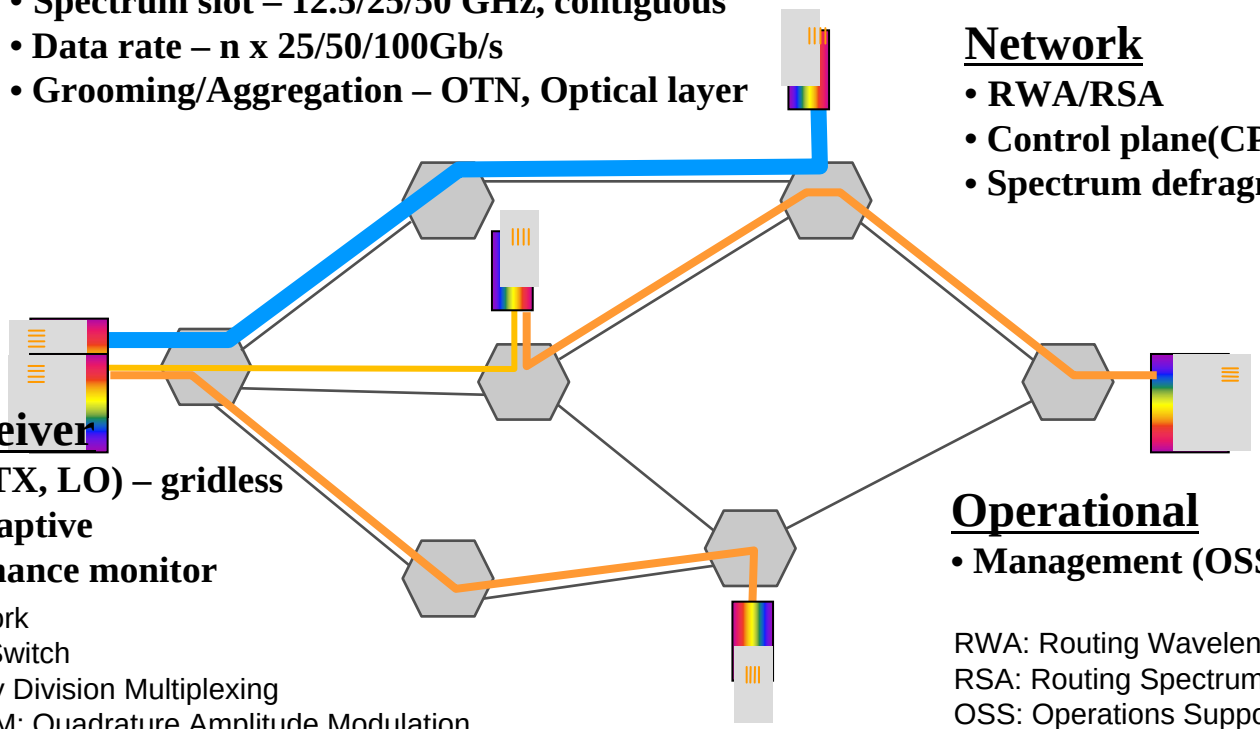
- WSSflex
- MUX/DEMUXflex

Network

- RWA/RSA
- Control plane(CP)
- Spectrum defragmentation

Transmission

- OFDM - #subcarriers, #bands, rate
- mPSK, mQAM



Transceiver

- Laser (TX, LO) – gridless
- Rate adaptive
- Performance monitor

Operational

- Management (OSS)

OTN: Optical Transport Network
WSS: Wavelength Selective Switch
OFDM: Orthogonal Frequency Division Multiplexing
PSK: Phase Shift Keying, QAM: Quadrature Amplitude Modulation

RWA: Routing Wavelength Assignment
RSA: Routing Spectrum Assignment
OSS: Operations Support System

Summary

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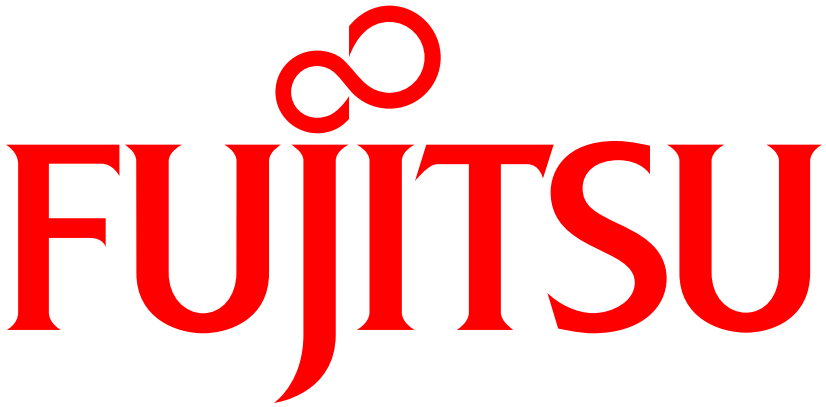
- I introduced Fujitsu's " Human centric intelligent society" vision and related activities.
- The ICT paradigm shift has a large impact on networks, and the new challenges are necessary in telecom related R&D.
- Fujitsu is making a contribution to society, through advanced ICT and total system/solution creation.



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