Internet of Things: Yesterday, Today, Tomorrow

Kris Pister
Prof. EECS, UC Berkeley
Founder, Dust Networks

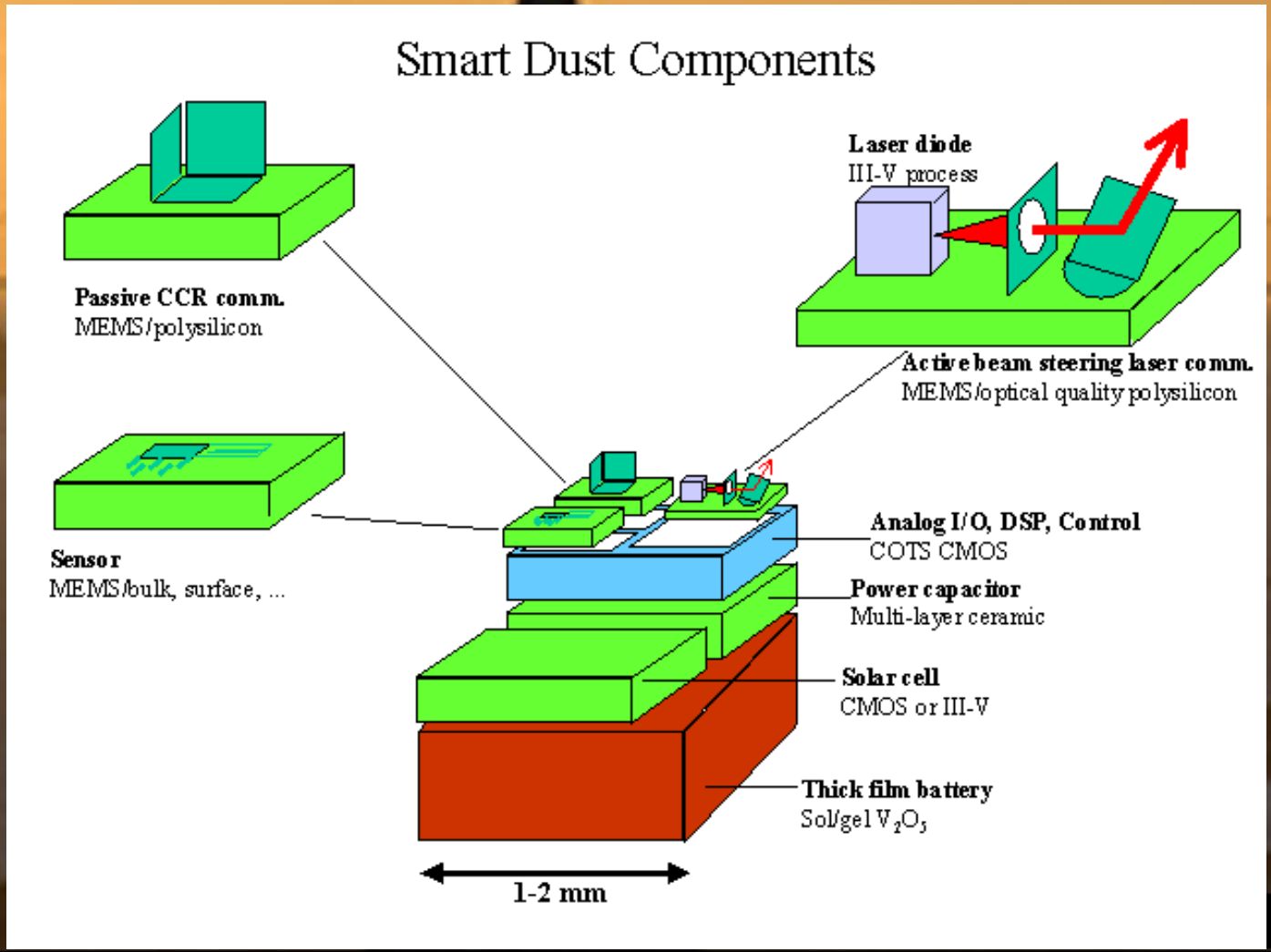
LINEAR TECHNOLOGY

BSAC

Vision 2030

What happens when sensors become tiny and wireless?

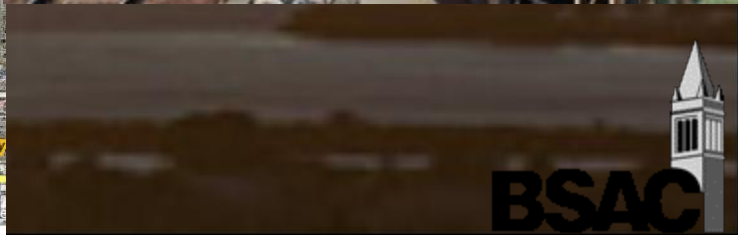
RAND, 1992



Smart Dust, 2001


2 INCH HF COMP SHOES


Map
Castro St
John T Knox Fwy
Richmond-San Rafael Bridge
580
W Cutting Blvd
2000 ft
500 m
©2006 Google - Map data ©2006 NAVTEQ™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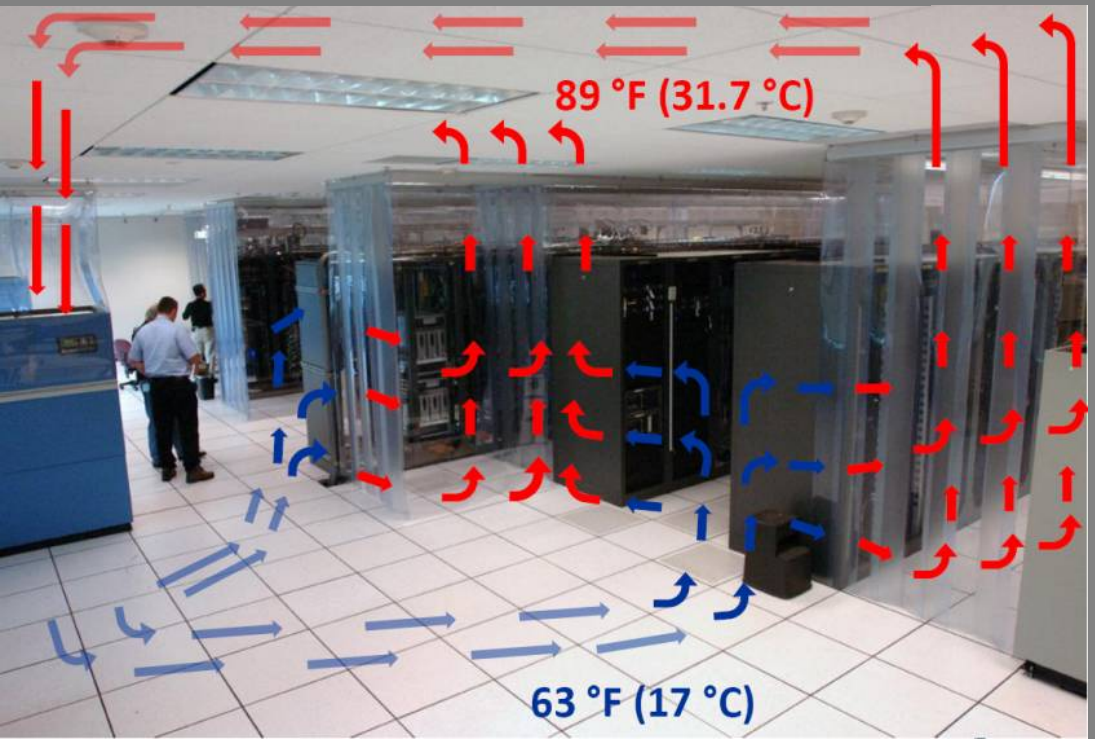
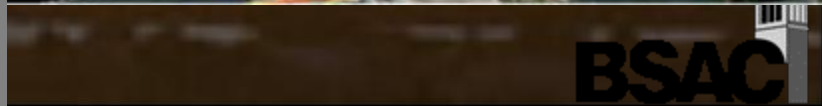
OPEN 24 HOURS
and Convenience Store
FOOD MART
MONEY CHANGER
GLOBE
SMART


89 °F (31.7 °C)
63 °F (17 °C)


Marshfield Way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Middle East Desert Sand Storms

Emerson Process Managmenet, *Extreme Wireless Applications*

-48 ˚F with a wind chill of -70 ˚F Wireless Transmitter on the North Slope of Alaska

Emerson Process Managmenet, *Extreme Wireless Applications*

In Alaska, measures leak detection of pipeline running under a road mile from nearest device/gateway.

Emerson Process Managmenet, *Extreme Wireless Applications*

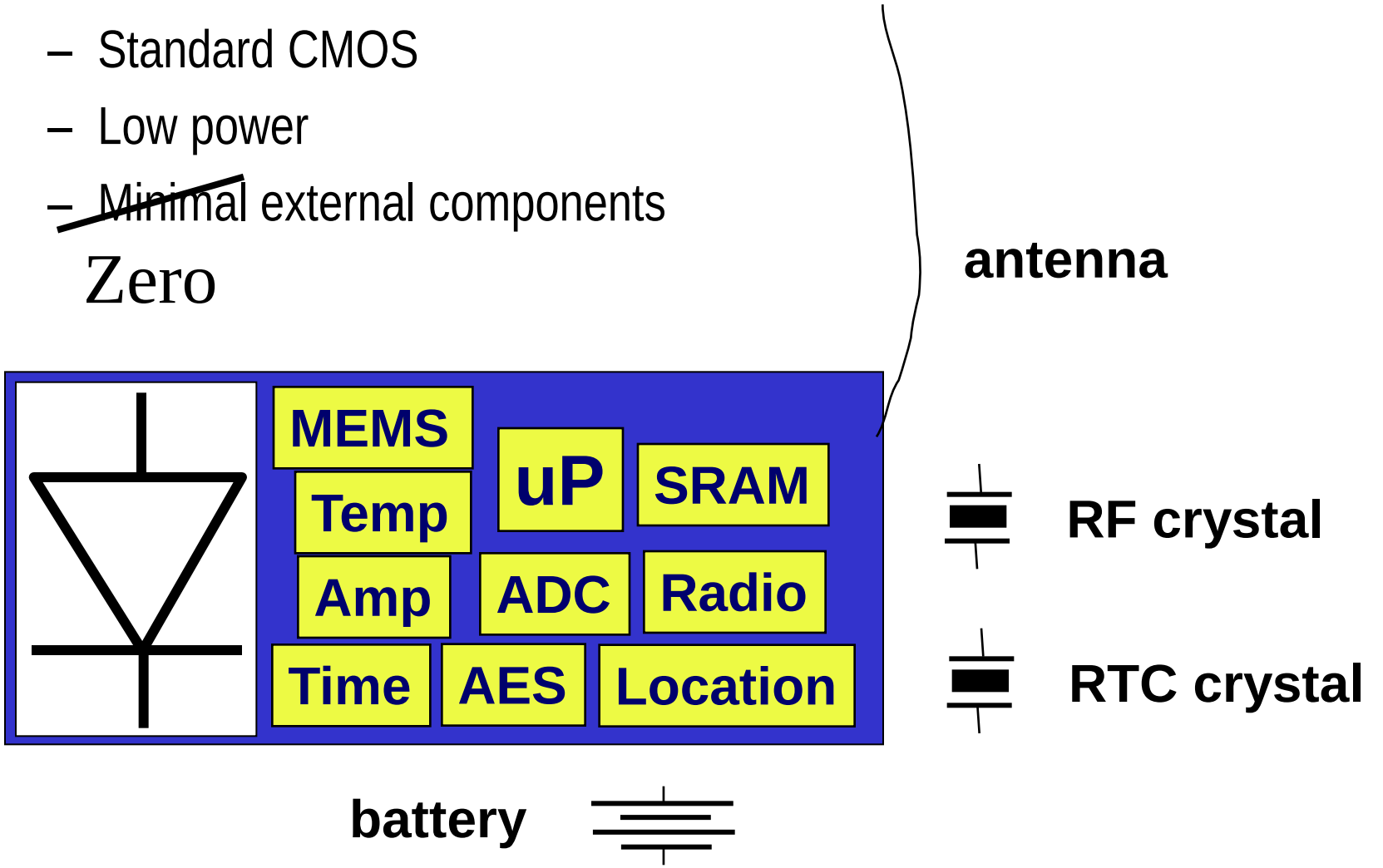
FPSO – Floating Platform, Storage and Offloading

Emerson Process Managmenet, *Extreme Wireless Applications*

Single-chip mote?

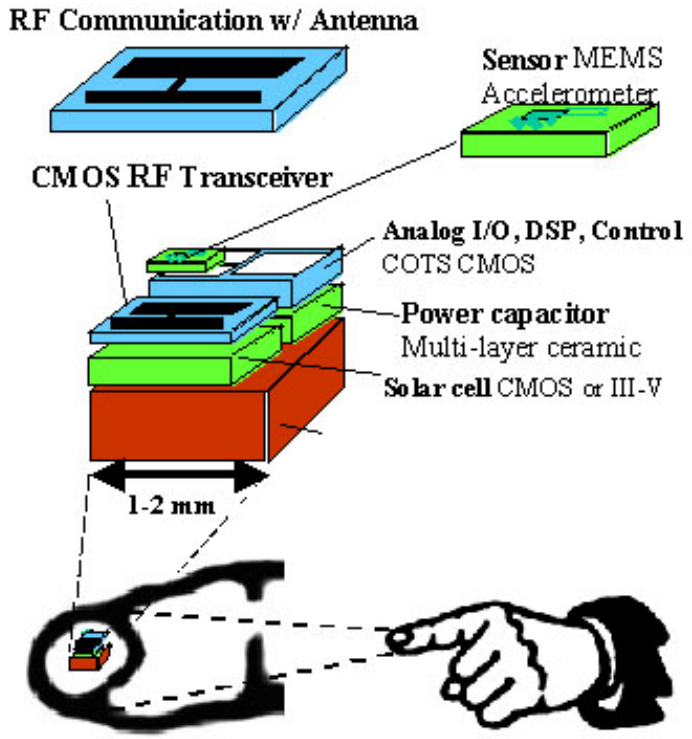
- Goals:
  - Standard CMOS
  - Low power
  - ~~Minimal~~ external components

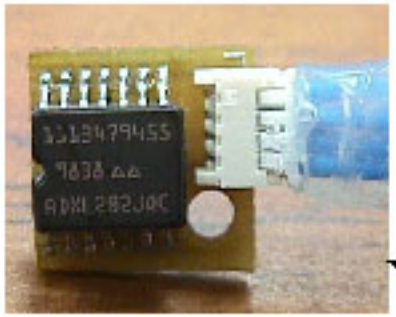
Zero



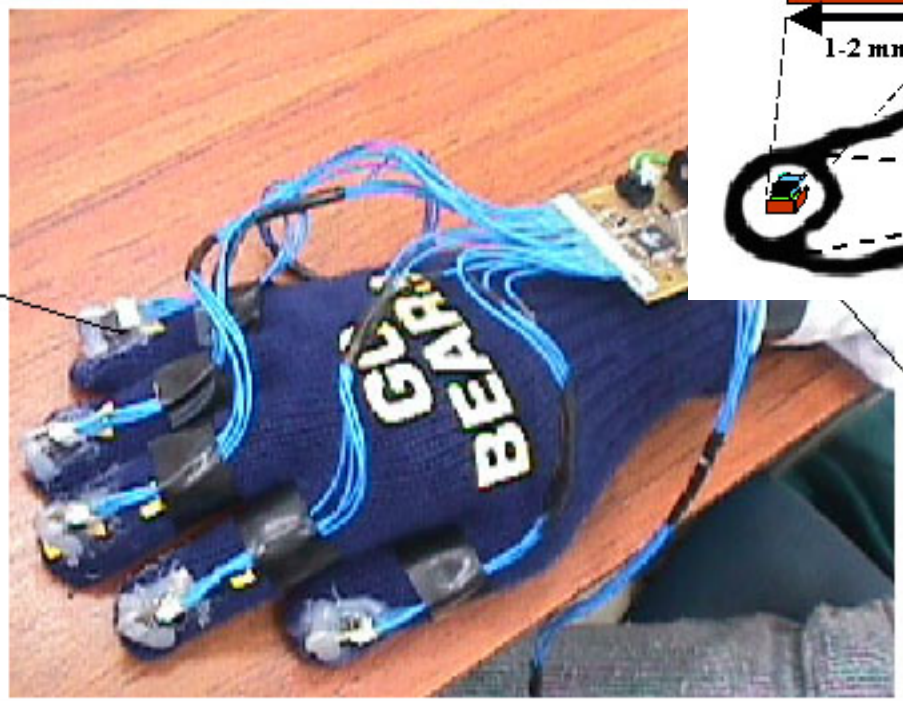
Acceleration Sensing Glove, 1999

- Accelerometers on fingertips
- Wireless on wrist
- Basic keyboard, mouse motions
- Mouse, keyboard, sign language





Finger accelerometer



Wrist controller, RF transmitter and battery pack

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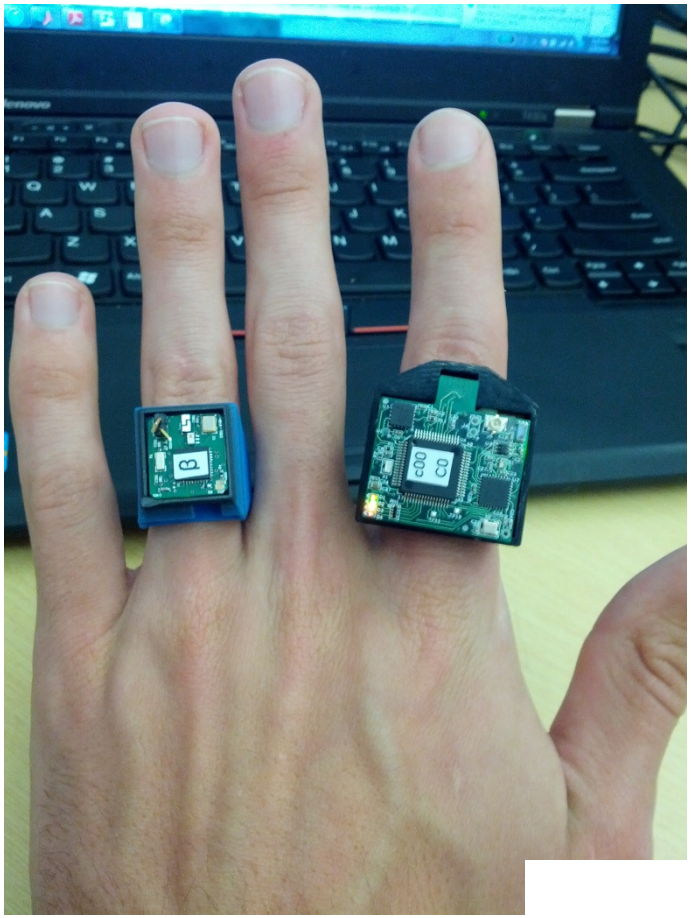
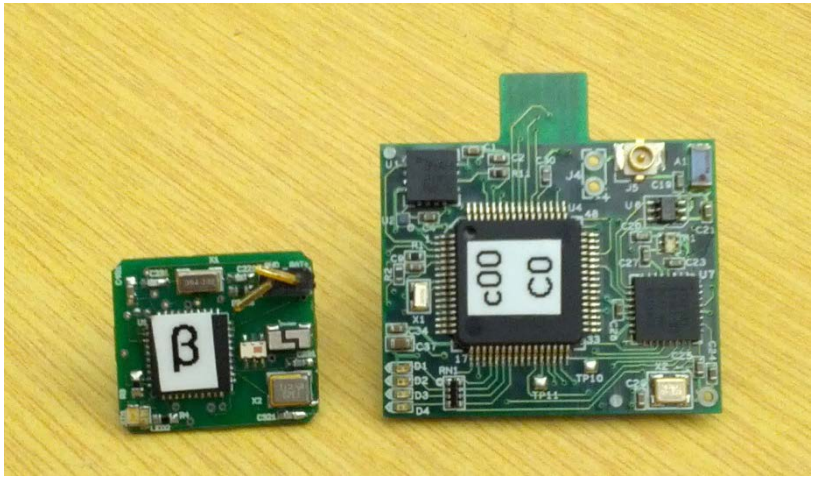
Ring GINA

- *Guidance and Inertial Navigation Assistant*
- 9 axis IMU
- Ring form factor
  - Ring GINA
- Bluetooth GINA





"Ring GINA: A Wearable Computer Interaction Device", Greenspun, Pister, 2013

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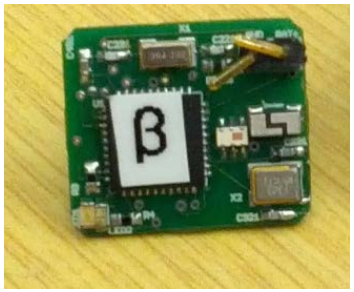
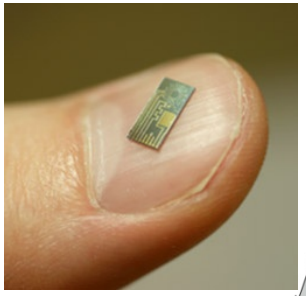
Progression

- Single chip mote
- Finger tip accelerometers
- Virtual keyboard

…and beyond





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The Future

- Reliable, secure, low-power, interoperable
  - IPv6 on 802.15.4E
- Single-chip motes
  - Integrated MEMS for sensing, timing, …
- Solar, thermal, vibrational, RF scavenging
- Even-lower-power RF
  - 60 GHz low-power mesh
  - Mostly Mechanical Radios

Tech Transfer: Supported Research + BSAC Visiting Industrial Fellows

With 1-3 years in residence

Japanese/Korean Members 2006-2014

HONDA The Power of Dreams

Prof. Liwei Lin Group

muRata

Prof. Al Pisano Group

HITACHI Inspire the Next

Prof. Liwei Lin Group

YAMATAKE

Prof. Al Pisano Group

SAMSUNG

Prof Liwei Lin Group

SONY

Prof Kris Pister Group

Panasonic ideas for life

Prof. Liwei Lin Group

SAMSUNG

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SONY

Prof David Horsley Group

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HITACHI Inspire the Next

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TAIYO YUDEN North America

Prof. Liwei Lin Group

TOYOTA

Prof. Bernhard Boser Group

SHARP

Prof. Al Pisano Group

Fujitsu North America
Technology Forum 2015

Wearable Technology for Human Empowerment

Naoyuki Sawasaki
Fujitsu Laboratories Ltd.

February 11, 2015

Human Empowerment

Empowering people and society by integrating real and digital worlds

- ICT supports abilities of individuals by advanced front interface engaging multiple senses and enabling natural operations

- Human Interaction Technology
- Ultra-Realistic Audio & Video

Multi-Sense Interfaces

- Contextual Computing
- Wearable Assistance-Technology

Enhanced Abilities

- Smart Communication Platform

Total Connectivity

Wearables as Means for Human Empowerment

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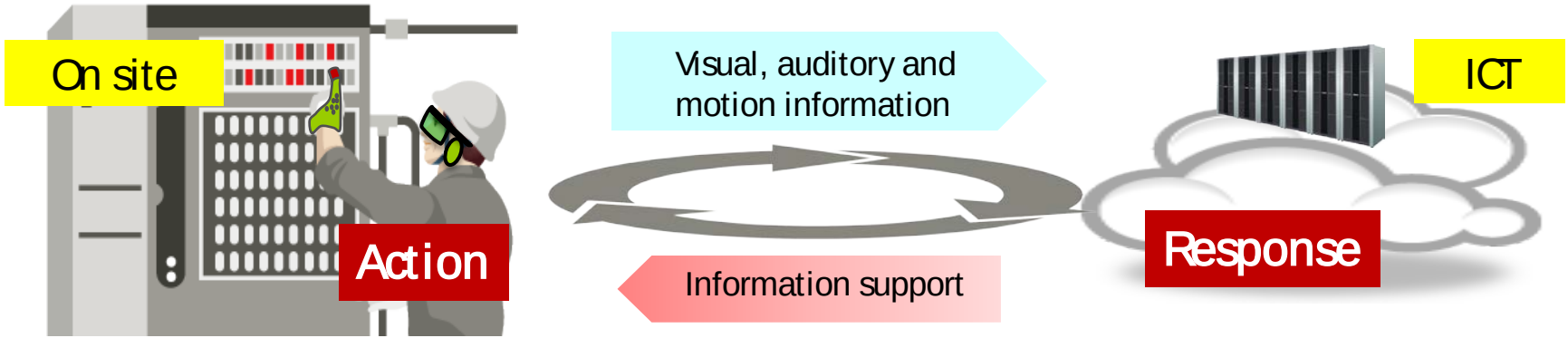
Enable front user interface to support various activities in the field

Custom	Configured to be optimal interface to various work scenarios
Continuous	Constantly available with people and can assist in real-time
Direct	Enable to link human behavior to information in the cloud



Work Together with Intelligent Cloud

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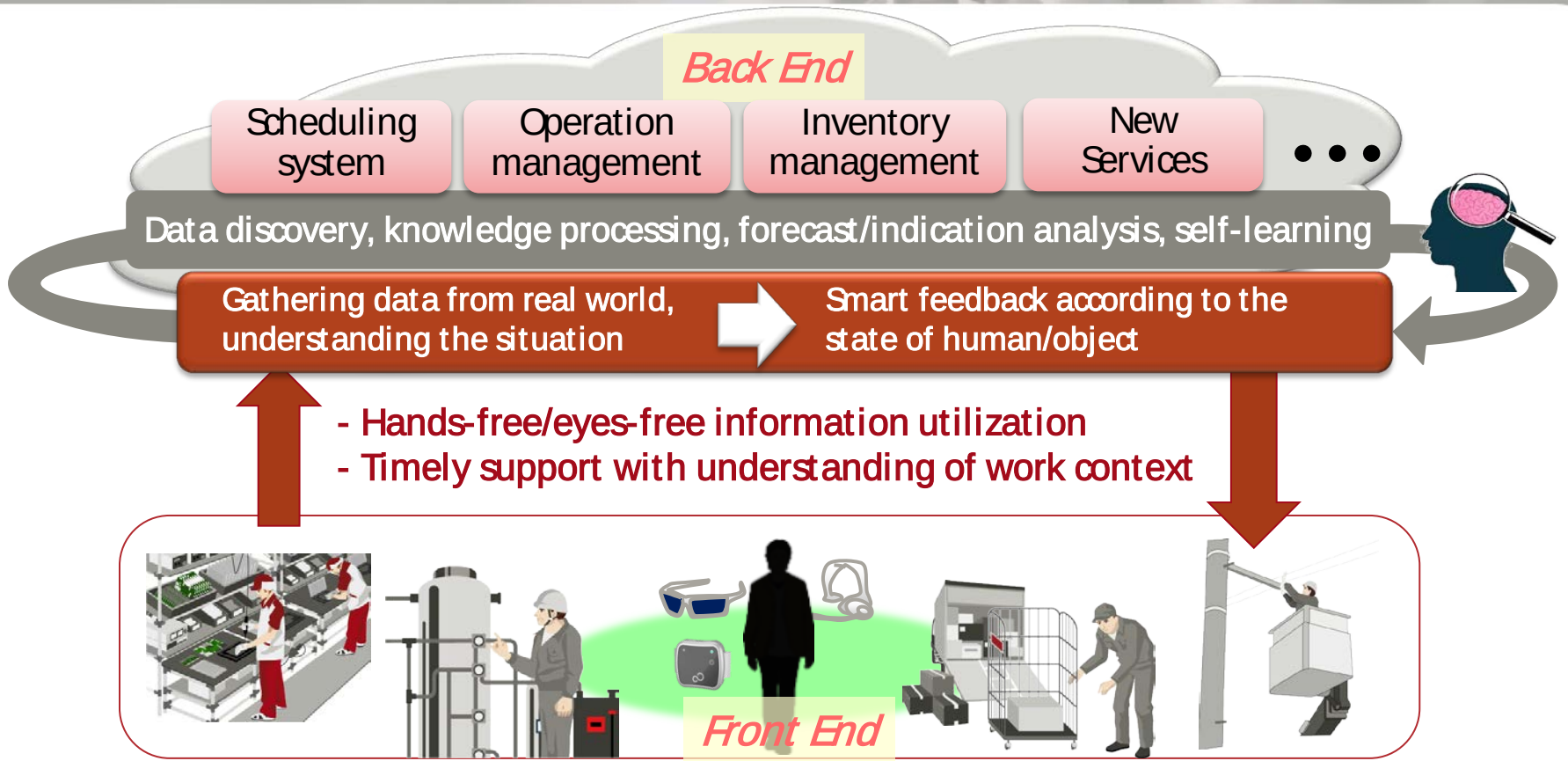

Development of Wearables for Industrial Applications

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UI Component for Optimized user interface of cloud services

- Head mounted display with embedded camera and voice communication
- Input devices for various work scenarios to minimize user's operations
  - Research on devices enable more **direct** interaction with services.

HMD

Wearable keypad

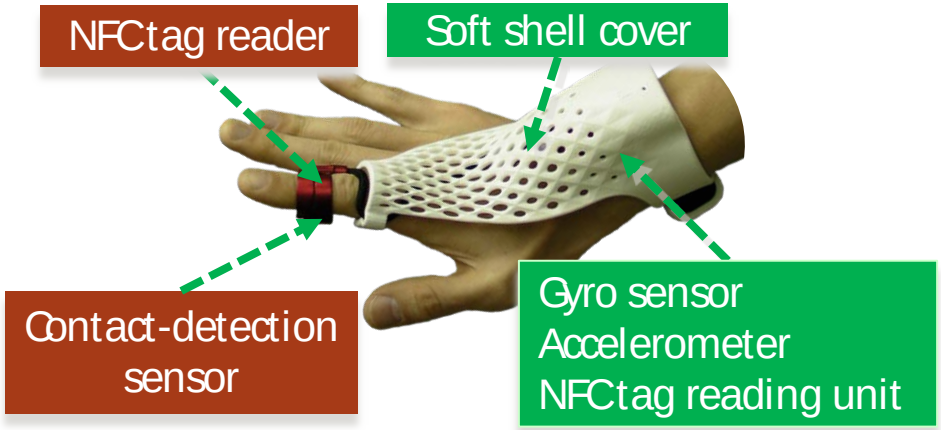
Glove-style

Ring-style

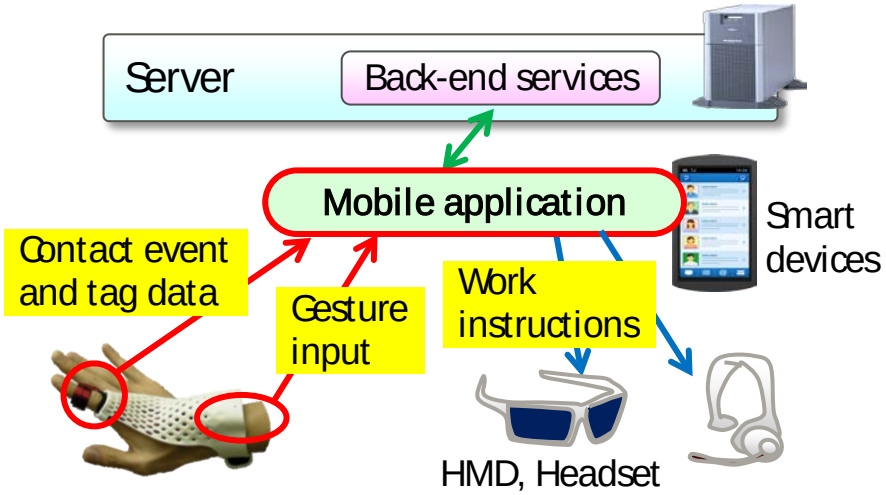
Glove-Style Wearable Wrist Device

Enables direct interaction with services by simple physical motions

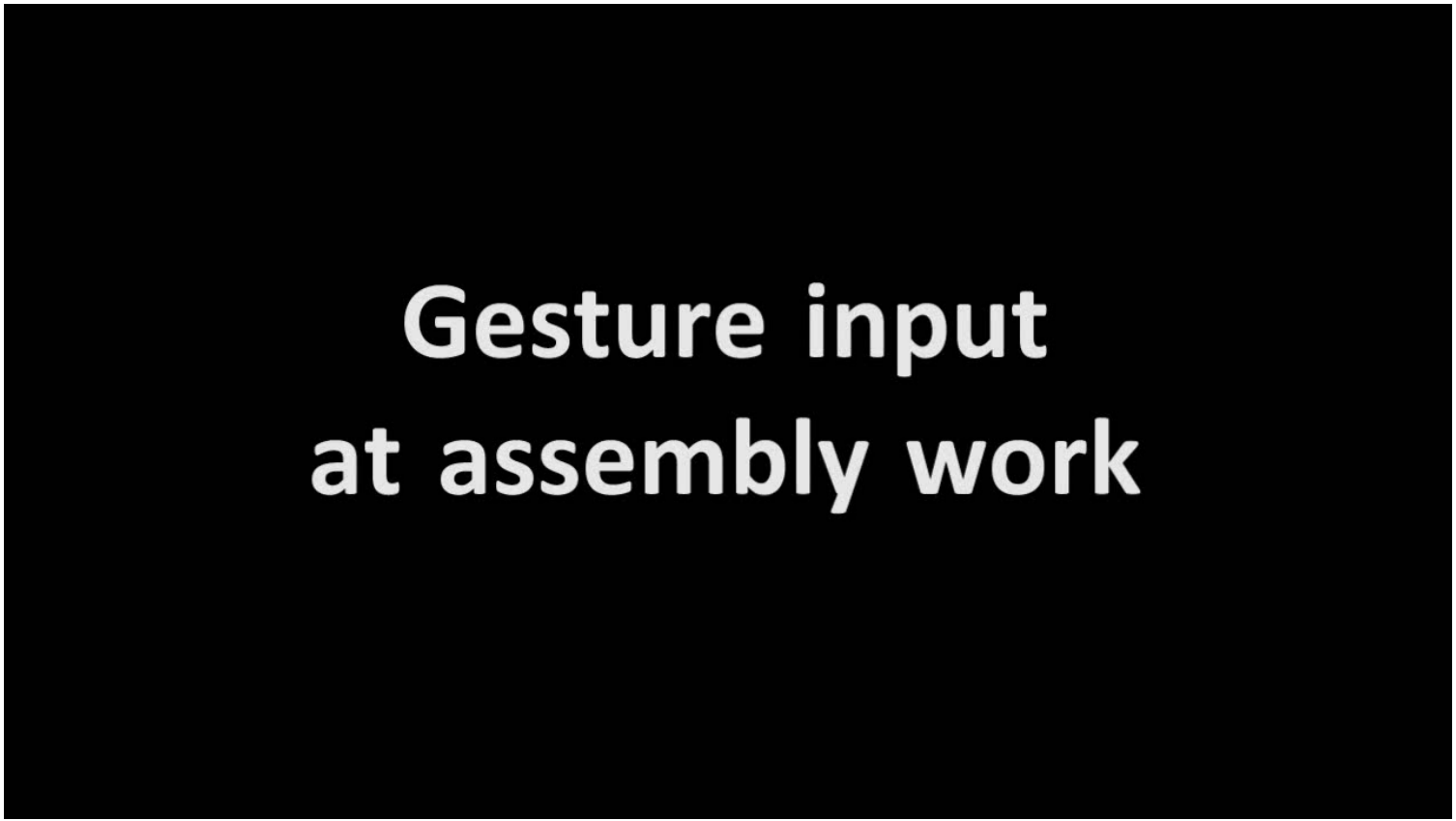
- Triggers required services immediately with a touch operation
  - NFC tag reader on the finger tip enables “wake on touch” operation
- Hand gesture input by motion sensors
  - Reliable gesture-recognition algorithm works with a variety of tasks and postures



NFC: Near Field Communication



Demonstrations



Demonstrations

Wearable Ring Device

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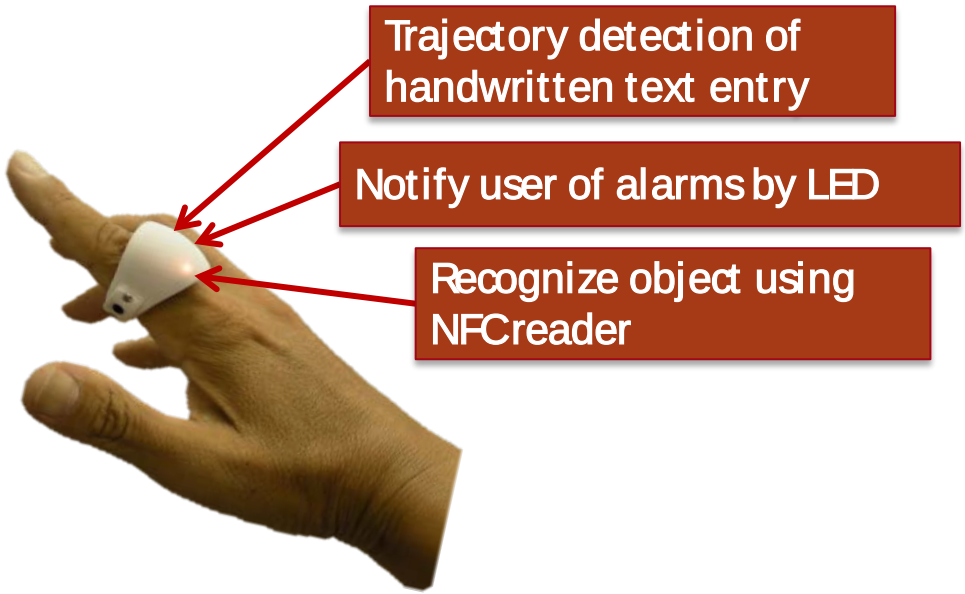
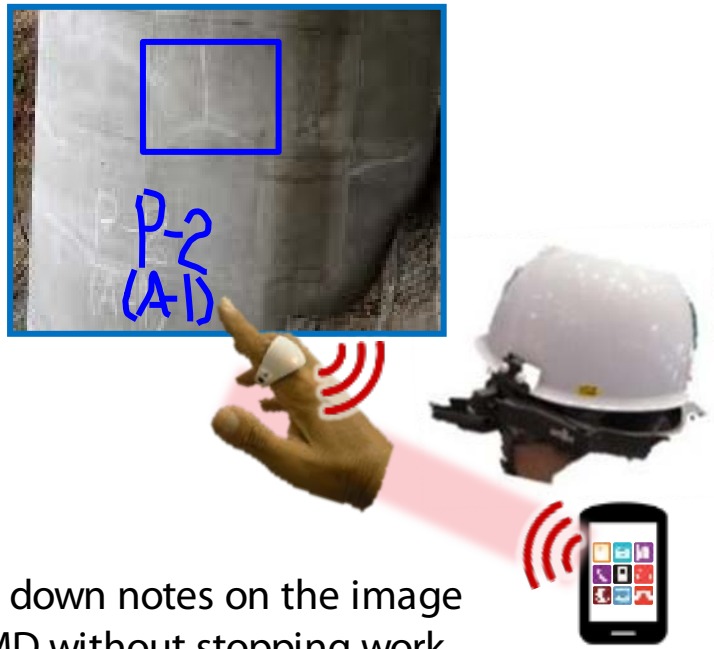
Compact & lightweight device that can be used in various field works

- "Air-writing": text entry by writing in the air
- Create handwritten memos on images





Write down notes on the image in HMD without stopping work

Demonstrations

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Expansion of Internet of Things

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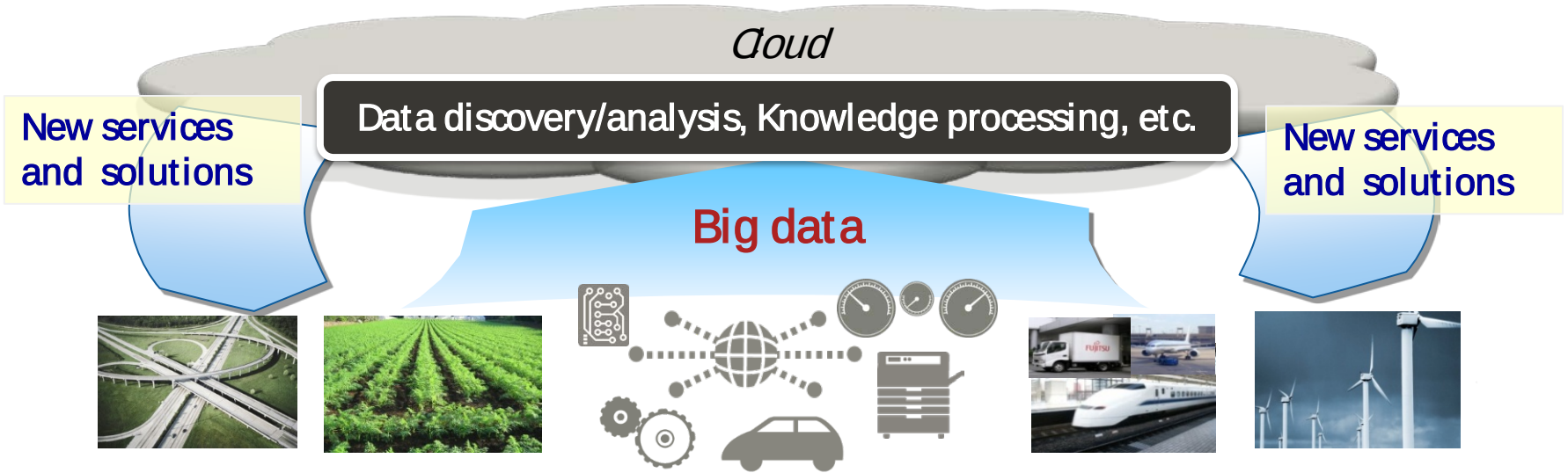
New services will be created by the big date from connected devices

- Over 50 billion “Things” will be connected to network in 2020
- Market forecast in 2020 : Over 1 trillion dollars



Wearables and IoT : Hyper-connected space

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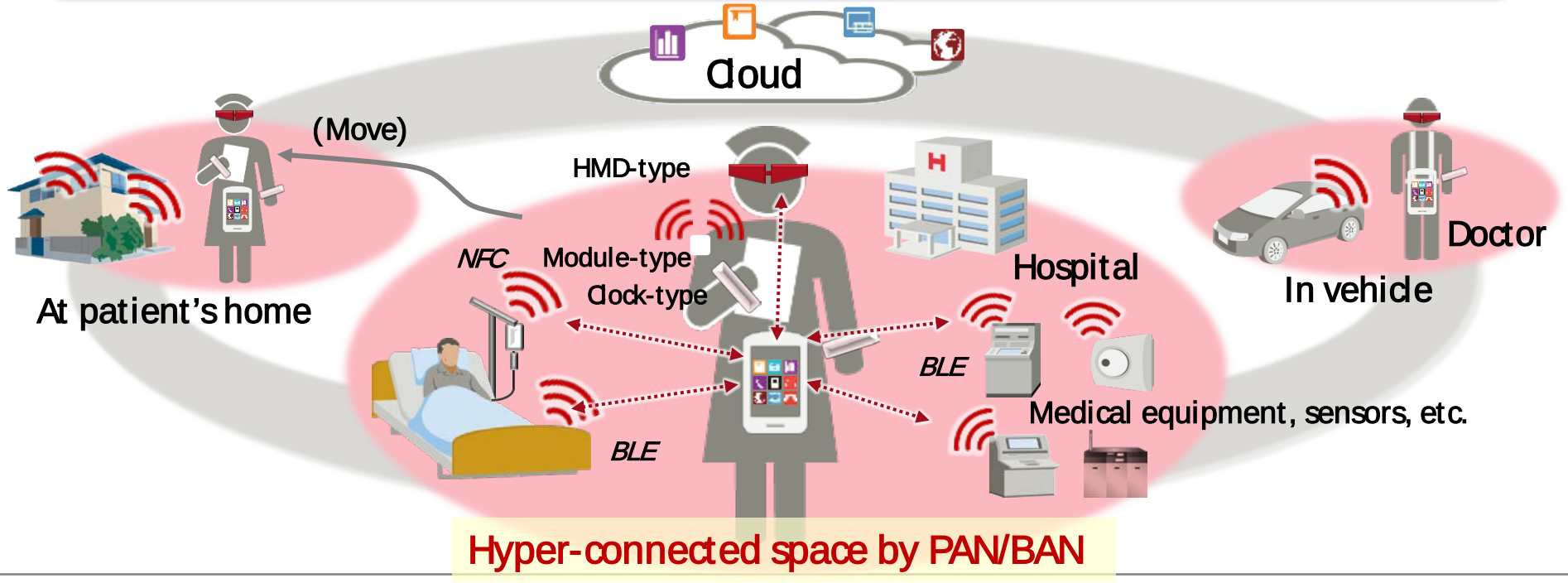
Wearables and IoT devices can be dynamically connected around the activity space of human being



Future Applications of Wearables and IoT

- Elemental technologies continue to be advanced rapidly. It is important to brush them up to unearth and expand the application areas.
- What kinds of new applications can be created?

Infrastructure Maintenance

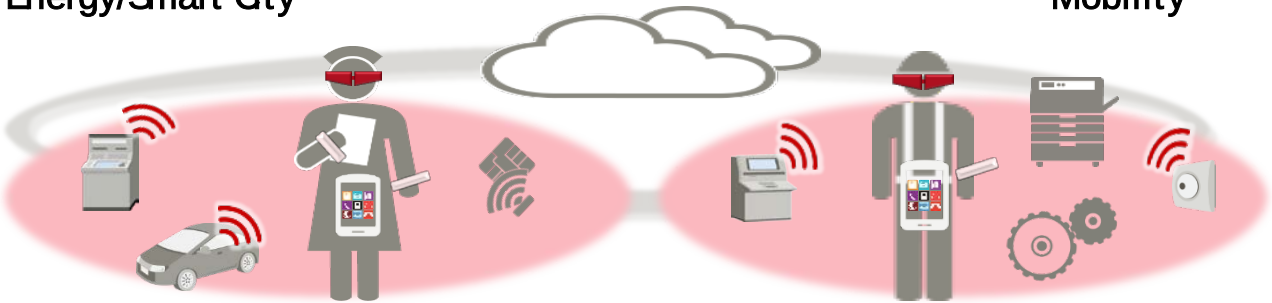
Energy/Smart City

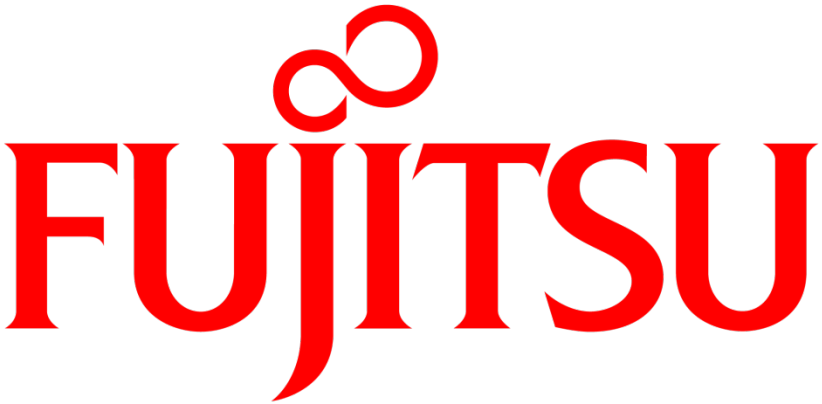
Transportation/ Logistics

Healthcare

Mobility

Education





shaping tomorrow with you