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# Recent Activities in RFID area

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Shigeya Suzuki / Jin Mitsugi

Auto-ID Labs Japan / WIDE Project / Keio University

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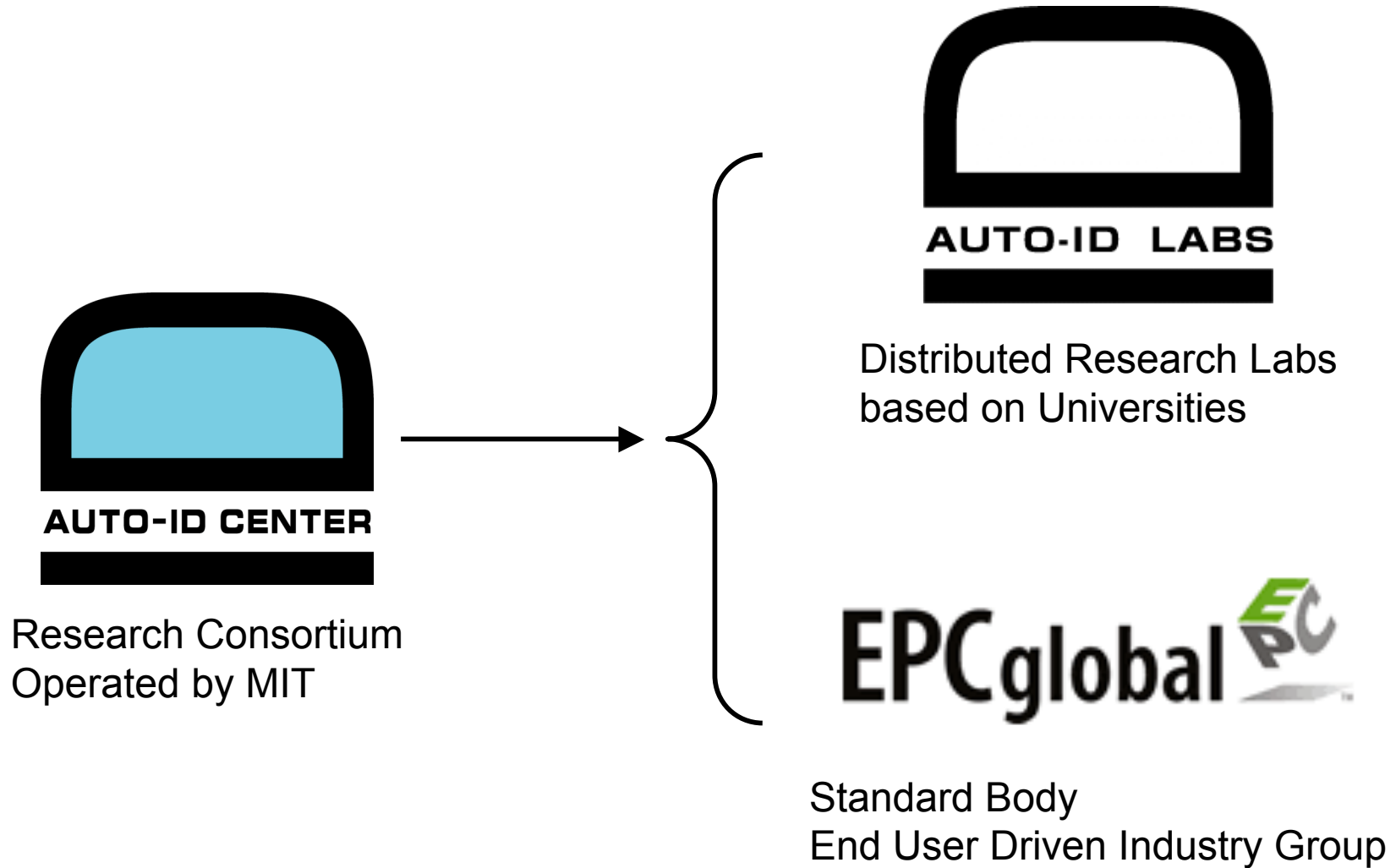
# What is Auto-ID Lab?

- Auto-ID Labs is a federation of research universities that has evolved from the Auto-ID Center, initially founded in 1999 to develop an open standard architecture for creating a seamless global network of physical objects.

... Creating “Internet of objects”



# Reorganize 2001



# What is EPCglobal?

- EPCglobal Inc is industry's trusted partner for driving the global adoption and implementation of the EPCglobal Network across industry sectors. Our mission is to make organizations more effective by enabling true visibility of information about items in the supply chain. To that end, EPCglobal develops and oversees standards for the EPCglobal Network. Additionally, EPCglobal provides a global EPC™ number registry service for electronic product codes in the supply chain. As a joint venture between GS1 and the Uniform Code Council (UCC), EPCglobal Inc leverages a nearly thirty-year heritage of successfully partnering with industry. EPCglobal is a neutral, consensus-based, not-for-profit standards organisation.

... Focusing use of RFID on Supply Chain Management (SCM)

... EPCglobal created base on the activities of Auto-ID Center



# Why Keio (WIDE) involved to Auto-ID?



- WIDE has been actively working on activities related to the motivation to create “real space internet”
  - Network for mobile “intelligent” node
    - Mobile IP (KAME/Nautilus)
    - Internet Car
  - RFID related research
    - Meeting support application using passive/active tags
  - Other activities including:
    - Differential-GPS related activities

# Auto-ID Labs Organization

- World wide, seven labs
  - The University of Adelaide, AU
    - School of Electrical & Electronic Engineering
  - The University of Cambridge, UK
    - Institute for Manufacturing
  - Shanghai Fudan University, CN
  - Information and Communications University, KR
  - KEIO University, JP
    - KEIO Research Institute at SFC
  - Massachusetts Institute of Technology, US
  - University St.Gallen, CH
    - Institute of Technology Management
- Each has specialty in research area





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# **Auto-ID Lab, Keio Research organization**

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# Keio Lab Research Specialty

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- Technology (Led by Prof. Jun Murai)
  - Internet related technologies (as you know...)
  - RF area
- Business and Social Model (Led by Prof. Jiro Kokuryo)





# Auto-ID Lab, Japan Research organization



- Director

- Jun Murai, Ph.D  
(Keio University)

- Secretariat

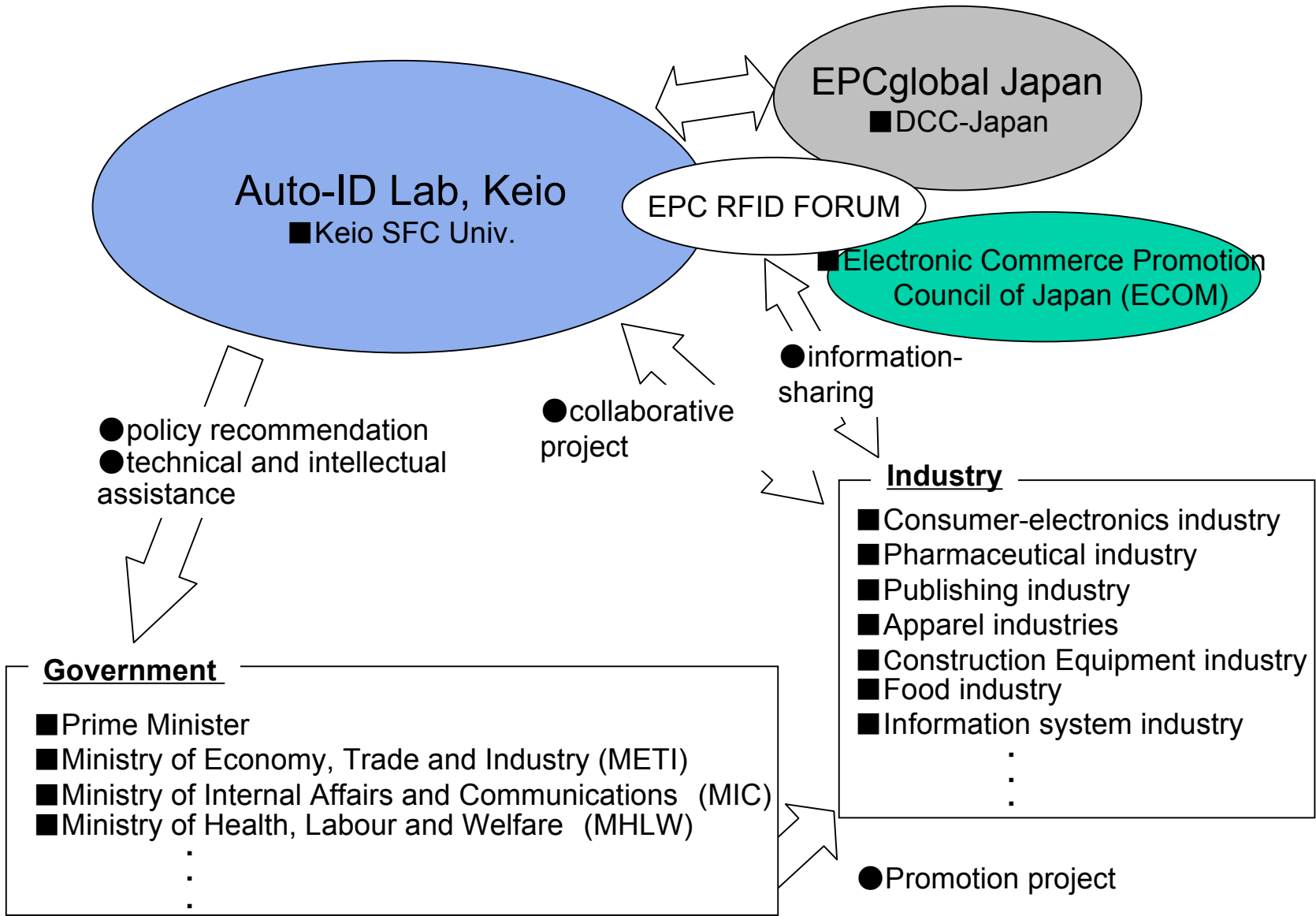
- Kimiko Ishikawa (Keio Research Insutitute at SFC)

- Associate Director

- Osamu Nakamura, Ph.D.  
(Keio University)
- Toshiharu Ishikawa  
(Dai Nippon Printing)  
Industrial planning
- Yojiro Uo, Ph.D.  
(IJJ Lab./Keio University)  
Shigeya Suzuki  
(Keio University)  
Research and Development
- Masaki Umejima  
(Keio University)  
Social Acceptance

- Naohito Okude, Ph.D.  
(Keio University)  
Application design
- Jiro Kokuryo, M.B.A, D.B.A.  
(Keio University)  
Business and Social model
- Hisakazu Hada, Ph.D.  
(Keio University)  
Testbed and Experiment
- Jin Mitsugi, Dr.Eng.  
(Keio University)  
Standardization and technolog
- Yukiko Yumoto  
(Keio University)  
Industrial Deployment

# Cooperative relationship in Japan



# Keio Lab Activities (FY2004) - 1

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- Internet Technologies
  - Software of systems which make use of RFID, includes:
    - Overall System Architecture and Specification
    - ONS - locate a service
      - (EPCglobal Spec) design, resolver sample implementation
    - Storage/Database design
  - Several experiment at trade shows, etc.
    - We use UHF tag at our Research Forum, first time in Japan
    - Help some pilot test in Japan (Government fund)

# Keio Lab Activities (FY2004) - 2

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- RF Technologies
  - UHF RFID fundamental link model establishment
  - Prediction of tag performance
  - Work with government to introduce UHF tags in Japan
  - Measurement of read performance of tags in realistic environment
- Business and Social Model
  - How we can develop business which make use of IDs acceptable by society.

# Recent RFID activities in Japan

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- Ubiquitous-ID Center
  - Led by KEN Sakamura (University of Tokyo/TRON)
  - Join many companies in Japan
  - Tight cooperation with Auto-ID Lab, Keio
- Hibiki Project
  - Low-cost UHF tag technology development project
- Government funded Field Trials
  - Seven projects were funded by METI
  - To develop new business model with RFID
  - Spectrum allocation and Ubiquitous Networking by MIC

# Hibiki Project

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- Background
  - In year 2003, METI (ministry of Economy, Trade and Industry), asked for proposals on low-cost UHF tag technology development
  - Hitachi has applied and was accepted
- Hibiki Project led by Hitachi
- Goals
  - Achieve in 2 years period (2004-2005) to develop UHF band RFID inlet technology which would provide selling price of 5 Japanese yen (little less than 5 US cents)  
Needs to be interoperable with global standard (ISO, EPCglobal)

# Field trials in Japan

- To encourage new business model with RFID, METI conducts 7 RFID field trials in Japan.
  - Apparel /Department store
    - women's apparel logistics at warehouse
    - Woman's shoes logistics and sales promotion
  - International Logistics
    - To increase efficiency of supply chain management, readability of palletized products
  - Publishing
    - Source-tagging book productive process, logistics, user-service
  - CD/DVD
    - Logistics from maker to retailer
  - Pharmacy
    - Logistics, readability of item-level tagging
  - Construction machine maker
    - Readability, visualization process of parts delivery (logistics)
  - Home electric appliance
    - Logistics from maker to wholesaler
- Many Field trials and prototype implementation by companies.

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# Appendices

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# Software

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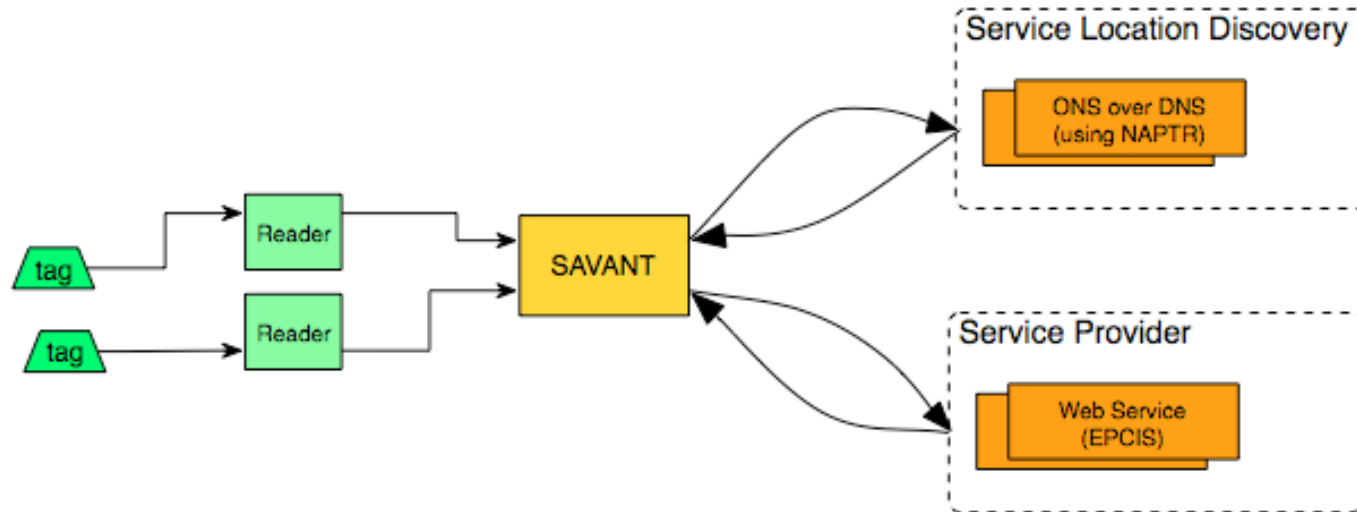
# Auto-ID System Original Concept

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- Apply cost-effective tags encoded with globally unique code at item level
- Establish standard based architecture to provide service bound to the tag

.. To create “Internet of Objects”

# Original Auto-ID Center Picture: SAVANT

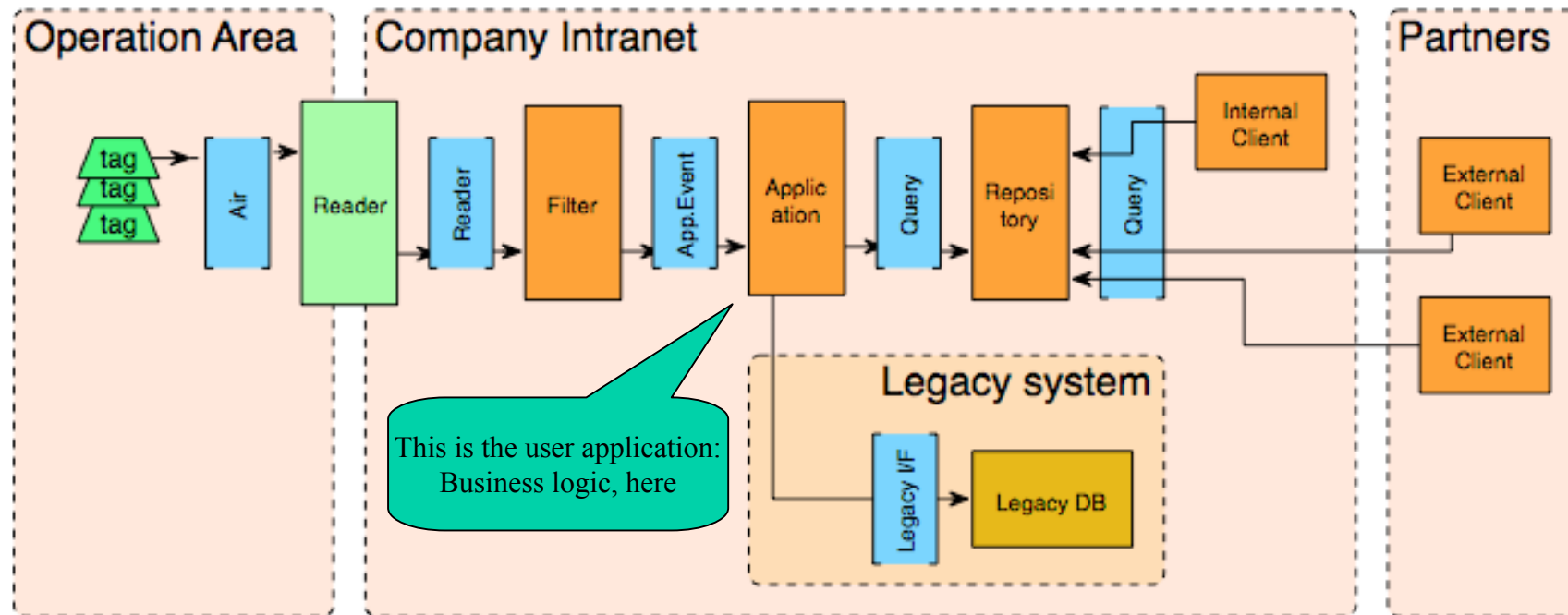


- Event Handler “Savant” read/aggregate/filter then forward a request specified by ONS, to some WebService.
- Savant act as an information router.

# Framework of EPCnetwork

- EPC – globally unique code
  - Total 96 bits (current version)
    - Header(8), Manager(8 to 35), Class(36 to 59), Serial(60 to 95)
  - Air protocol: Class 1 Gen 2 Spec is the latest
  - Encoding scheme: Tag Data Standard
- ONS(Object Naming Service) – provide a service to locate a service from an EPC
- Several other inter-functional-module APIs are in development
  - EPC-IS – provide some information service to clients
  - Reader protocol

# Current EPCglobal Framework



- Well defined layer of event generator area
- Application is where user implement their application
- Query interface and logical model of data in repository are defined in terms of Supply Chain Management application

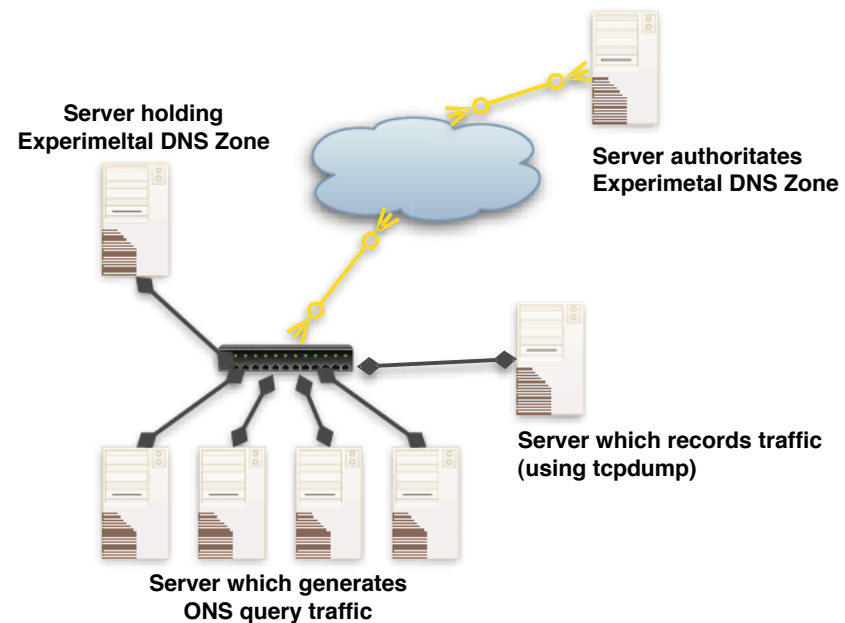
# ONS Specification

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- Auto-ID Lab Japan actively participate to define the ONS Specification at EPCglobal working group
- Several sample resolver implementations are developed
- Several experiments using ONS over DNS

# ONS over DNS Experiment

- Object Name Service(ONS) is a core technology which allow to locate a server which contains information bound to given EPC. One of ONS deployment option is based on Domain Name System(DNS).
- According to it's distributed nature and different characteristics from relational database technology which is very common to supply chain management, we need to prove how ONS over DNS work well in supply chain management field.
- We started experiment of ONS over DNS and just finished early experiment.



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# Hardware

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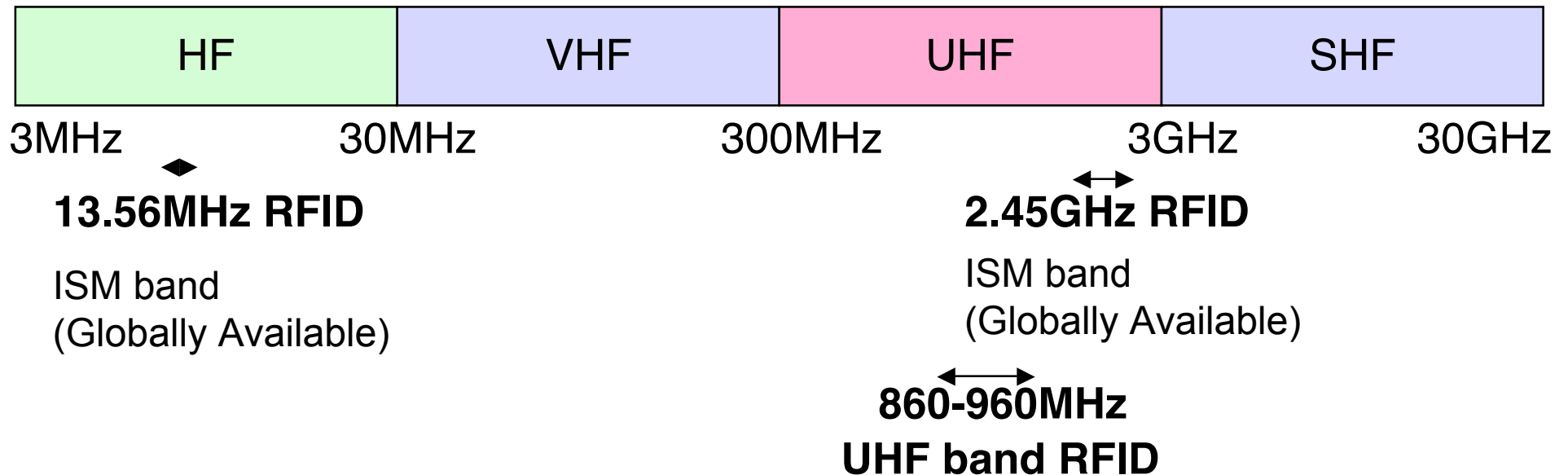
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# RFID wireless technology very basics

There are three major RFID available frequency bands HF (13.56MHz), UHF(860-960MHz), Microwave(2.45GHz).

Frequency band 13.56MHz and 2.45MHz is globally available while the frequency allocation in UHF band varies.



# Typical usage of RFID frequency bands

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- 13.56MHz:
  - Railway toll system(Japan: 13million cards issued)
  - National Identification card (China:1billion will be issued in next few years)
- 860-960MHz:
  - Supply Chain Management(Walmart, DoD, Metro)
- 2.45GHz:
  - Manufacturing management

# RFID : Recent Developments in Wireless technology and Radio Regulation

- Technical development
  - EPCglobal UHF Class 1 Generation 2 Air protocol is finalized and now in ISO TYPE-C discussion
- Business trials abound
  - Number of RFID business trials have been performed.
- Regulatory development
  - Local radio regulations to allow UHF band RFID have been developed in Korea, Japan and EU.

# EPCglobal Gen2 Air-Protocol

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- Features
  - Interoperability
  - Fast reading (Reader to tag 160kbps, Tag to reader 640kbps)
  - Tags can accommodate international usages (adapt to various local radio environment)
  - High functionality tags
    - Tag Kill function with password
    - Tag lock function with password

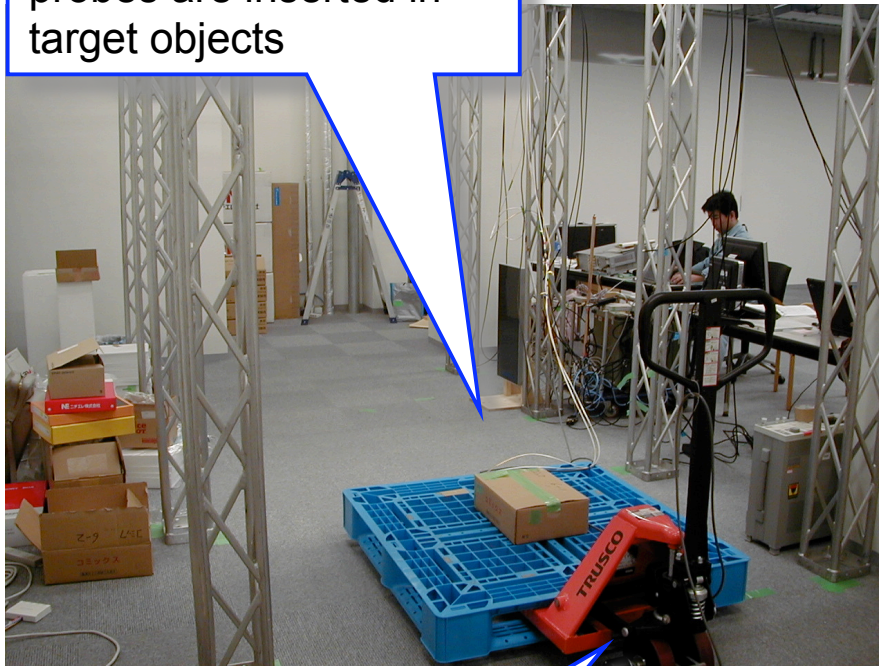
## **Auto-ID Lab. Japan achievement in wireless technology**

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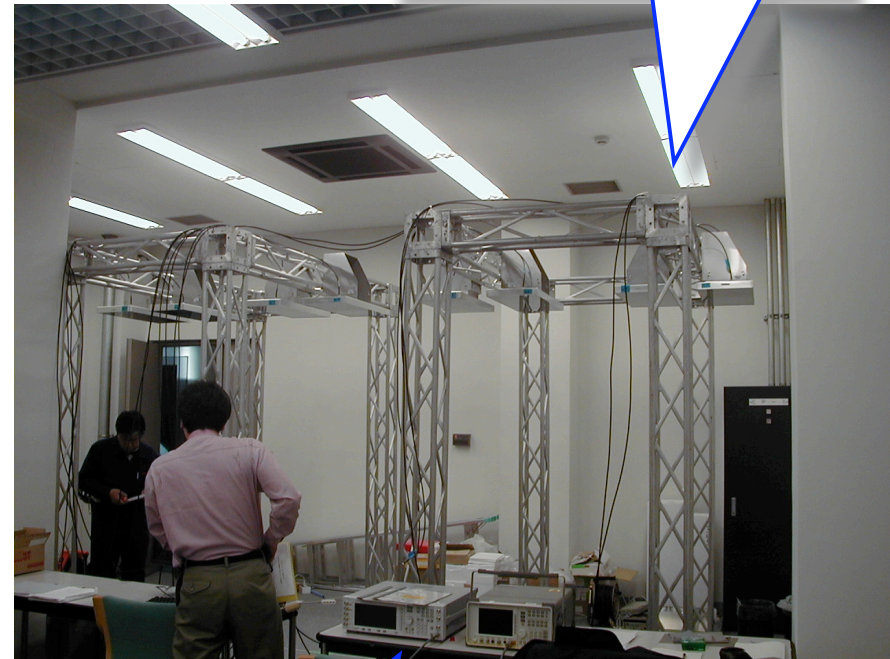
1. Prediction of multiple tag reading performance.
2. Tag readability evaluation with industrial bodies.
3. Extensive contribution to Japan local radio regulation development.

## RFID gate experiment

Specially designed probes are inserted in target objects



Multiple RFID readers



movable pallet with accurate position sensor

Measuring Instrument

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# **Business Model and Social Acceptance**

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# An innovation begin to germinate when unifying Product ID, Personal ID and Activity ID at one field

