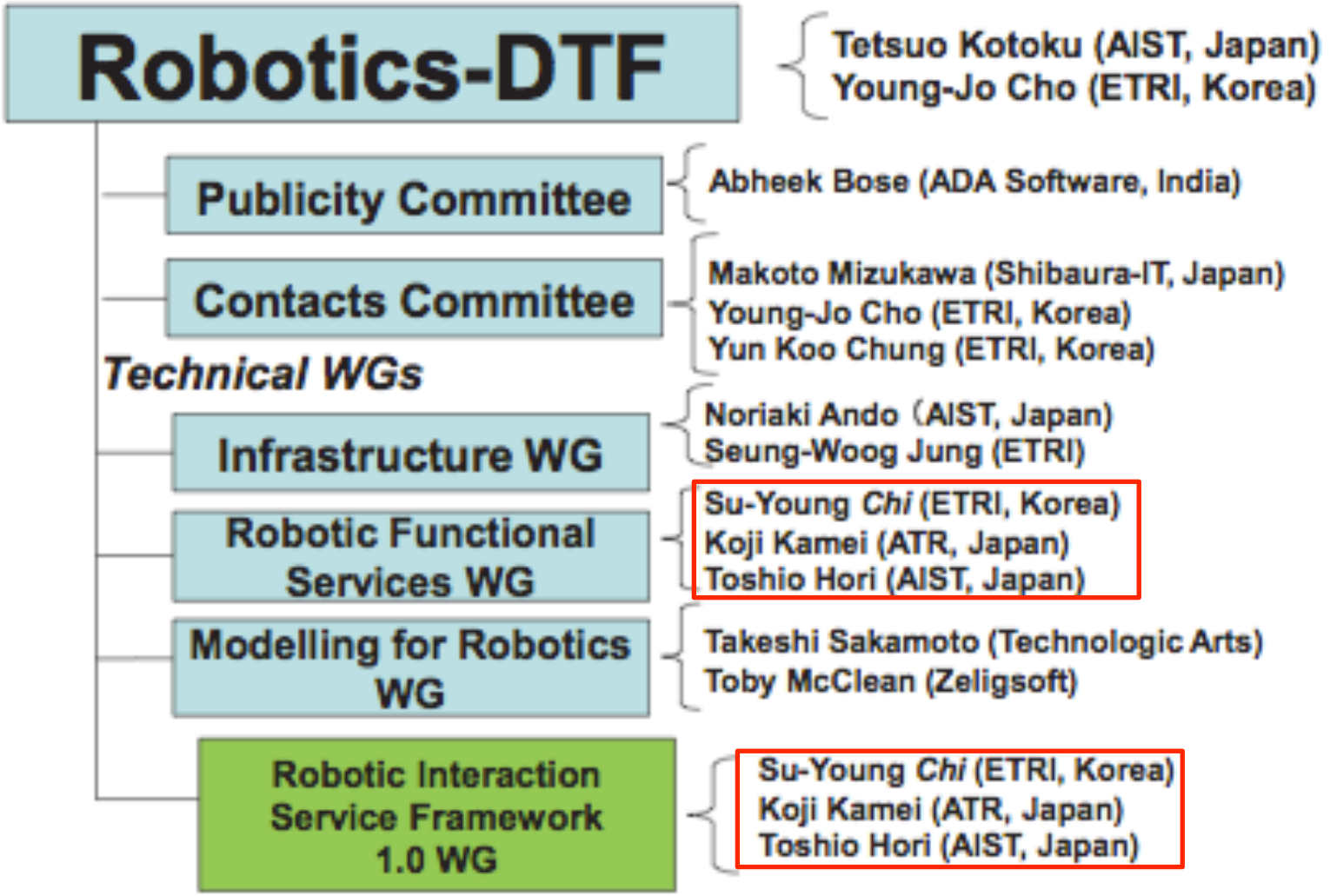
Part 1: Introduction to RLS 1.1 Spec.
Part 2: Introduction to RoIS 1.0 Spec.
Part 3: Introduction of UNR Platform

an implementation of RoIS and RLS Spec. in Japan

Presentation: Koji Kamei (JARA / ATR)
Co-Chair of Robotic Functional Services WG

OMG Robotics Information Day, Burlingame, Dec. 11, 2012

Organization (from March. 20th, 2012)



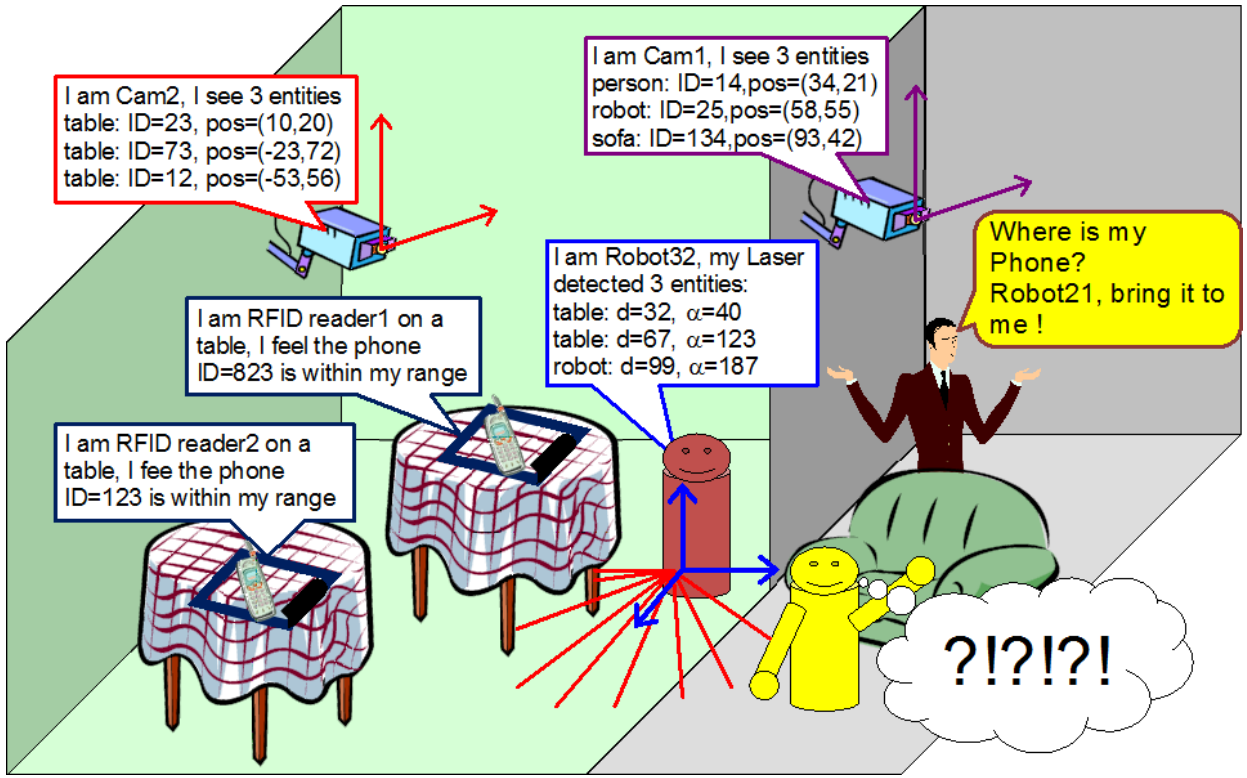
Introduction to Robotic Localization Service (RLS-1.1) Specification

Shuichi Nishio (JARA / ATR)
Chair of Robot Localization Service (RLS-1.1) RTF

Koji Kamei (JARA / ATR)

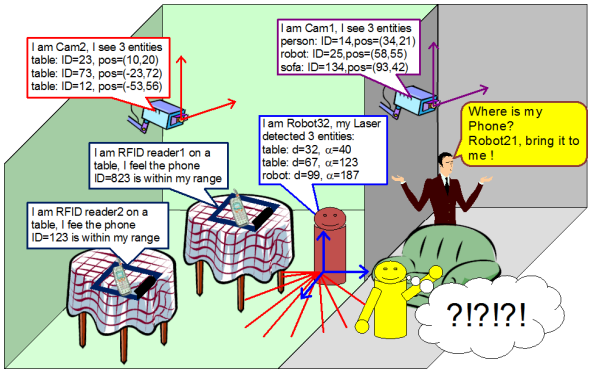
RLS: Robotic Localization Service

Defines a localization service for providing robotic services:
ex. navigation, manipulation and human-robot interaction.



Challenging issues in the example

- Some sensors only provide partial location information.
  - The camera sensor can only provide 2D information, and RF tag reader can only provide proximity information.
- Sensor outputs are not always correct.
  - They might measure two or more entities as a single object or even miss it.
- Matching observations between different sensors require efforts.
  - The identity association problem happens every time multiple sensors are used: the wall camera and the laser range scanner install in the robot provide different aspects of objects.



RLS Features

- A new framework for robotic localization (“RoLo” used as prefix)
  - Representation of location information specific to robotic usage.
  - Based on the widespread GIS standards. (ISO/TC211)
- Architecture package (RoLo architecture)
  - Data architecture for representing structures and accompanying operations for representing information necessary for robotic usage.
  - Coordinate system / coordinate reference system definitions for pose or identity information.
  - Structures for representing error estimation.
- Data Format package (RoLo format)
  - Data formats for formatting and exchanging resulting localization data.
- Interface package (RoLo service)
  - Service interface for treating resulting localization data.
  - A basis for dynamically negotiating module functionality information.

RLS: History

2007/06: RFP for Robot Localization Service (RLS) issued. (Brussels)
2007/12: initial submissions from ETRI and JARA. (Burlingame)
2008/06: revised submission. FTF chartered. (Ottawa)
2009/06: final report from FTF approved. (Costa Rica)
2010/02: RLS 1.0 published. (formal/2010-02-03)
2011/06: final report from RLS1.1-RTF approved. (Salt Lake City)
2012/08: RLS 1.1 published. (formal/2012-08-01)

Liaison with ISO/TC211 will be considered as a part of RLS 2.0 work.

submitted by

Electronics and Telecommunications Research Institute (ETRI)
Japan Robot Association (JARA)
Samsung Electronics Co., Ltd.

supported by

Hitachi, Ltd. / National Institute of Advanced Industrial Science and Technology / New Energy and Industrial Technology Development Organization / Shibaura Institute of Technology / Technologic Arts Incorporated / University of Tsukuba

Changes in RLS version 1.1

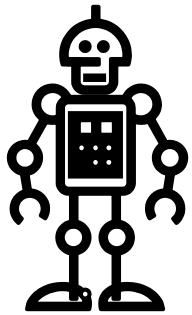
- Bug fixes
- Pose representation extended
  - representing pose information in combination with position information.
  - partially revised in this version and will be totally revised in the next version (in coordination with ISO/TC211).
- Identity (ID) Information extended
  - two coordinate reference systems and accompanying coordinate systems are defined for identity systems that are represented in numerical values and symbolic values
- Usage examples extended

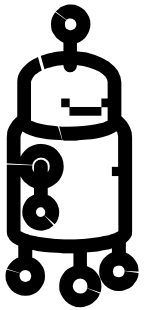
Introduction to Robotic Interaction Service (RoIS-1.0) Specification

Su-Young Chi (ETRI), Young-Jo Cho (ETRI)
Toshio Hori (AIST), Koji Kamei (JARA/ATR)

Service Robots in Our Living Environment

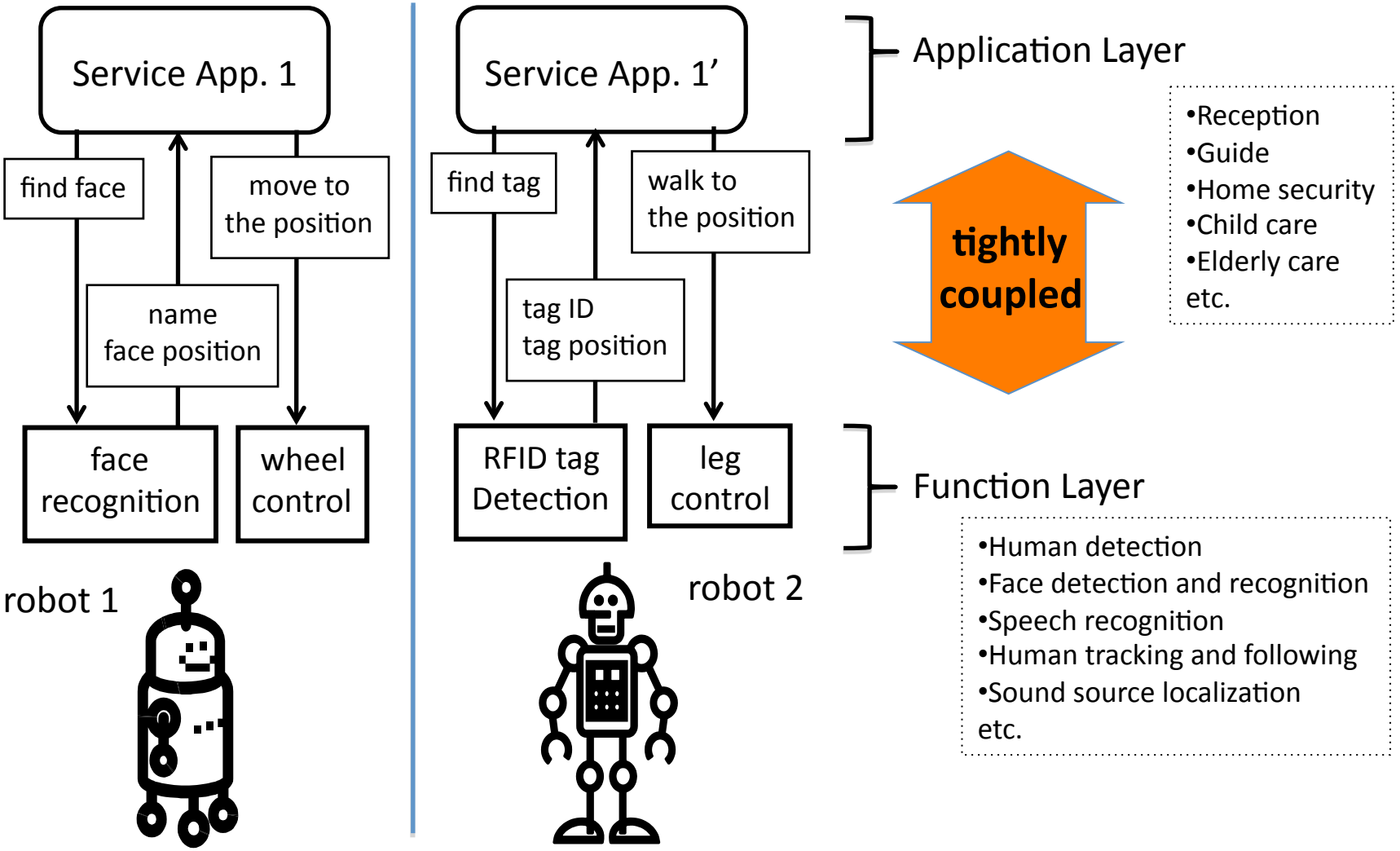
- Possible robotic services:
  - Reception service at the entrance
  - Guide service in museums
  - Home security
  - Childcare/Nursing robots
  - Elderly care robots, etc.



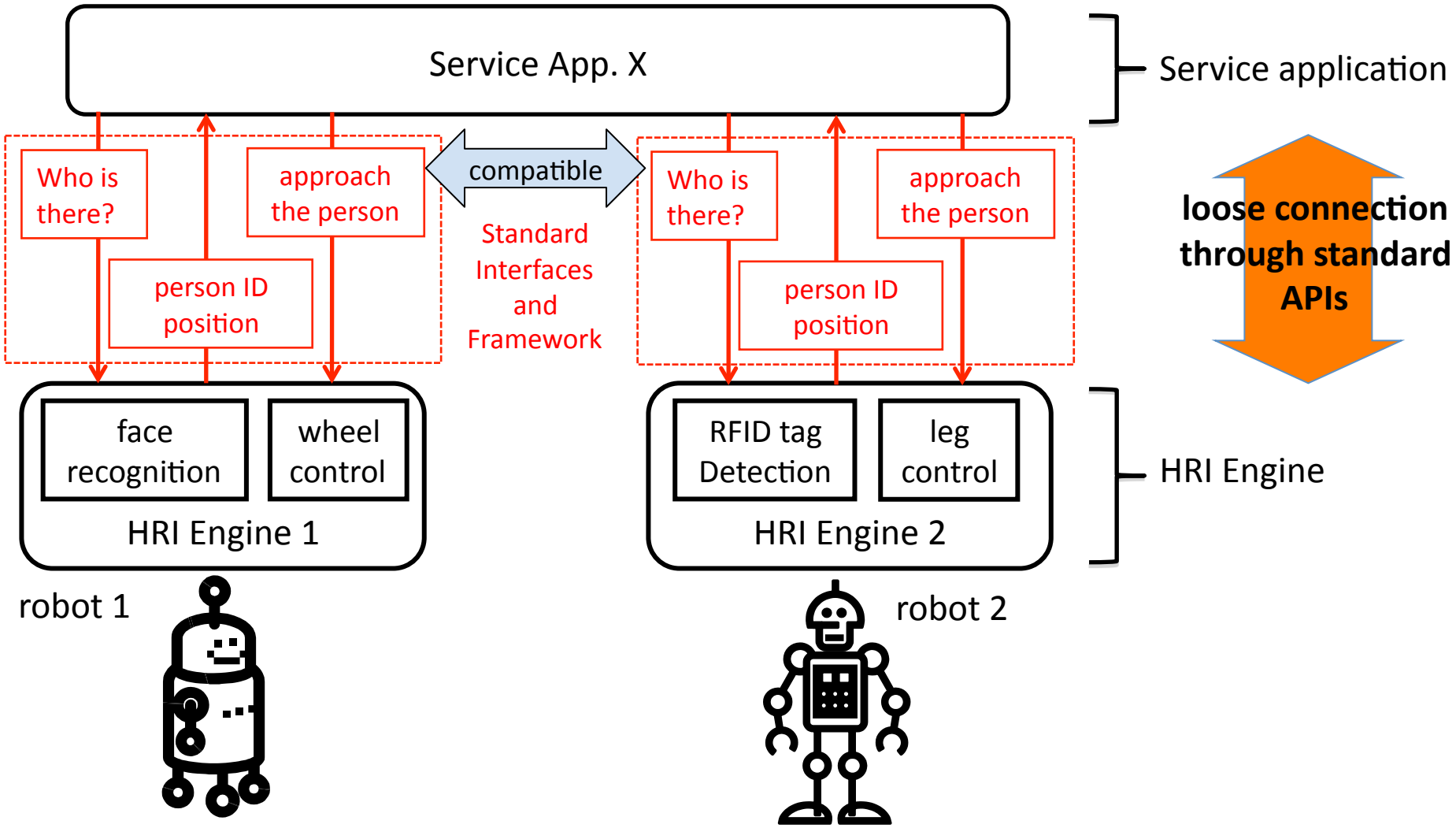


⇨ The service robot market will grow dramatically...

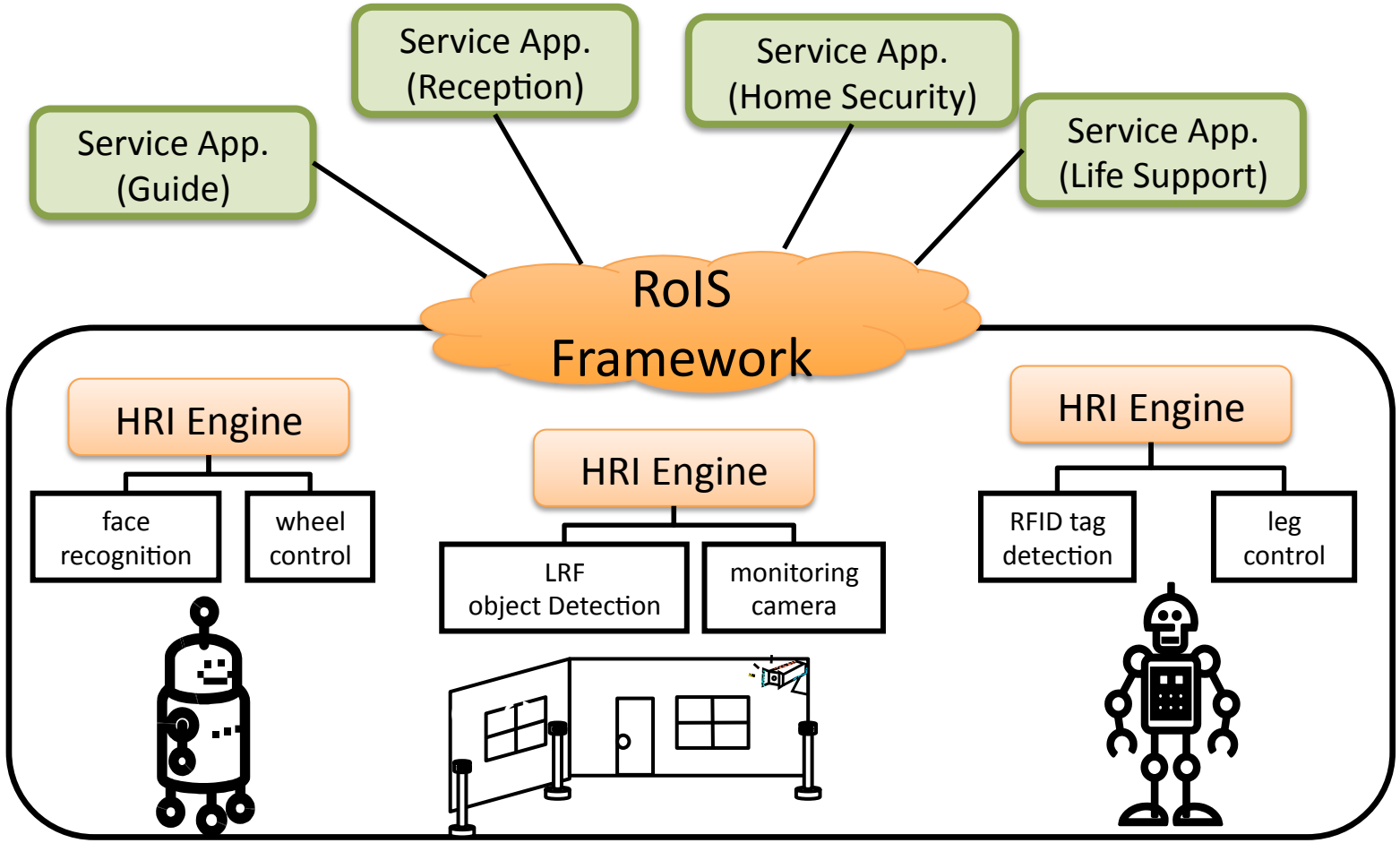
Existing Robotic Service Applications



Possible Solution of Software Reuse

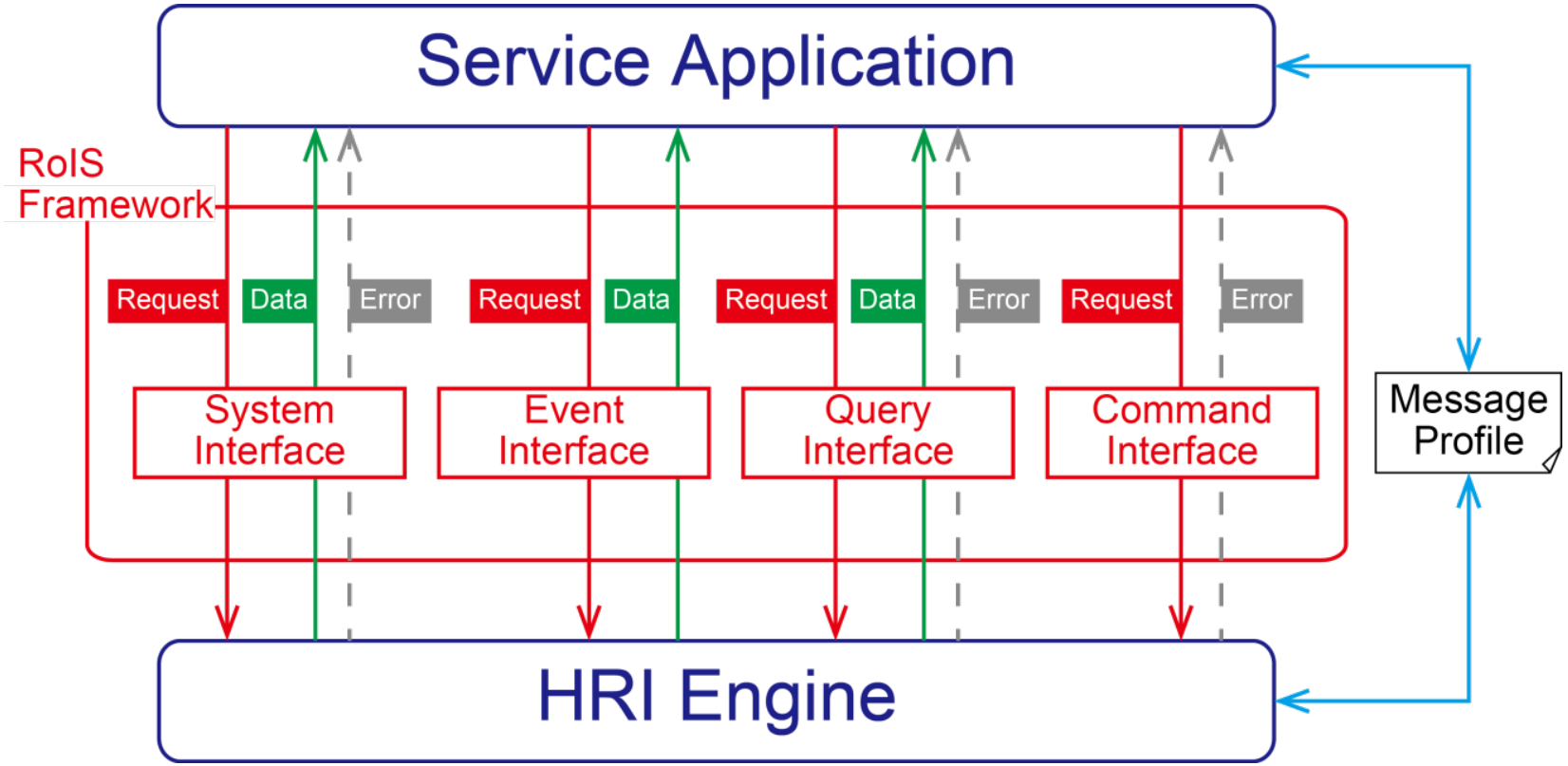


Schematic Picture of RoIS Framework



RoIS Framework defines messaging protocols between services and HRI Engines and profile description of functional components including 15 basic components.

Interfaces of RoIS Framework and its message flows



Interfaces defined in RoIS Framework

- **System Interface**
  - Manages the connection status between the Service Application and HRI Engine.
- **Event Interface**
  - Enables the Service Application to receive notifications on changes in HRI-Engine status.
- **Query Interface**
  - Enables the Service Application to query the HRI Engine on information it holds.
- **Command Interface**
  - Enables the Service Application to send commands to the HRI Engine.

HRI functions for Robotic Services

- Robotic services require Human-Robot Interaction functions
  - **To understand the surroundings**, such as
    - Person detection, Person identification,
    - Sound detection and
    - Speech recognition,

    } **Sensor-related functions**
  - **To provide services**, such as
    - Speech synthesis,
    - Reaction,
    - Navigation and Follow.

    } **Actuator-related functions**

⇨ RoIS provides 15 Basic HRI Components.

15 Basic HRI Components

Sensor-related Components

名称	機能
System Information	Acquire the system status
Person Detection	Detect number of person (s)
Person Localization	Detect position of people
Person Identification	Identify person(s)
Face Detection	Detect number of face(s)
Face Localization	Detect position of face(s)
Sound Detection	Detect number of sound sources
Sound Localization	Localize sound source(s)
Speech Recognition	Recognize spoken language
Gesture Recognition	Recognize person's gesture

Actuator-related Components

名称	機能
Speech Synthesis	Generates robot speech
Reaction	Performs specified reaction
Navigation	Moves to specified target location
Follow	Follows a specified target object
Move	Moves to specified distance or curve

Robot developers (i.e. HRI Engine providers) can provide HRI functions not listed here as User-defined HRI Components (with their profiles).

RoIS: History

2010/06: RFP for Robotic Interaction Service (RoIS) Framework issued. (Long Beach)

2010/12: initial submissions from ETRI and JARA. (Burlingame)

2011/06: revised submission approved. FTF chartered. (Salt Lake City)

2011/08: RoIS 1.0 Beta1 published. (dtc/2011-08-06)

2012/06: final report from FTF approved. (Cambridge)

2012/09: RoIS 1.0 Beta2 published. (dtc/2012-06-27)

RoIS 1.0 Specification will be published soon.

submitted by

Electronics and Telecommunications Research Institute (ETRI)
Japan Robot Association (JARA)

supported by

Advanced Telecommunications Research Institute International / Future Robot Co., Ltd. / Hitachi, Ltd. / Korean Robot Association / National Institute of Advanced Industrial Science and Technology / New Energy and Industrial Technology Development Organization / Shibaura Institute of Technology / Technologic Arts Incorporated / University of Tokyo / University of Tsukuba

UNR Platform

a software platform for robotic services that implements RoIS and RLS Specifications

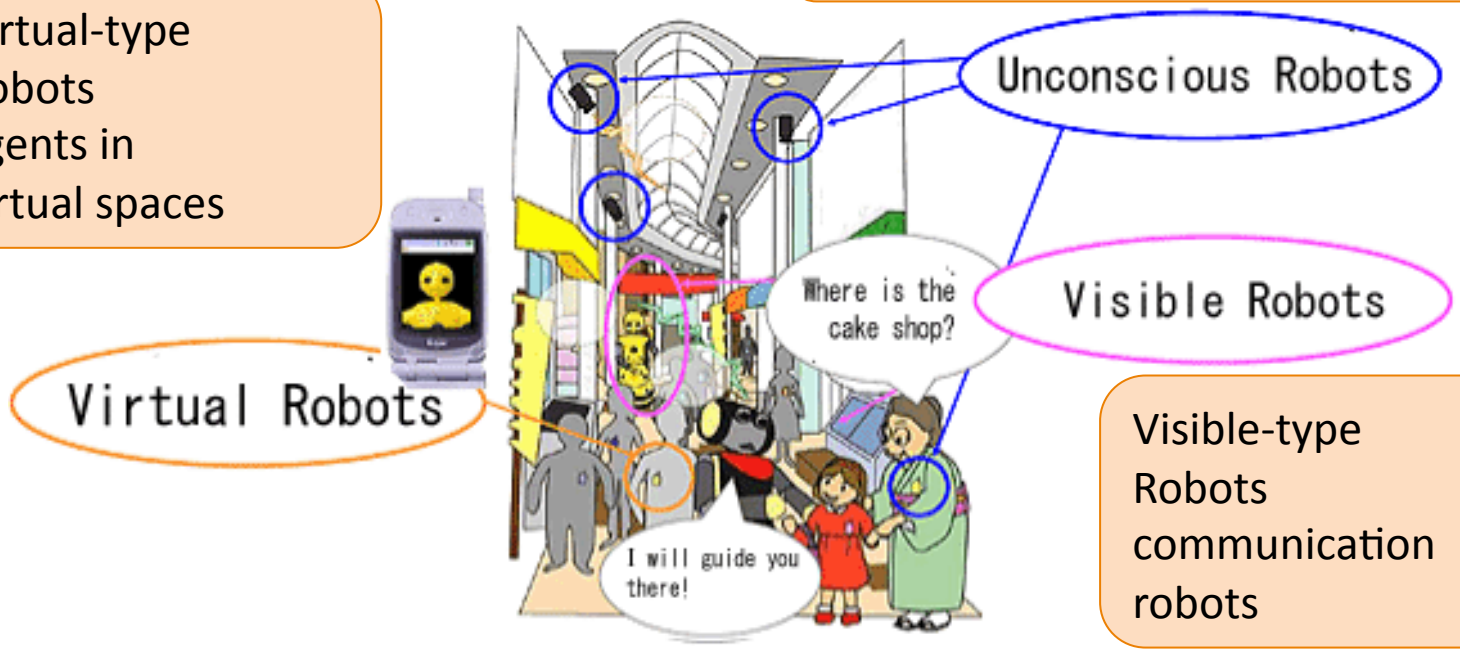
Koji Kamei (ATR)

Shuichi Nishio (ATR)

Networked Robot System (2004 - 2009)

Unconscious-type Robots
sensors embedded in environments

Virtual-type
Robots
agents in
virtual spaces



Visible-type
Robots
communication
robots

Coordination of three different kinds of robots
to support activities of people in real-world environments

Ubiquitous Networked Robots for Life Support (2009 – 2013)

One location (NR)

2004-2009

Multiple locations (UNR)

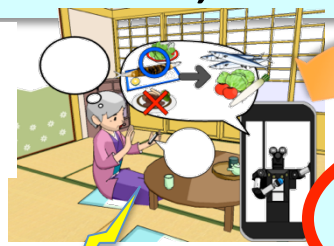
Human-Robot Interaction

Hospital, Rehabilitation center, …

Home, Nursing home, …

Multi-Robot Collaboration and Coordination

One location to Multi-location

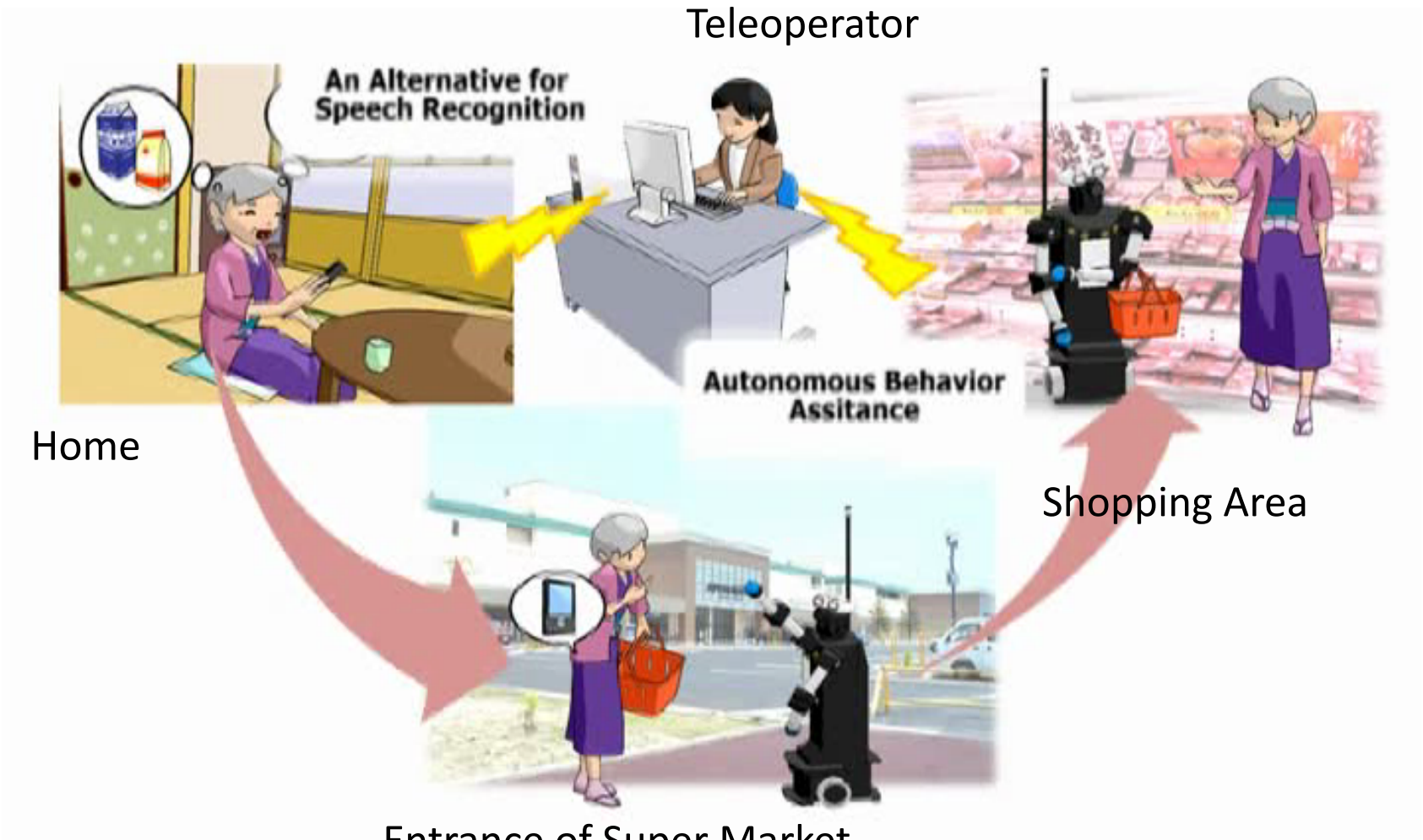


Ubiquitous Network Robots Platform

Shopping mall, Station, …

Tele-operated Communication

Shopping Support for Elderly Customer (2009)



Shopping Guidance with UNR over Three Areas

Area 1: Home

Shopping list with a smart phone

Advanced ICT will be available

Area 2: Entrance of Super Market

Say hello with networked robots

Fully equipped environment in sensor network or WLAN environment

Area 3: Shopping Area

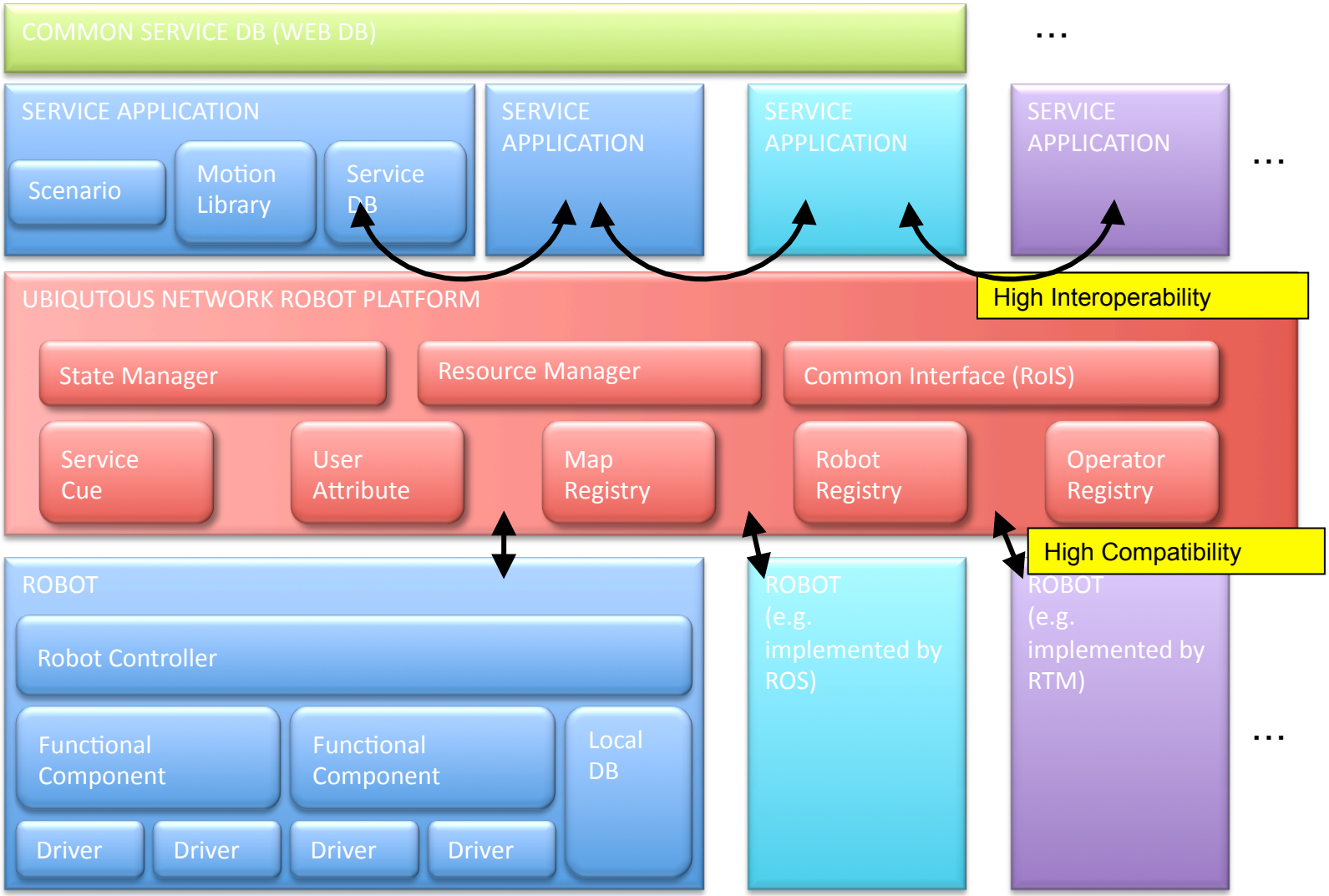
Combination of Autonomy and Tele-operation

Communication with robots create emotional happiness

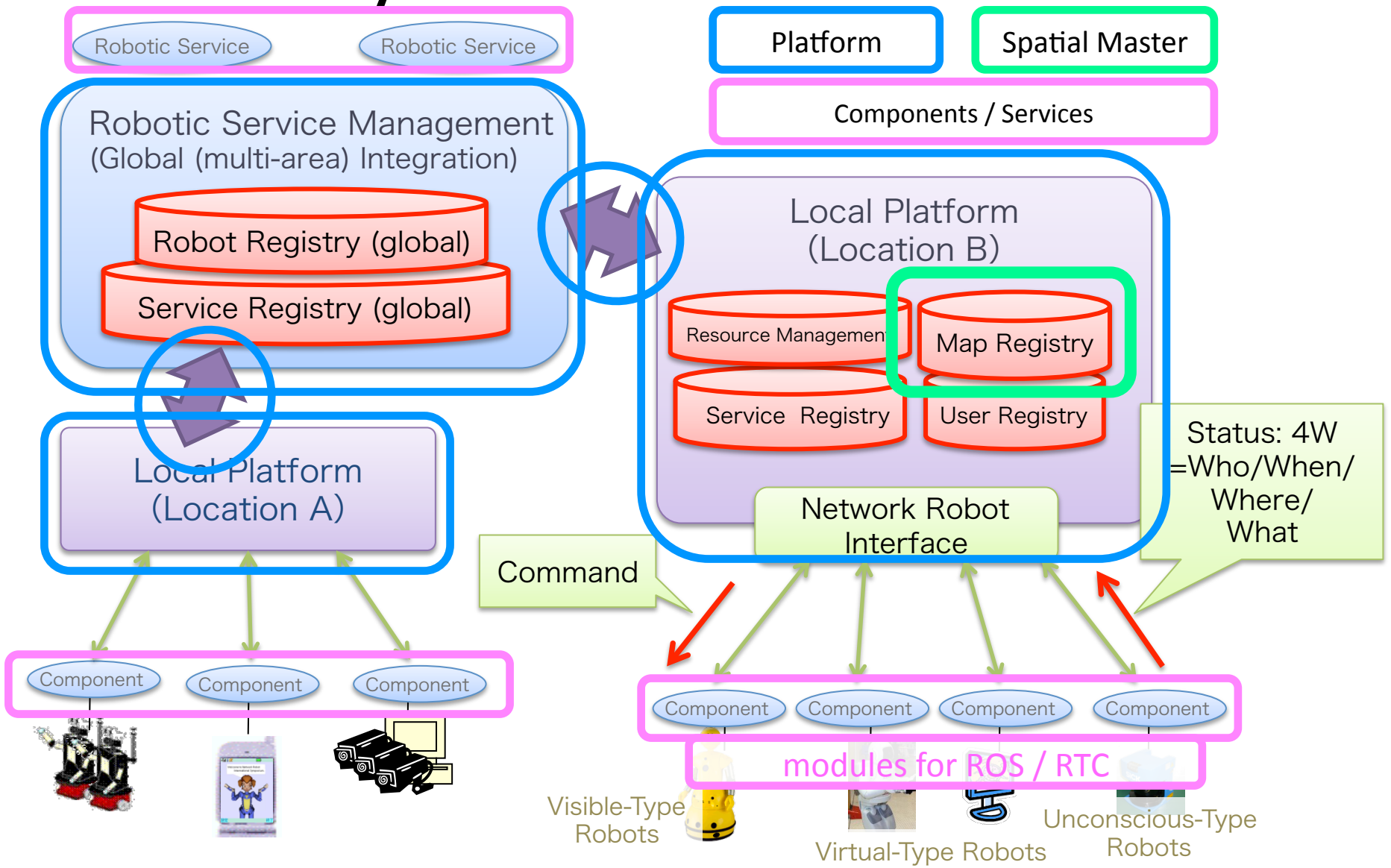
UNR Platform

- separates the developments of robots and robotic service applications.
- connects various service applications to appropriate robots in a variety of places.
- permits service applications to share their own data between each other.

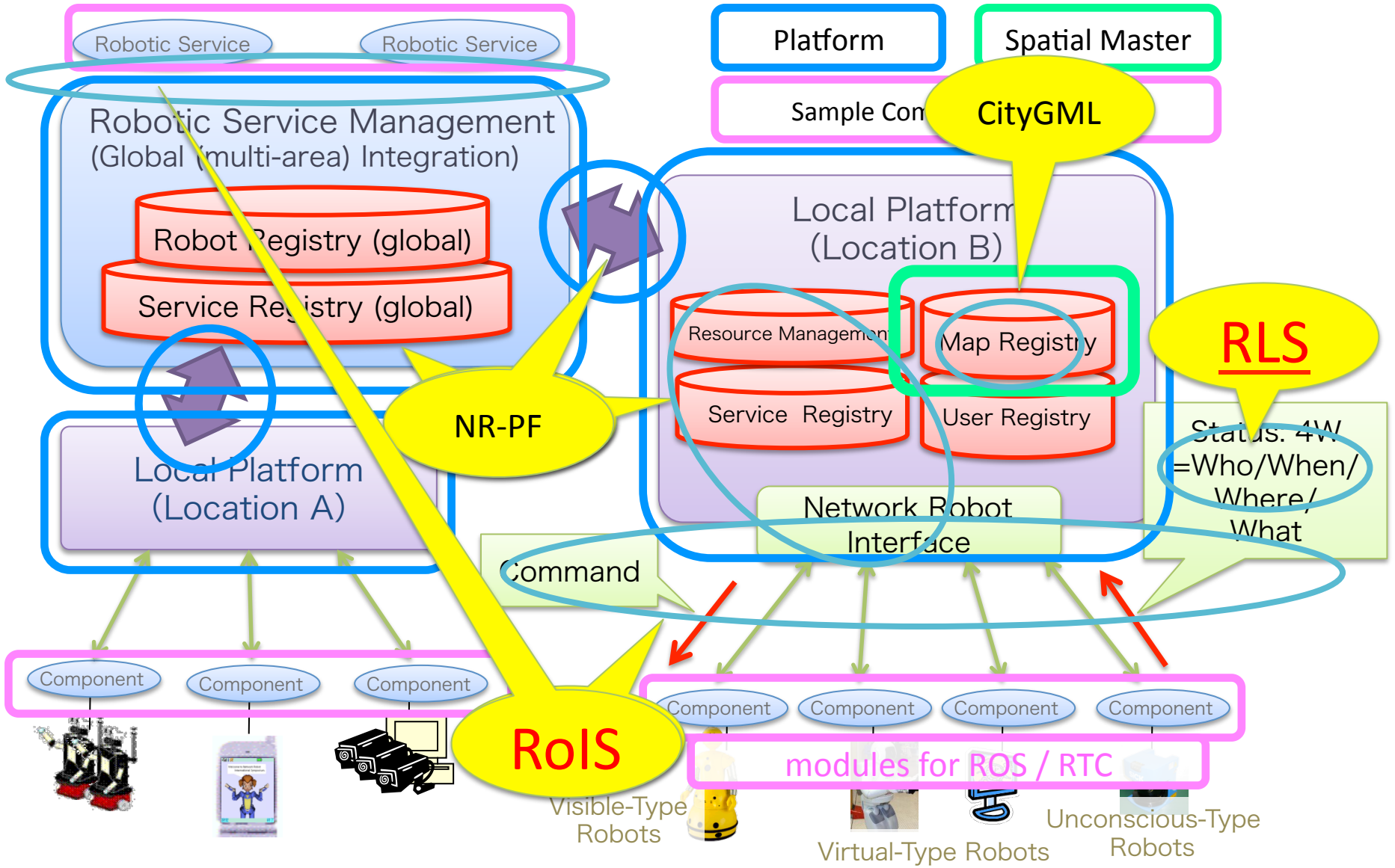
UNR Platform Architecture



Two-Layer Platform Architecture

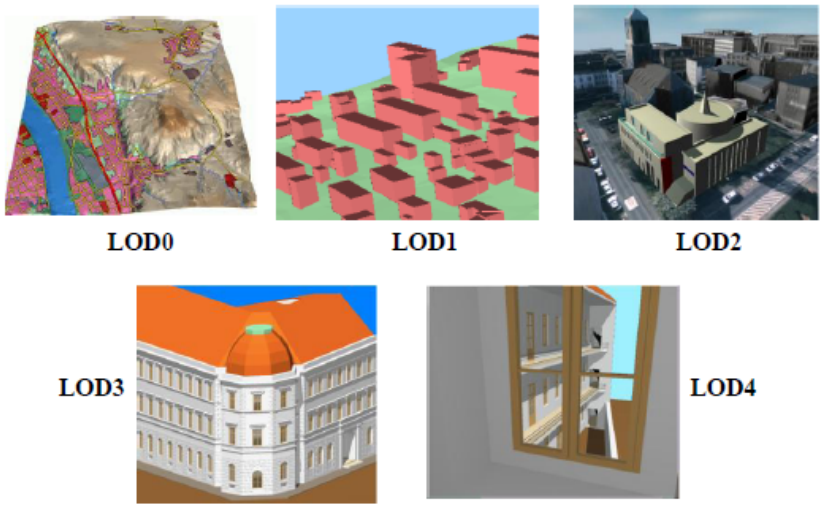


Standardization



OGC CityGML

- OGC: Open Geospatial Consortium
- CityGML: City Geography Markup Language
  - An open data model and XML-based format for the storage and exchange of virtual 3D city models
  - CityGML 1.0 (2008/08) → CityGML 2.0 (2012/04)



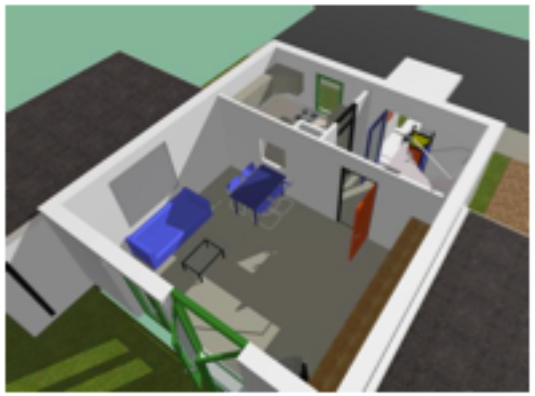
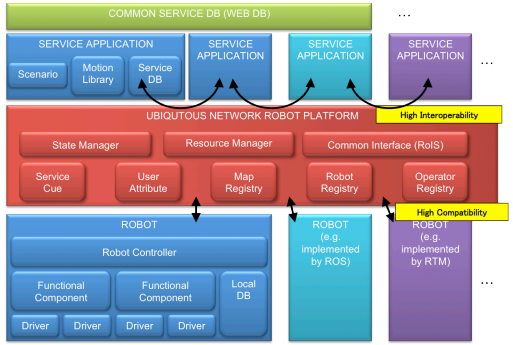


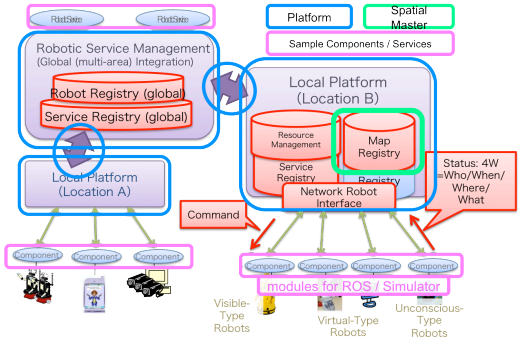
Fig. 2: The five levels of detail (LOD) defined by CityGML (source: IGG Uni Bonn)

from http://portal.opengeospatial.org/files/?artifact_id=47842

ITU-T SG16/Q25 F. USN-NRP

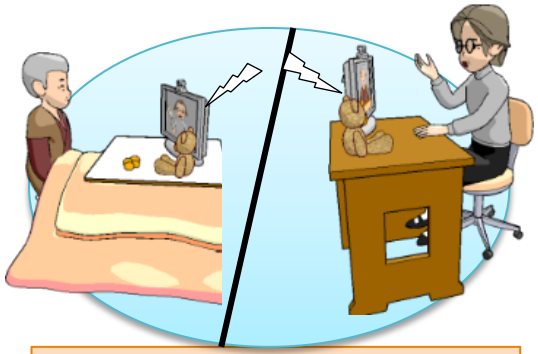
- Functional requirements for Network Robot Platform
- ITU-T SG16 Q25(USN: Ubiquitous Sensor Network)
- Originally proposed as NRP (Network Robot Platform) then expanded to multi-location UNR architecture.
- Expected to reach “concent” in Jan. 2013.



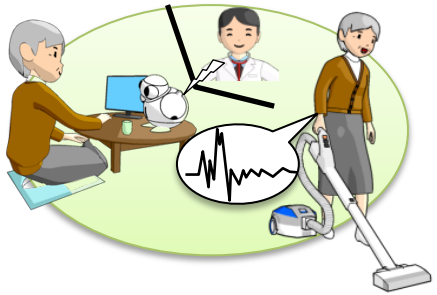


Robotic Services

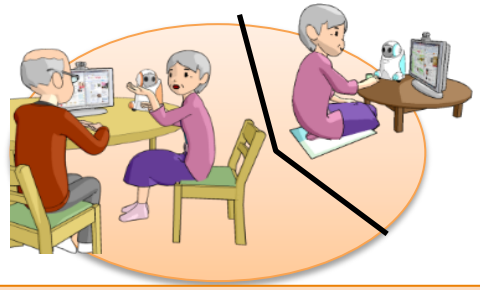
- Shop guidance
- Shopping support
- Touring support



Active hearing



Health care



Community building support

Cloud Networked Robotics

Cloud Networked Robotics

Koji Kamei, Shuichi Nishio, and Norihiro Hagita, Advanced Telecommunications Research Institute International (ATR)
Miki Sato, DENSO Corporation

Abstract

This article proposes a new field of research called *Cloud Networked Robotics*, which tackles the issues for supporting daily activity, especially for the elderly and the disabled, throughout various locations in a continuously and seamless manner by abstracting robotic devices and providing a means for utilizing them as a *cloud of robots*. With recent advances in robotic development environments and in integrated multi-robot systems, robots are acquiring richer functionalities and robotic systems are becoming much easier to develop. However, such stand-alone robotic services are not enough for continuously and seamlessly supporting daily activity. We examine the requirements in typical daily supporting services through example scenarios that target senior citizens and the disabled. Based on these requirements, we discuss the key research issues in cloud network robotics. As a case study, a field experiment in a shopping mall shows how our proposed prototype infrastructure of cloud networked robotics enables multi-location robotic services for life support.

IEEE Network Magazine, vol. 26, no. 3, pp. 28-34, May 2012
Special Issue on Machine and Robotic Networking
http://dx.doi.org/10.1109/MNET.2012.6201213

UNR Platform Alpha Release

- URL
  - http://www.irc.atr.jp/std/UNR-Platform.html
- Alpha Release includes…
  - Platform System
  - Spatial Master Database System
  - Sample Programs
    - Sample Component and Service
    - Sample Scenario for Component Allocation
  - Documents
    - User Guide (How to setup and execute sample programs)
    - Programming Guide (How to use API libraries)
    - Technical Documents (Class Diagram, Sequence Diagram)

Open Source