Robotics Domain Task Force Final Agenda ver.1.0.3						**robotics/2007-03-01**
OMG Technical Meeting - **San Diego, CA**, USA -- March 26-30, 2007						
		TF/SIG		http://robotics.omg.org/		
		Host	**Joint (Invited)**	**Agenda Item**	**Purpose**	**Room**
Sunday (Mar. 25)						
				No business		
Monday (Mar. 26) WG activity						
9:00	10:00	Robotics	(SDO)	Robotics Steering Committee	Robotics/SDO Joint Meeting Kick-off	San Remo, Ground FL
10:00	12:00	RTC-FTF		**RTC FTF meeting** (2h): - Rick Warren	discussion	San Remo, Ground FL
		Robotics		**Profile WG(2h):** - Seung-Ik Lee, Bruce Boyes	discussion	Portofino A, Ground FL
12:00	13:00	**LUNCH**				Pavilion, Ground FL
13:00	18:00			Architecture Board Plenary		Aventine A, Ground FL
13:00	17:30	Robotics		**Robotic Services WG(4h)** : - Olivier Lemaire and Soo-Young Chi PM 13:00 - 13:15 : Welcome - Roadmap presentation PM 13:15 - 13:45 : "Short Introduction to the ISO19100 Specifications" - Olivier Lemaire (AIST) PM 13:45 - 14:15 : "A brief Report for ISO 19116 Positioning Service Standard" - Dr Han (ETRI) PM 14:15 - 14:40 : "Need for position data quality indication for Agricultural robots" - Dr Nagasaka (NARC) PM 14:40 - 15:10 : "Introduction to Localization related projects at AIST" - Dr Tetsuo Tomizawa (AIST) PM 15:20 - 16:00 : "Ultrasonic 3D tag system for robot localization" - Dr Toshio Hori (AIST) PM 16:00 - 16:40 : "Experience using ISO19100 for developing Robotic Systems" - Dr Itsuki Noda (AIST) PM 16:40 - 17:30 : Discussion	discussion	Portofino B, Ground FL
Tuesday (Mar. 27) Robotics Plenary						
9:00	10:00	Robotics		Robotics Information Day in Brussels Planning with OMG Marketing Staff	planning for next meeting	Portofino B, Ground FL
10:00	12:00	Robotics		**Profile WG(2h):** - Seung-Ik Lee, Bruce Boyes	discussion	Portofino A, Ground FL
				Robotic Services WG(2h) : - Olivier Lemaire and Soo-Young Chi AM10:00 - 11:30 : Discussion (cont'd) AM11:10 - 11:30 : "Introduction to User Identification Service" - Dr. Soo-Young Chi AM 11:30 - 12:00 : Roadmap review, Homework, Next meeting WG Schedule	discussion	Portofino B, Ground FL
12:00	13:00	**LUNCH**				Pavilion, Ground FL
13:00	13:15	Robotics		Joint Plenary Opening	Robotics/SDO joint plenary kick-off	Mykonos, 2nd FL
13:15	14:15	Robotics		Special Talk: Adaptive Service Media as Intelligent Environment - Hajime Asama (Univ. of Tokyo)	presentation and discussion	
14:15	**15:15**	Robotics		**Robotics Localaization Functional Service RFP** **- Olivier Lemaire (AIST)**	**1st Review**	
Wednesday (Mar. 28) Robotics Plenary						
9:00	12:00	RTC-FTF		RTC-FTF meeting (3h)		Athenia A, 2nd FL
12:00	14:00	**LUNCH and OMG Plenary**				Pavilion, Ground FL
14:00	15:00	Robotics	(SDO)	Special Talk: "Introduction to RoSta activities" - Erwin Prassler (GPS Gesellschaft für Produktionssysteme GmbH)	presentation and discussion	Athenia A, 2nd FL
15:00	16:30	Robotics	(SDO)	WG Reports and Roadmap Discussion (Robotic Services WG, Profiles WG)	reporting and discussion	
				Break (15min)		
16:45	17:15	Robotics	SDO	Contact Reports: - Makoto Mizukawa(Shibaura-IT), and Yun-Koo Chung(ETRI)	Information Exchange	
17:15	17:30	Robotics	(SDO)	Publicity SC Report, Next meeting Agenda Discussion	Robotics/SDO joint plenary closing	
17:30				Adjourn joint plenary meeting		
17:30	18:00	Robotics		Robotics WG Co-chairs Planning Session (Agenda for Brussels, Draft report for Friday)	planning for next meeting	Athenia A, 2nd FL
18:00	20:00	**OMG Reception**				Pavilion, Ground FL
Thursday						
9:00	12:00	RTC-FTF		RTC-FTF meeting (3h)		Parlor 1207, 12th FL
12:00	13:00	**LUNCH**				Pavilion, Ground FL
13:00	18:00			Architecture Board Plenary		Aventine A, Ground FL
17:00	18:00	MARS		Agenda Coordinatging Meeting - Brussels TM	planning for next meeting	Palatine A, Ground FL
Friday						
8:30	12:00			AB, DTC, PTC		Aventine BC, Ground FL
12:00	13:00	**LUNCH**				Pavilion, Ground FL
Other Meetings of Interest						
Monday						
8:00	8:45	OMG		New Attendee Orientation		Aventine C, Ground FL
9:00	12:00	OMG		Tutorial - Introduction to OMG's meeting and Middlewere Specifications		Delphi A, 2nd FL
18:00	19:00	OMG		New Attendee Reception (by invitation only)		Palm Court, Ground FL
Tuesday						
9:00	12:00	OMG		Tutorial - Introduction to the Data Distribution Service		Aventine A, Ground FL
17:00	18:00	OMG		RTF/FTF Chairs' Workshop		Rhodes, 2nd FL
Wednesday						
9:00	17:00	OMG		OMG Architecture Driven Modernization(ADM) Information Day		Avantine A, Ground FL
9:00	17:00	OMG		SOA Consortium Breakout / Meeting		San Remo/Portofino, Ground FL

Please get the up-to-date version from http://staff.aist.go.jp/t.kotoku/omg/RoboticsAgenda.pdf

Minutes of the Robotics DTF Plenary Meeting – Approved
December 5-6, 2006-12-06, Washington DC, USA
Robotics/2007-03-02

Minutes Highlights
. RTC has been discussed for finalization in meeting of RTC Finalization Task Force.
. 6 invited presentation in the Robotics DTF plenary meeting.
. Discussion of RFPs and roadmaps in 3 WGs
. Robotics publicity flyer of 4 pages completed
. WIKI system is recommended for discussion and reporting.

List of Generated documents

- robotics/2006-12-01 Final Agenda (Tetsuo Kotoku)
- robotics/2006-12-02 Anaheim Meeting Minutes [approved] (Hung Pham)
- robotics/2006-12-03 Steering Committee Presentation (Tetsuo Kotoku)
- robotics/2006-12-04 Roadmap for Robotics Activities (Tetsuo Kotoku)
- robotics/2006-12-05 Next Meeting Preliminary Agenda - DRAFT (Tetsuo Kotoku)
- robotics/2006-12-06 Software Radio Specification Overview (Jerry Bickle)
- robotics/2006-12-07 Plenary Opening Presentation (Tetsuo Kotoku)
- robotics/2006-12-08 Heterogeneous Network Middleware for a Personal Robot (Vitaly Li)
- robotics/2006-12-09 RTM on Java/HORB: Eclipse meets RT Components (Satoshi Hirano)
- robotics/2006-12-10 IEEE 1588: An Update on the Standard and Its Application (John C. Edison)
- robotics/2006-12-11 IEEE 1451 Smart Sensor Interface Standards (Kang Lee)
- robotics/2006-12-12 Super Distributed Objects - an example of implementation - (Shigetoshi Sameshima)
- robotics/2006-12-13 Anybot Studio (Soon-Hyuk Hong)
- robotics/2006-12-14 Robotic Devices and Data Profiles WG Report (Bruce Boyes)
- robotics/2006-12-15 Robotic Devices and Data Profiles WG Discussion (Seung-Ik Lee and Bruce Boyes)
- robotics/2006-12-16 Robotic Functional Services WG Report (Olivier Lemaire)
- robotics/2006-12-17 Robotic Functional Services WG Meeting Schedule (Olivier Lemaire)
- robotics/2006-12-18 Business case for the RFP on Robotic Localization Service (Olivier Lemaire)
- robotics/2006-12-19 Propose the Interaction Model Architecture for HRI Components Standardization (Su-Young Chi)
- robotics/2006-12-20 Infrastructure WG Report (Rick Warren)
- robotics/2006-12-21 Lego NXT and Microsoft Robotics Studio User Report (Bruce Boyes)
- robotics/2006-12-22 A Report of JAUS "Information Day" (Hung Pham)
- robotics/2006-12-23 Contact Report - ISO/TC184/SC2 (Makoto Mizukawa)
- robotics/2006-12-24 KIRSF - Contact Report (Yun-Koo Chung)
- robotics/2006-12-25 (Abheek Bose)
- robotics/2006-12-26 Closing Presentation (Tetsuo Kotoku)

- robotics/2006-12-27 DTC Report Presentation (Yun-Koo Chung)
- robotics/2006-12-28 Washington Meeting Minutes - DRAFT (Yun-Koo Chung, Bruce Boyes)

MINUTES

Dec. 5th, 2006, Tuesday, Kennedy Room
Attendees: 38
Abheek bose(ADA Software)
Antonello Cesavola (Honda Research Inst)

Bruce Boyes (Systronix)
BumHyeon Baek(KangWon National Univ)
Dave Stringer (Borland)
Fumio Ozaki (Toshiba)
Hirano Satoshi (AIST)
Ho-Chul Shin (ETRI)
Hong Seong Park(KangWon National Univ)
Hung Pham (RTI)
Jae Young Choi(KangWon National Univ)
Jan Popkon (Telelogic)
John Eidson(Agilent Technologies Inc.)
Kang Lee (NIST)
Kyuseo Han (ETRI)
Makoto Mizukawa (SIT)
Noriaki Ando (AIST)
Olivier Lemaire (JARA)
Rick Warren (RTI)
Rumtao Qu (AIST)
Shigetoshi Sameshima (Hitachi Ltd.)
Saehwa Kim(SNU)
Saku Egawa (Hitachi)
Seong Hoon Kim (KangWon National Univ)
Seung-Ik Lee (ETRI)
Soon Hyuk Hong (Samsung Electronics)
Su-Young Chi (ETRI)
T. Junggefeldr (SAAB)
Takaya Kubota (AIST)
Takashi Tsubouchi(U. of Tsukuba)
Tetsuo Kotoku (AIST)
Toshio Hori (AIST)
Vitaly Li (KNU)
Wonpil Yu(ETRI)
Yeon-ho Kim
Young Hoon Cho (KAIRA)
Yuichi Miyamoto(OIS)
Yun Koo Chung (ETRI)

9:45-10:00 Plenary opening

. Anaheim minutes were reviewed and approved. (1st motion Mizukawa(Shibaura I.T.), 2nd motion Yun Koo Chung(ETRI), White Ballot by Rick Warren(RTI))
. Washington meeting minute taker: Yun Koo Chung, Bruce Boyes

Presentation:
10:00-11:00 Heterogeneous Network Middleware by Vitaly Li (KangWon National Univ)
Robots are considered a distributed system, and they want deterministic behavior. Ethernet is not considered adequate for this. Their model considers CAN, RS232, USB, IEEE1394, ethernet (socket streams and data grams), and others. There is some provision for QoS but not

fully implemented, e.g., to prevent fast paths from overloading slower networks. They plan to be RTC-compliant. Architecture of HeNeM

During break: discussion with Kang Lee, Seung-Ik Lee and Bruce Boyes about 1451 and robotic sensors. One of Kang Lee's colleagues would like to present on Tue at San Diego about the OMG Ontology for sensors

11:00-12:00 RTM on Java/HORB: Eclipse meets RT Components

Satoshi Hirano, Runtao Qu, Takaya Kubota (Network Middleware Research Group, AIST).

. They are very pro-Java. In their experience, Java is 2-10X more productive than C++. It is safer, no pointer, security hole with stack overflow), and almost virus-free. Lots of students use Java.
. AIST technology is available for license.
. RTC implementation of RTM on JAVA/HORB
. Implementing a pendulum motion using network
. Performance issue – CORBA is too slow and may not suitable for real time requirement of a robot system.
. Deployment related to RTC. They had a long list of Deployment issues and requests, which I didn't entirely follow. They want to use a *deployment server* which will support perhaps millions of robots. They've been told their wish list is impossible. But they believe it can be done by starting simple and then adding more, to see what is possible
. Network middleware for embedded systems
. HORB: lightweight Java middleware

13:00-14:00 IEEE 1588 An updated on the standard and its application
by John Edison (Agilent)

. IEEE 1588 synchronizes real time clocks in nodes of a distributed networked system. Enables measurement and control based on time, not just on receipt of the message. 1588 is also LEC 61588. At least six vendors sell chips with 1588 support. Version 2 will go to ballot in June, 2007. 1588 version 2 has goals: Sub-nanosecond synchronization shorten timing messages, 2008. make them equal length (for telecom) - V2 Sync message is 46 octets vs 165 in V1.
. Application
Industrial automation and motion control, Test and measurement, Military and aerospace, Power Distribution,
Home Audio-visual: IEEE 802.1as – Sony, Guita, game, .., home Ethernet synchronous.. → biggest industry
Tlecommunications, Robot Team in action: Process relative motion, communication between Robots, IEEE 1588 on wireless communication

14:00-15:00 IEEE 1451 Smart sensor interface standards
by Kang Lee (NIST, IEEE TC9 chair), kang.lee@nist.gov

. Background – How IEEE 1451 comes about
. TEDs is similar to our idea for robotic transducer tagging. There are four levels of TEDs: Meta-TEDS, Transducer Channel, Calibration, and Geographic Locaiton, PHY, Mfgr defined, Text-based (XML). 1451.4 covers TEDs. TEDs can also be cached on the NCAP.
. Sensors<->TIM<->NCAP<->network
. Distributed smart sensor / actuator system
. 1451.5 is a new IEEE effort for wireless sensors.
See http://grouper.ieee.org/groups/1451/5/
. SSHWG - Sensor Standard Harmonization Working Group started in Dec 2005, currently discussing Ontology as a tool for harmonization and use cases.
. ANSI N42.42 Data format standard for radiation detectors in XML.
. Sensor Ontology might be a way to get many transducers to share data. For an overview of ontology see http://en.wikipedia.org/wiki/Ontology_(computer_science)

. 1451 in SensorNet - Chicago wants city-wide network for disaster preparation.
Also military wants secure WiFi, Bluetooth, ans Zigbee for ship-based sensor and automation networks.
. Trends: fast moving toward networked, digital, and wireless communications for sensors. : industry and manufacturers, military, homeland security applications

15:30-16:30 Super Distributed Objects: An example of SDO
by Shigetoshi Sameshima, Hitachi

SDO-based systems have three levels of heterogeneity. Apparently Hitachi is the first commercial implementer of SDO, e.g., in a product used for personal and home security and monitoring, with ability to monitor a home security camera from almost anywhere in the world. This technology is called SUM - SDO Ubiquitous Middleware.
. SDO History; 1999/11 Forum on Super Distributed Systems at OMG meeting
. IT penetration changes system structure: centralized system → distributed system
. Application: commercial system is not available yet, but will be produced in near future.

16:30-17:30 Introduction to Anybot studio, Soon-Hyuk Hong (Samsung Electronics)
Robot software platform for total solution was introduced with video demo.
Anybot Studio: Robot S/W Total solution for network-based robot system, URC(Ubiquitous Robotic Companion), Robot S/W platform(GRIS), Robot simulator, server platform(middleware, protocol), Remote management tools, contents authoring tools, Robot simulator and behavior interpreter was introduced.

Dec 6, 2006 Wednesday, Kennedy Room
Attendees: 31

Abheek bose(ADA Software)
Antonello Ceravola (Honda Research Inst.)
Bruce Boyes (Systronix)
BumHyeon Baek(KangWon National Univ)
Dave Stringer (Borland)
Hong Seong Park(KangWon National Univ)
Hung Pham (RTI)
Kyuseo Han (ETRI)
Makoto Mizukawa (SIT)
Noriaki Ando (AIST)
Olivier Lemaire (JARA)
Ozaki, Fumio(Toshiba)
Rick Warren (RTI)
Roger Burkhart (John Deere)
Rumtao Qu (AIST)
Saku Egawa (Hitachi)
Satoshi Hirano (AIST)
Seong Hoon Kim (KangWon National Univ)
Seung-Ik Lee (ETRI)
Shigetoshi Sameshima (Hitachi)
Soon Hyuk Hong (Samsung Electronics)
Su-Young Chi(ETRI)
Takashi Tsubouchi(U. of Tsukuba)
Takaya Kubota (AIST)

Tetsuo Kotoku (AIST)
Toshio Hori (AIST)
Vitaly Li (KangWon National Univ)
Wonpil Yu(ETRI)
Yeon-ho Kim(SAIT)
Young Hoon Cho(KAIRA)
Yun Koo Chung (ETRI)

09:00-12:00 Report of 3 WGs:
Robotics device and data profile: Report

. Meetings: Mon 10:00-17:00
. Presentation on IEEE-1588 and IEEE-1451: Supports 1451-compliant access methods to our RFP
. Related activities: IEEE1451, IEEE 1588, JAUS, CANOPEN
. Draft of programmer API view is mostly complete.
. discussion of whether RFP is needed separate for the hardware-view, or if it can be included.
. Add existing specifications (IEEE 1451 & 1588, JAUS, OMG SmartSensor and SDO) to RFP

Robotics functional Service WG – report

. Meetings: Mon 10:00-17:00, Tue 10:00-15:00, Wed 09:00-12:00
. 10:45 –11:15 : Business Case of the Location Calculation Interface (Yeonho Kim –Samsung)
. 11:15–11:45 : Business Case of the Localization Service (Olivier Lemaire –AIST)
. Ubiquitous robots scene: main differences between robotic systems and information systems: Self localization & Ubiq. Localization
. Mandatory requirements: Provide PIM and at least one RTC_PSM of LS
. New Localization Service(LS) structure
. Business case for the RFP on Robotic localization Service
.Propose the Interaction Model Architecture for HRI Components Standardization
. Roadmap

Infrastructure WG – report

. Joint Meeting with SBC
. Roadmap: Sandiego:
  - Talks: Zeligsoft SW radio tool demo, MS Robotic studio presentation (Bruce)
. Have Deployment & Configuration RFP requirements ready to discuss
. Roadmap: Brussels (June): Issue draft RFP (3 Weeks before)

Presentations
14:00-15:00 LEGO NXT and MS Robotics Studio User report by Bruce Boyes (Systronix)

. Demonstrate interoperability between Microsoft's Robotics Studio and Lego NXT robots. – much harder to use
. MSRS Architecture – DSSP
. DSSP is a simple SOAP – based application protocol .
. MSRS disappoint us, Maybe We expected too much.
. Goals for OMG Mar '07 (San Diego)
  - Robot-Fusion will show interoperability between Java-based robots and smart sensors
  - Hope to integrate Microsoft's Robotics Studio, Java VEX/JCX robots and SunSPOTs using 802.15.4 wireless as well as the Phase 1 Lego NXT bots and Bluetooth.
. Goals for OMG Jun '07 (Brussels)
  - Integrate mobile and stationary devices in a cooperative real-time task.

15:30 – 16:30 JAUS Information Day Report: SAE AS-4 for Unmanned Systems
By Hung Pham (RTI)

. AS-4A Architecture Framework, AS-4B Network environment, AS-4C Information Modeling & Definition, JAUS Service Specification in future
. Motion for author of RFP to study JAUS specification for RFP: approved
(1st motion: Hung Pham, 2nd motion: Abheek, White ballot: Bruce)

16:30 – 17:00 Contact report
ISO Contact report by Makoto Mitzukawa (Shibaura.I.T)
. ORIN(Open Resource Interface for the Network)
. RAPI (Robot comm.. framework and application program interface): [subset of ORIN] was proposed in June 7~8, 2007, Washington DC
. AG MEETING: 2007-01-19
. IROS 2006 Workshop: Robotics Standardization. (Oct. 10, China)
. SICE-ICASE 2006, 20papers regarding Robotics standardization (Oct. 19, Korea)

KIRSF Contact Report, by Yun Koo Chung, ETRI
. KIRSF Standardization activities reports
. TTA Certification test introduced: TTA can certify, verify and test: RF & Electricity, Telecommunication, Service and Safety.
. URC Robots in pilot business reports: URC has over 300 robots have been distributed and serviced. Low cost (under $1000) due to complex services existing on server rather than the robot.
RUPI (Robot Unified Platform Initiative) - all standards from URC technology are called RUPI.

Robotics Wiki is now at http://portals.omg.org/robotics

17:00-17:30 Publicity SC report by Abheek Bose, ADA Software
. Cooperates with OMG staff: Dana Morris, Stephanie Covert, Mike Bergman (OMG)
. all member companies are requested to send high-resolution logos to Stephanie@omg.org

Next Meeting Agenda Discussion by Tetsuo Kotoku, AIST
. document number assigned
. Use a WIKI's system
. Information Day: in Brussels APPROVED: (1st Kotoku, 2nd Chung, White Balot Miztukawa)
Information Day in Brussels: There are now seven requests for Information Day space in Brussels. This is more than expected, so OMG will need to contract for more space. Plan on 40-60 people in the Robotics Information Day space. Robotics group needs to be sure that the space will be well-utilized since it will cost extra money.
. Preparing WG for Information day Approved: motioned (1st Kotoku, 2nd Pham, White Ballot: Mitzukawa)
. Next Meeting Agenda (March 26 – 30, San Diego USA)
- Mon ~ Tu (AM): Steering Com.(Mon morning), WG activities (in parallel)
- Tue(PM) ~ Wed: Robotics-DTF plenary meeting, WG report, Guest and member presentation, Contract report, Next meeting agenda
- Thursday: .WG activity(optional), RTC-FTF Meeting
- **Roadmap approved: motioned (1st Kotoku, 2nd Rick Ballot Mitukawa)**

Adjourned joint plenary meeting at 17:45

Prepared and submitted by Yun Koo Chung(ETRI) and Bruce Boyes(Systronix).

Robotics Domain Task Force Steering Committee Meeting

March 26, 2007

San Diego, CA, USA

Hyatt Regency La Jolla at Aventine

Washington Meeting Summary

- RTC has been discussed for finalization
- 6 invited presentation in the plenary
- Discussion of RFPs and roadmap in 3 WGs
- Robotics-DTF flyer of 4-pages completed
- Wiki system is recommended for discussion and reporting

Agenda

- Agenda Review
- Minutes and Minutes Taker
- Publicity
- Roadmap Discussion
- Next meeting Schedule

Agenda Review

Mon(March.26):

Steering Committee

Services WG, Profiles WG, RTC-FTF

Tue(March.27):

Profiles WG, Services WG

Task Force Plenary

Wed(March.28):

Task Force Plenary (Afternoon)

Thu(March.29):

WG activity follow-up?

Please check our final agenda.

Minutes and Minutes Taker

- Process:
  - Make a draft with in 5days
  - Send the initial draft to robotics-chairs@omg.org
  - Post the draft to the OMG server within a week
  - Make an announcement to robotics@omg.org
  - Send comments to robotics@omg.org
  - Approve the revised minutes at the Next meeting

- Volunteers for this Meeting
  - Tetsuo Tomizawa (AIST) and Soo Young Chi (ETRI)

We have to post our meeting minutes within a week!

Publicity Activities

- Robotics Wiki is available
  http://portals.omg.org/robotics

- Robotics-DTF fly sheet

- Information Day: Brussels
  (Meeting with Marketing Staff on Tuesday morning)

Our fly sheet will be authorized in San Diego

Organization

- **Robotics-DTF** — Yun-Koo Chung (ETRI, Korea); Tetsuo Kotoku (AIST, Japan); Hung Pham (RTI, USA)
  - **Steering Committee** — All volunteers
    - **Publicity Sub-Committee** — Abheek Bose (ADA Software, Indea); Masayoshi Yokomachi (NEDO, Japan); Olivier Lemaire (AIST, Japan); Yun-Koo Chung (ETRI, Korea)
    - **Contacts Sub-Committee** — Makoto Mizukawa (Shibaura-IT, Japan); Yun-Koo Chung (ETRI, Korea)
  - ***Technical WGs***
    - **Infrastructure WG** — Noriaki Ando (AIST, Japan); Rick Warren (RTI, USA); Saehwa Kim (SNU, Korea)
    - **Robotic Services WG** — Soo-Young Chi (ETRI, Korea); Olivier Lemaire(AIST, Japan)
    - **Profile WG** — Bruce Boyes (Systronix, USA); Seung-Ik Lee (ETRI, Korea)

Roadmap Discussion

- Confirm the process of working items
- Create new items
  (we need volunteers)

Next Meeting Agenda

June 26-30 (Brussels, Belgium)

Monday:

Steering Committee (Morning)
Robotics Information Day

Tuesday:

WG activity [3WG in parallel]

Wednesday :

Robotics-DTF Plenary Meeting
- Guest and Member Presentation
- Contact reports
- DTC report - Draft

Next Meeting Agenda

- Make a rough agenda at the previous meeting. (rough sketch)
- Agenda planning session on Wednesday after plenary session
- Post a preliminary agenda 4weeks before the meeting.
- Print a final agenda at the meeting site.

We have to post our preliminary Agenda a month before!

Roadmap for Robotics Activities

Item	Status	DC Dec-2006	San Diego Mar-2007	Brussels Jun-2007	Jacksonville Sep-2007	Burlingame Dec-2007	Washington DC Mar-2008	Ottawa Jun-2008	POC / Comment
RTC Finalization Task Force	In Process			Comment Due 7/2	Report	Report Deadline 10/5			Rick(RTI)
SDO Revision Task Force	In Process	Chartered							Sameshima(Hitachi)
Flyer of Robotics-DTF [Publicity Sub-Committee]	In Process	review Draft	issue ver.1.0						Abheek(ADA Software)
Localization Service RFP [Services WG]	In Process	draft RFP	1st review RFP	RFP		Initial Submission	Pre-review	Revised Submission	
User Identification RFP [Services WG]	Planned		discussion	discussion	1st Draft	2nd Draft	1st review RFP	RFP	
Programmers API: Typical device abstract interfaces and hierarchies RFP [Profile WG]	In Process		RFP Outline	1st review RFP	RFP		Initial Submission	Pre-review	
Hardware-level Resources: define resource profiles RFP [Profile WG]	In Process		RFP Outline	1st review RFP	RFP		Initial Submission	Pre-review	
etc…	Future								to be discussed
Robotics Information Day [Technology Showcase]	Planned		Planning	Info. Day					Yokomachi(NEDO), Kotoku(AIST)
Robot Technology Components RFP (SDO model for robotics domain)	done Sep-2006	Adopted Specification ptc/2006-11-07							Rick(RTI) and Noriaki(AIST)
Robotic Systems RFI [Robotics: Initial Survey]	done Apr-2006								Lemaire, Chung, Lee, Mizukawa, Kotoku
Charter on WGs [Service, Profile, Infrastructure]	done Apr-2006								Lemaire(JARA), Chi(ETRI), Bruce(Systronix), Lee(ETRI), Rick(RTI), Ando(AIST)
Charter on Robotics TF	done Dec-2005								Kotoku(AIST),
Charter on Robotics SIG	done Feb-2005								Kotoku(AIST), Mizukawa(Shibaura-IT)

robotics/2007-03-05

Robotic Devices & Data Profile WG Discussion at San Diego Technical Meeting

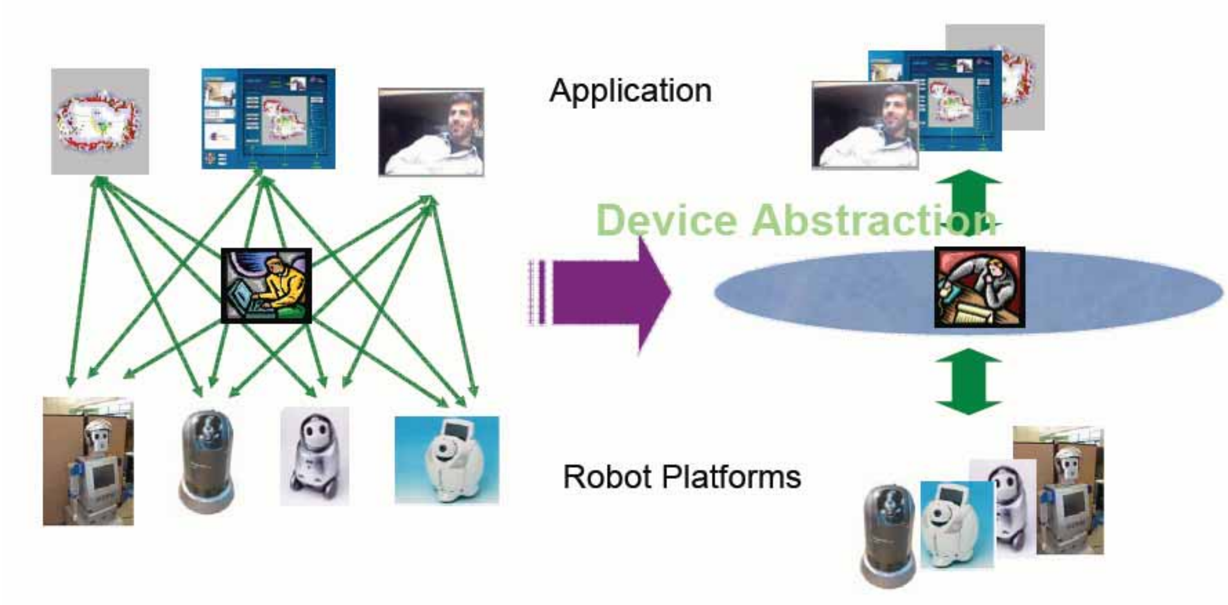
03/26/2007-03/27/2007

Seung-Ik Lee, Bruce Boyes

Meeting schedule

- **Monday: 26 March, 10:00-12:00**
- **Tuesday: 27 March, 10:00-12:00**

Need for Standards



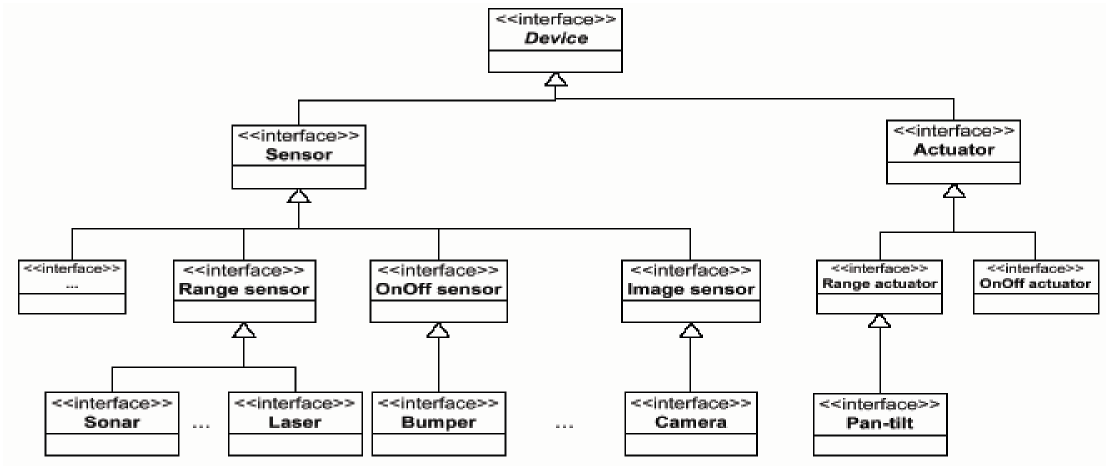
Discussion of Issues

- **Classification or categorization concept**
- **How to adopt new devices once our WG's specification published?**
- **Other discussion**

Categorization of devices

- **We need a way to categorization of devices**
  - **Levels of abstractions like class hierarchy**
  - **Each abstraction provides a common set of interfaces corresponding to its abstraction level**

- **Example categorization (Hierarchy)**



Categorization of devices

- **Issues**
  - **No single, absolutely correct categorization exists !!!**
  - **We could require submitter's own view of categorization.**
  - **But, how can we deal with new devices after our spec. has published?**

→ There should be some stand process and guide lines to easily adopt new devices and categories

→ This requirement need to be included in the RFP

Mandatory requirements

- Propose a device classification or categorization methods that could be used for abstracting robotic devices
- By using the proposed classification methods, define abstract interfaces for robots and their devices including remote transducers which interact with robots
- profiles which describe capabilities and properties of the devices
- Enumeration and management of robots and robotic devices
- Propose a process or guideline for facilitating the adoption of new devices

discussions

- Related standards
  - In addition to the already identified related standards list, add UPnP standards to the list
- Reordering the mandatory requirements
  - Classification method requirement comes first
  - Then, add "by using the proposed classification method", define abstract interfaces….
- Option requirements
  - Be more specific with "synchronization" and "real-time capability"
- Adoption of other standards
  - How to adopt other related standards (e.g., IEEE 1451, 1588)

discussions

- We need submitters
  - Candidate submitters (hopefully)
    - Samsung elec.
    - ETRI
    - Systronix
    - AIST
    - Kangwon Univ.
- Comparison table of other related standards (IEEE 1451, JAUS, UPnP)
  - Volunteers : Seung-Ik Lee
  - Concentrate on the mandatory requirements when doing comparison.
- Timetable
  - First RFP review will be postponed to next meeting

robotics/2007-03-06

- OMG Robotics DTF-

- Robotic Functional Services Working Group -

Meeting Schedule

- San Diego TC Meeting -

San Diego (California, USA) – March 26, 2007

Co-chairs : Olivier Lemaire (olivier.lemaire@aist.go.jp) / Soo-Yong Chi (chisy@etri.re.kr)

Schedule

- **Monday**
- PM 13:00 - 13:15 : Welcome - Roadmap presentation
- PM 13:15 - 13:45 : *"Short Introduction to the ISO19100 Specifications“* -Olivier Lemaire (AIST)
- PM 13:45 - 14:15 : *"A brief Report for ISO 19116 Positioning Service Standard"* - Dr Han (ETRI)
- PM 14:15 - 14:40 : *"Need for position data quality indication for Agricultural robots"* - Dr Nagasaka (NARC)
- PM 14:40 - 15:10 : *"Introduction to Localization related projects at JST"* - Dr Tomizawa (AIST)
- Coffee Break
- PM 15:20 - 16:00 : *"Ultrasonic 3D tag system for robot localization"* – Dr Hori (AIST)
- PM 16:00 - 16:40 : *"Experience using ISO19100 in Robotic Systems"* - Dr Noda (AIST)
- PM 16:40 - 17:30 : Discussion

- **Tuesday**
- AM 10:00 – 11:10 : Discussion (cont’d)
- AM 11:10 – 11:30 : *“Introduction to User Identification Service”* – Dr Chi (ETRI)
- AM 11:30 – 12:00 : Roadmap review, Homework, Next meeting WG Schedule

- **Wednesday**
- AM 9:00 – 12:00 : WG Reports and Roadmap Discussion

Roadmap

Item	Status	San Diego Mar-2007	Brussels Jun-2007	Jackson ville Sep-2007	Burlingame Dec-2007	Wash. DC Mar-2008	Ottawa Jun-2008
Localization Service	On-going	Topic Discussion	RFP 1st Review	RFP	Init. Submis. 1st Review		
User Identification Service	Stand-by	Proposed	--	?	?	?	?

Steering Committee

- Roadmap Update
  - "Localization Service" RFP issuance postponed to Brussels meeting

Discussion Topics

- Our stance regarding to ISO19100
- Assert that our focus is in line with needs of businesses

Standardization of Geospatial Systems

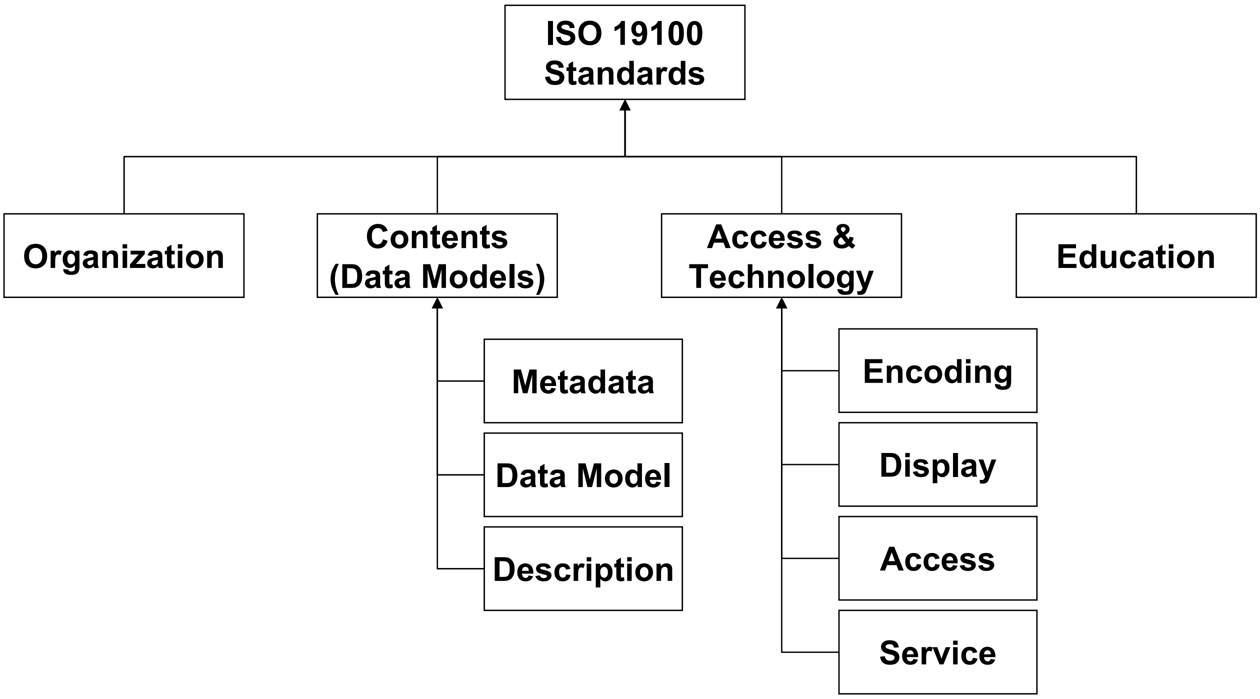
Introduction to the ISO 19100 specifications

ISO/TC 211

- Started in 1994
- Developed a well structured series of specifications (ISO19100) for the information related to phenomena involving, directly or not a position on earth
- The ISO19100 standards
  - Specify methods, tools and data management services (including the definition and description of the data) related to the acquisition, processing, analysis, access to, rendering and transfer of data between users, systems and places
  - Refers to other existing IT related standards when possible
  - Provides a framework for the development of application in domain that make use of geography related data
- The goal is to allow the exchange of geography related data :
  - Between the producers
  - Between the producers and the users
- 56 countries and 33 organizations are involved
- Works in collaboration with the OpenGIS Consortium (OGC)

The ISO 19100 Family of Standards

- ISO 19100 is a family of 42 standards
- It tries to cover all aspects of localization



ISO 19100 – 42 Standards… and more to come !

	Mo	Ma	Ub		Mo	Ma	Ub
6709 - Standard representation of latitude, longitude and altitude for geographic point locations				19130 - Sensor and data models for imagery and gridded data			
19101 - Reference model				19131 - Data product specifications			
19101-2 - Reference model - Part 2: Imagery				19122 - Qualifications and Certification of personnel			
19103 - Conceptual schema language				19123 - Schema for coverage geometry and functions			
19104 - Terminology Introduction				19124 - Imagery and gridded data components			
19105 - Conformance and testing				19125-1 - Simple feature access - Part 1: Common architecture			
19106 - Profiles				19125-2 - Simple feature access - Part 2: SQL option			
19107 - Spatial schema	◎	◎	◎	19126 - Profile - FACC Data Dictionary			
19108 - Temporal schema	◎	◎	◎	19127 - Geodetic codes and parameters			
19109 - Rules for applicaiton schema				19128 - Web Map server interface			
19110 - Methodology for feature cataloguing				19132 - Location based services - Reference model			
19111 - Spatial referencing by coordinates 19111 - Revision of ISO 19111:2003				19133 - Location based services - Tracking and navigation			
19112 - Spatial referencing by geographic identifiers				19134 - Multimodal location based services for routing and navigation			
19113 - Quality principles				19135 - Procedures for registration of geographical information items			
19114 - Quality evaluation procedures				19136 - Geography Markup Language			
19115 - Metadata				19137 - Generally used profiles of the spatial schema and of similar important other schemas			
19115-2 - Metadata - Part 2: Extensions for imagery and gridded data				19138 - Data quality measures			
19116 - Positioning services				19139 - Metadata - Implementation specification			
19117 - Portrayal				19141 - Schema for moving features			
19118 - Encoding				19142 - Web Feature Service			
19119 - Services 19119 Amd. 1				19143 - Filter encoding			
19120 - Functional standards				19144-1 - Classification Systems – Part 1: Classification system structure			
19121 - Imagery and gridded data				19144-2 - Classification Systems – Part 2: Land Cover Classification System LCCS			
19129 - Imagery, gridded and coverage data framework				19145 - Registry of representations of geographic point location			

Already Available	Being Revised	Available 2007	Available 2008	Cancelled	Early Stage

ISO 19100 - Organization

- Specifications that provide the base infrastructure to develop higher level specifications :
  - ISO19101 : Reference model
  - ISO19103 : Conceptual schema language
  - ISO19104 : Terminologies
  - ISO19105 : Conformance and testing
  - ISO19106 : Profiles
  - ISO19135 : Procedures for item registration

ISO 19100 - Contents

- Specifications that describe geographic data related format and structures so as to better understand them :
  - ISO 19107:2003 - Spatial schema
  - ISO 19108:2002 - Temporal schema
  - ISO 19109:2005 - Rules for application schema
  - ISO 19110:2005 - Methodology for feature cataloguing
  - ISO 19111:2003 - Spatial referencing by coordinates
  - ISO 19112:2003 - Spatial referencing by geographic identifiers
  - ISO 19113:2002 - Quality principles
  - ISO 19114:2003 - Quality evaluation procedures
  - ISO 19115:2003 - Metadata
  - ISO 19123:2005 - Schema for coverage geometry and functions
  - ISO 19125-1:2004 - Simple feature access -- Part 1: Common architecture
  - ISO 19125-2:2004 - Simple feature access -- Part 2: SQL option
  - ISO/TS 19127:2005 - Geodetic codes and parameters
  - ISO 19130 - Sensor and data models for imagery and gridded data
  - ISO 19137 - Generally used profiles of the spatial schema and of similar important other schemas
  - ISO/TS 19138:2006 - Data quality measures
  - ISO 19139 - Metadata - Implementation specification

ISO 19100 – Access & Technology

- Specifications related to the accessibility of the data (sharing, exchange) and services enabling access to data :
  - ISO 19116:2004 - Positioning services
  - ISO 19117:2005 - Portrayal
  - ISO 19118:2005 - Encoding
  - ISO 19119:2005 - Services
  - ISO 19125-1:2004 - Simple feature access -- Part 1: Common architecture
  - ISO 19125-2:2004 - Simple feature access -- Part 2: SQL option
  - ISO 19128:2005 - Web map server interface
  - ISO 19132:xxxx - Location based services - Reference model
  - ISO 19133:2005 - Location-based services -- Tracking and navigation
  - ISO 19134:2007 - Location-based services -- Multimodal routing and navigation
  - ISO 19136:xxxx - Geography Markup Language

ISO 19100 - Education

- Specifications that deals with ways to ensure the standard will be applied properly:
  - ISO19122 : Qualifications and Certification of personnel

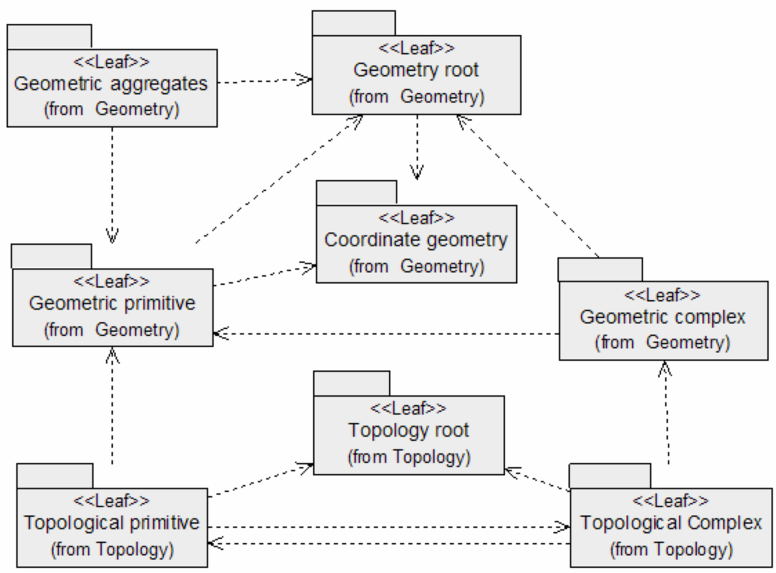
Is ISO 19100 applicable to Robotics ?

- The ISO19100 standard are inherently geo-centric
- The main targets are :
  - Car Navigation Industry
  - Large scale Location-based Service Industry
  - Systems involving GPS
  - Geographic Map Visualization Enhancement (a la Google Map)
  - Map Management and Distribution

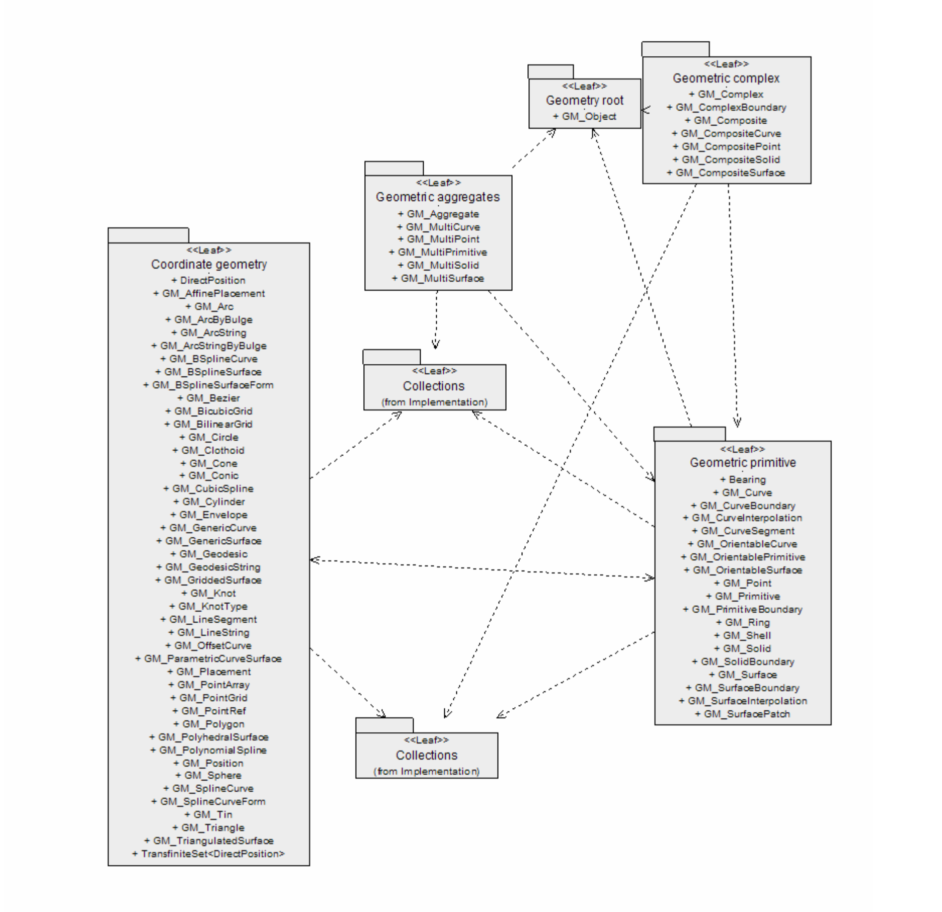
- Application to indoor robotics is not straight-forward. However, many concepts described in the “Contents” and “Accessibility” related standards also apply to Robotics

ISO 19107 - Spatial Schema : Overview

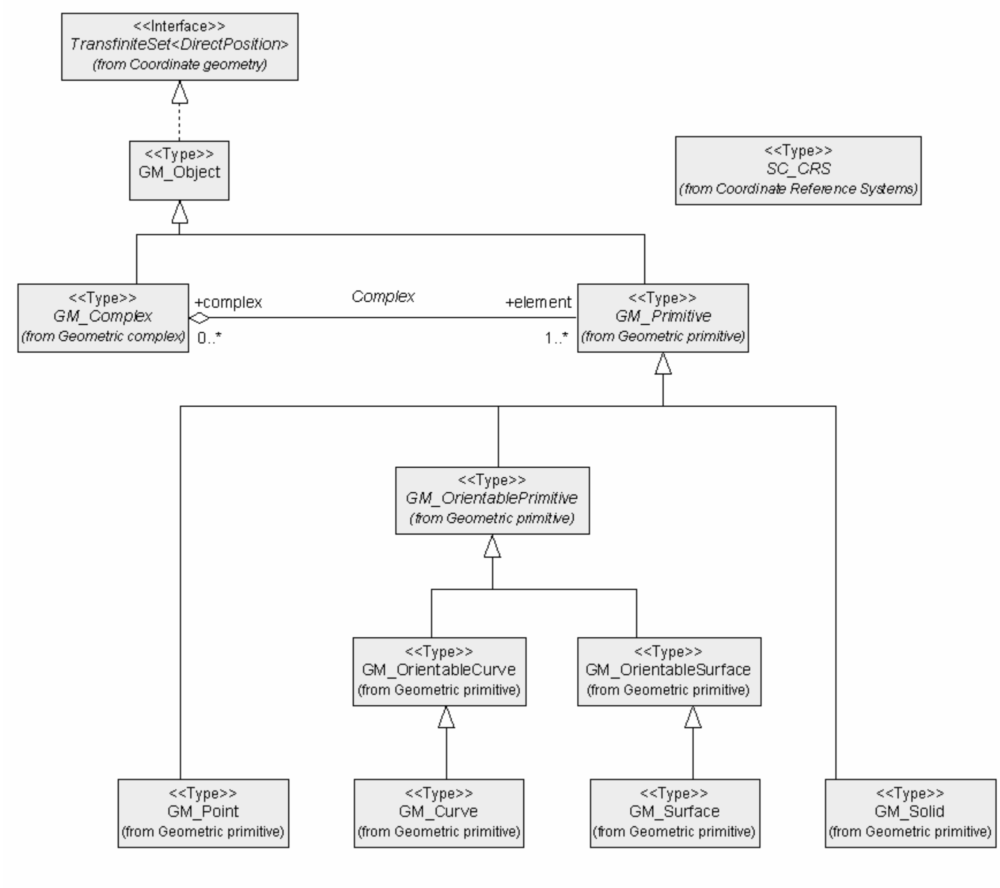
- Specifies conceptual schemas for describing the spatial characteristics of geographic features, and a set of spatial operations consistent with these schemas.
- It treats **vector geometry** and **topology** up to **three** dimensions.
- It defines standard spatial operations for use in access, query, management, processing, and data exchange of geographic information for spatial (geometric and topological) objects of up to three topological dimensions embedded in coordinate spaces of up to three axes.



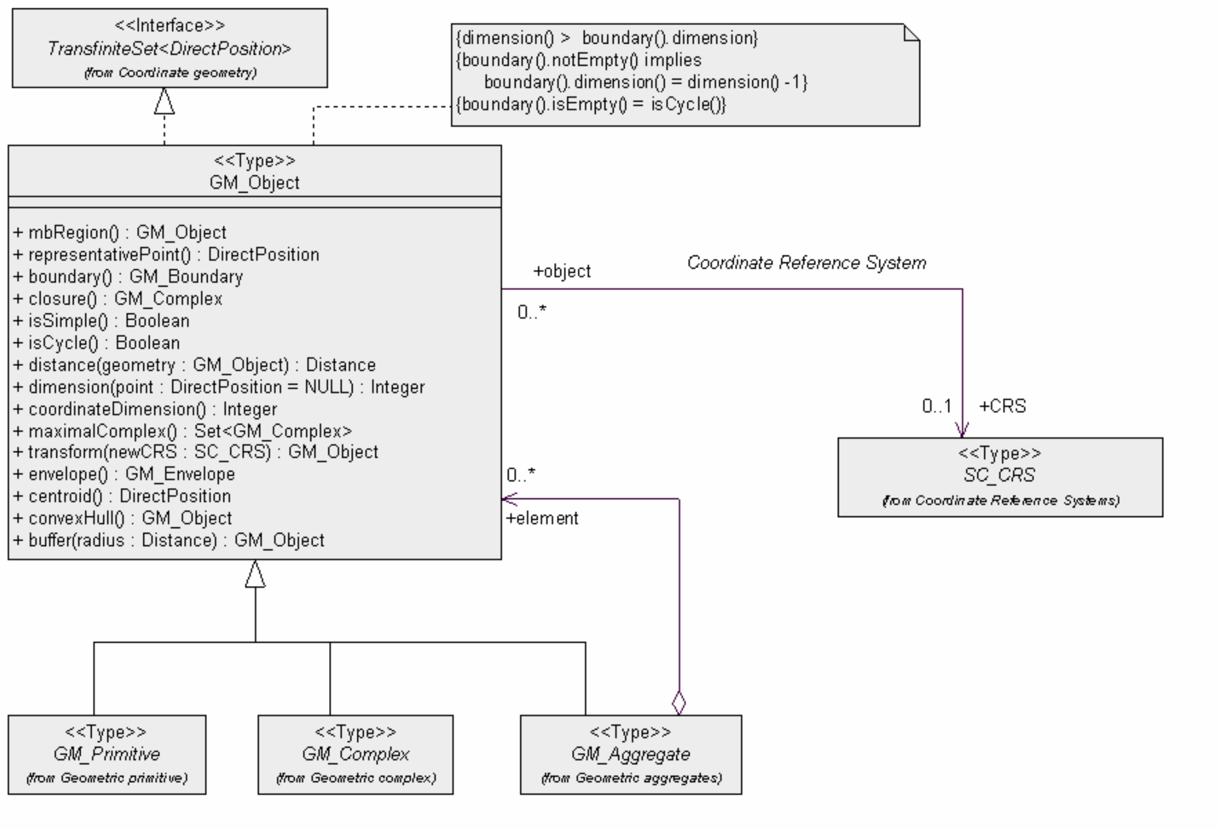
ISO 19107 - Spatial Schema : Geometry Packages



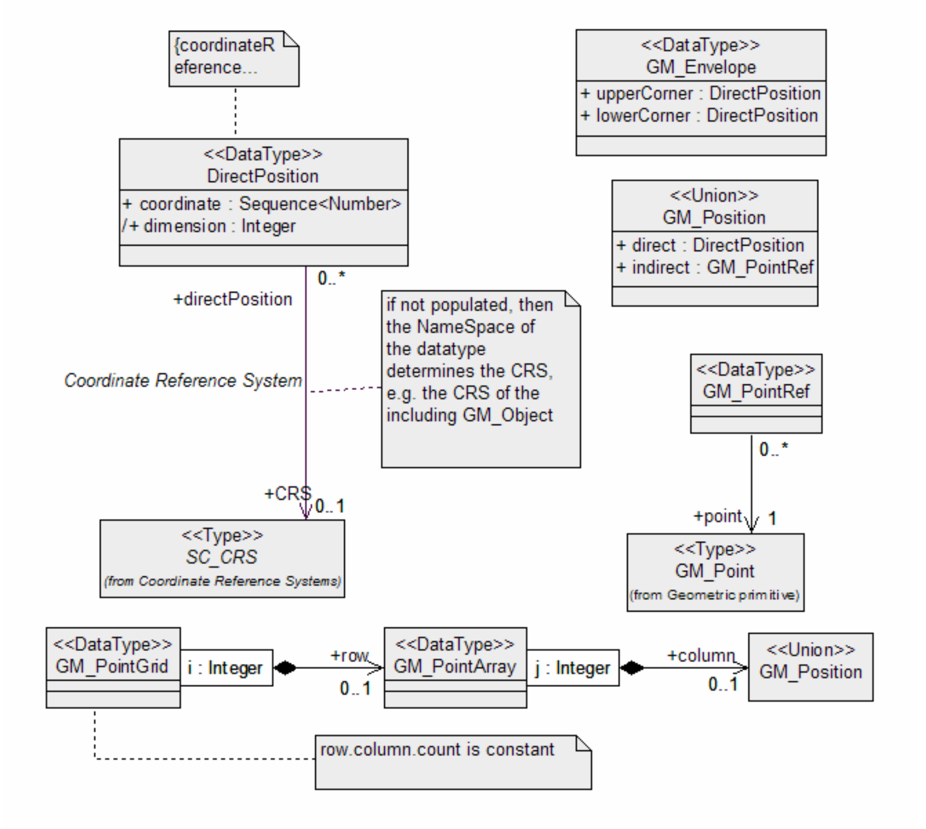
ISO 19107 - Spatial Schema : Geometry Root



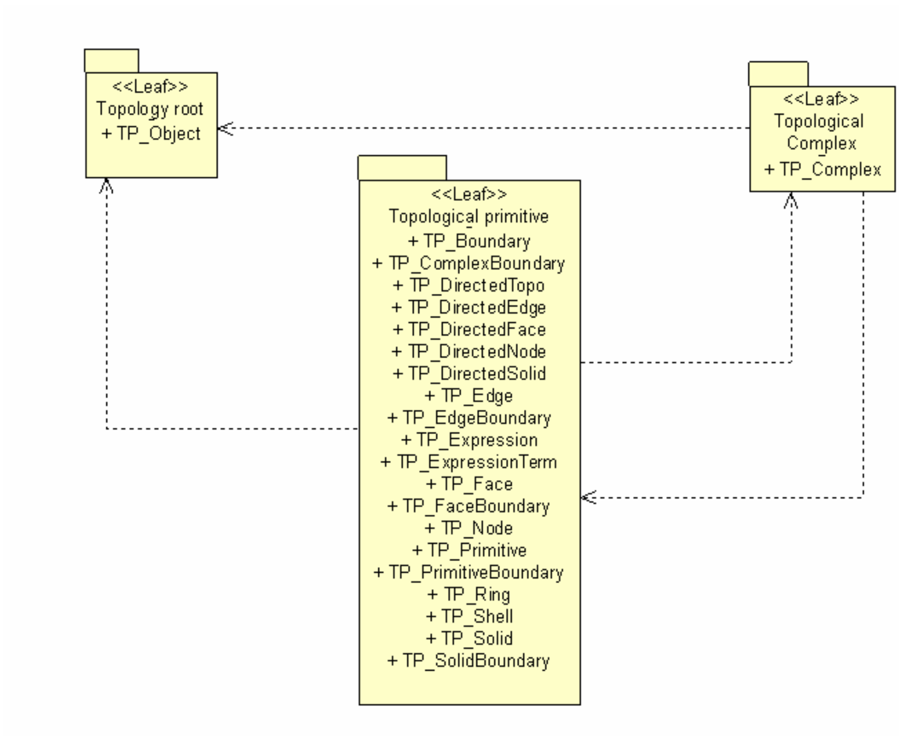
ISO 19107 - Spatial Schema : Geometry Object



ISO 19107 - Spatial Schema : Direct Position

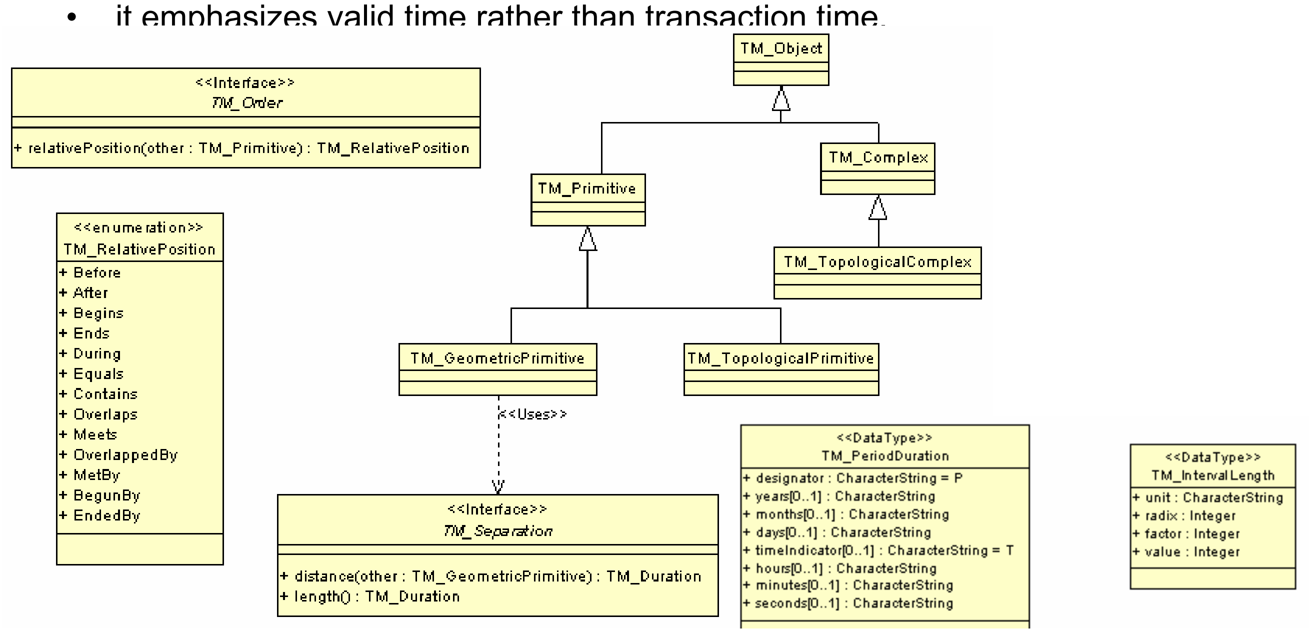


ISO 19107 - Spatial Schema : Topology Packages



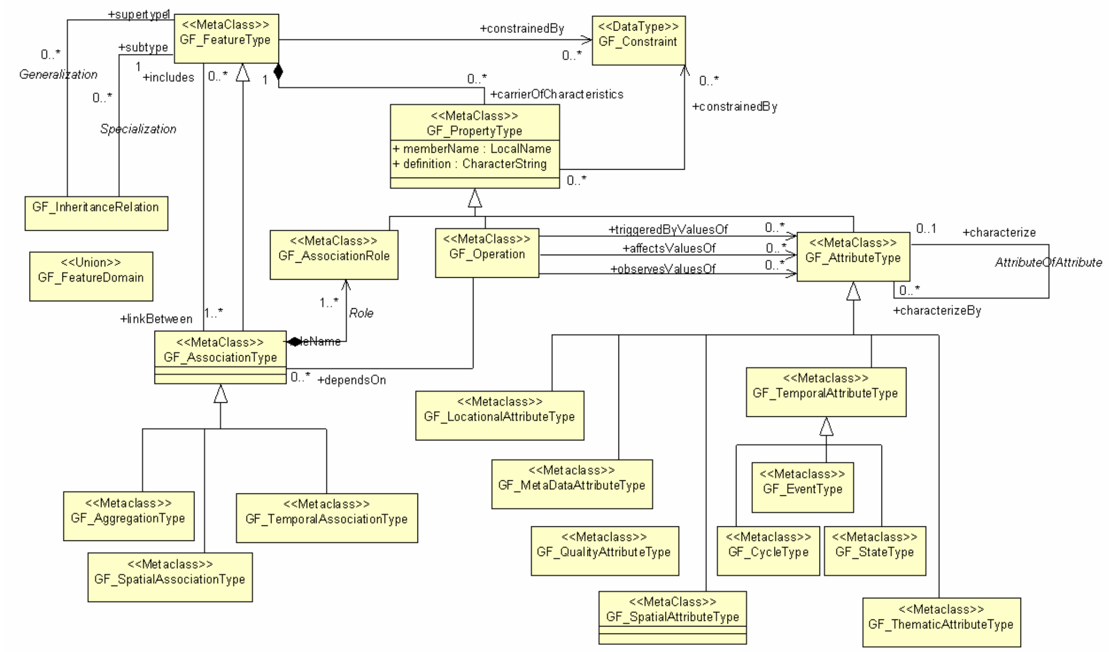
ISO 19108 - Temporal Schema : Overview

- Defines concepts for describing temporal characteristics of geographic information.
- Provides a basis for defining **temporal feature** attributes, feature operations, and feature associations, and for defining the temporal aspects of metadata about geographic information.
- Adds naturally a 4th dimension to the spatial schema, both geometrical and topological.
- it emphasizes valid time rather than transaction time.



ISO 19109 - Rules for application schema

- Defines rules for creating and documenting application schemas, including principles for the definition of features.
- Its scope includes the following:
  - conceptual modeling of features and their properties from a universe of discourse
  - definition of application schemas
  - use of the conceptual schema language for application schemas
  - transition from the concepts in the conceptual model to the data types in the application schema



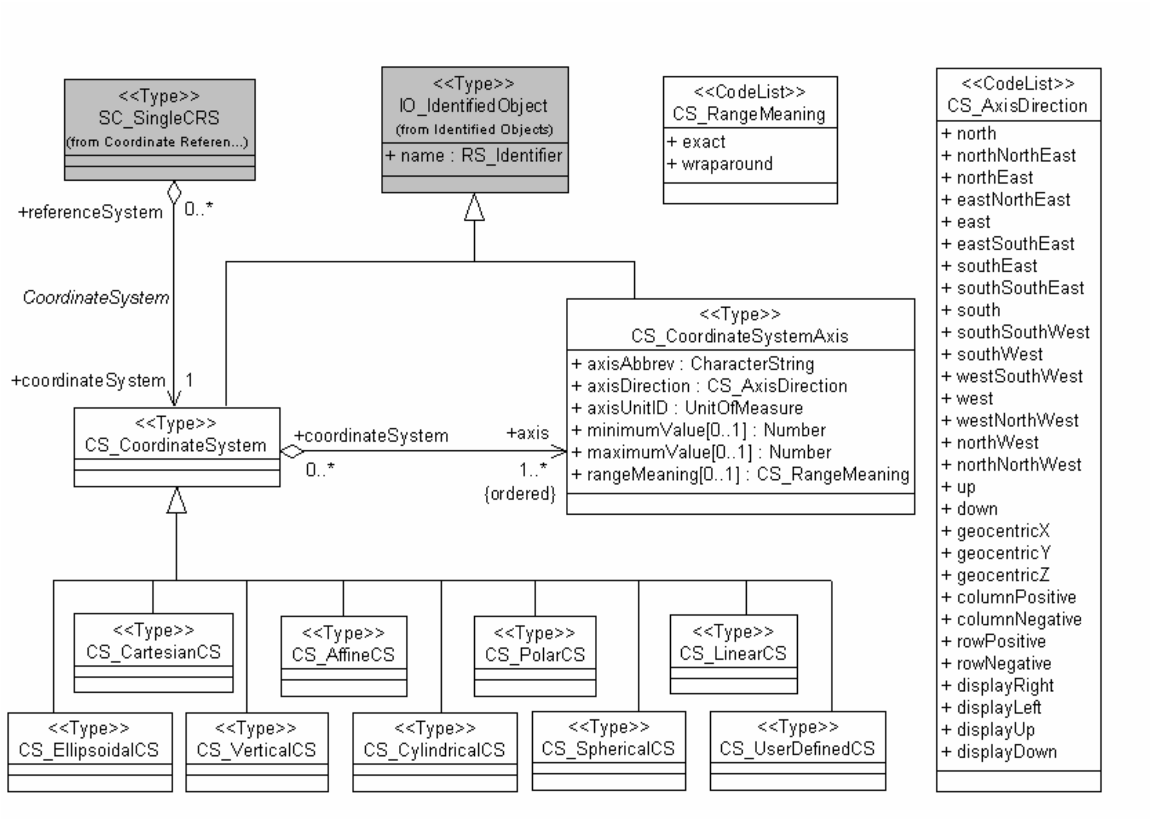
ISO 19110 - Methodology for cataloguing feature

- Defines the methodology for **cataloguing feature** types and specifies how the classification of feature types is **organized into a feature catalogue** and presented to the users of a set of geographic data.
- Is applicable to creating catalogues of feature types in previously uncatalogued domains and to revising existing feature catalogues to comply with standard practice.
- Its principles can be extended to the cataloguing of other forms of geographic data.
- May be used as a basis for defining the universe of discourse being modeled in a particular application, or to standardize general aspects of real world features being modelled in more than one application.

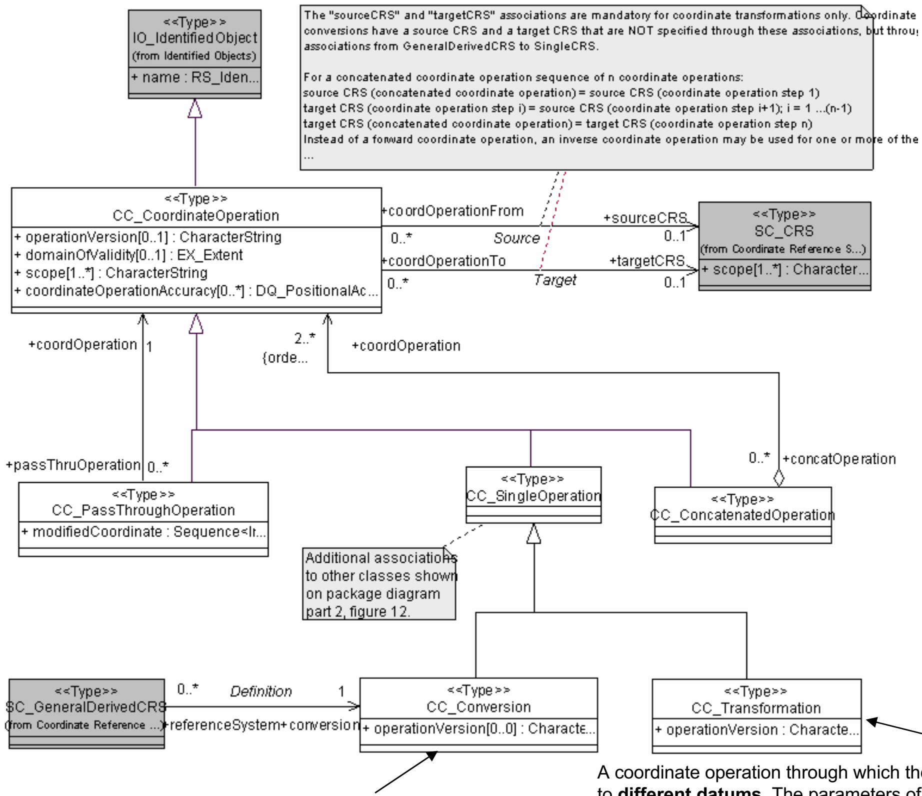
ISO 19111 - Spatial referencing by coordinates

- Defines the conceptual schema for the description of spatial referencing by coordinates.
- Describes the minimum data required to define 1-, 2- and 3-dimensional coordinate reference systems.
- Describes the information required to change coordinate values from one coordinate reference system to another.
- Is applicable to producers and users of geographic information. Although it is applicable to digital geographic data, its principles can be extended to many other forms of geographic data such as maps, charts, and text documents.

ISO 19111 - Spatial referencing by coordinates : Coordinate System



ISO 19111 - Spatial referencing by coordinates : Coordinate Operations

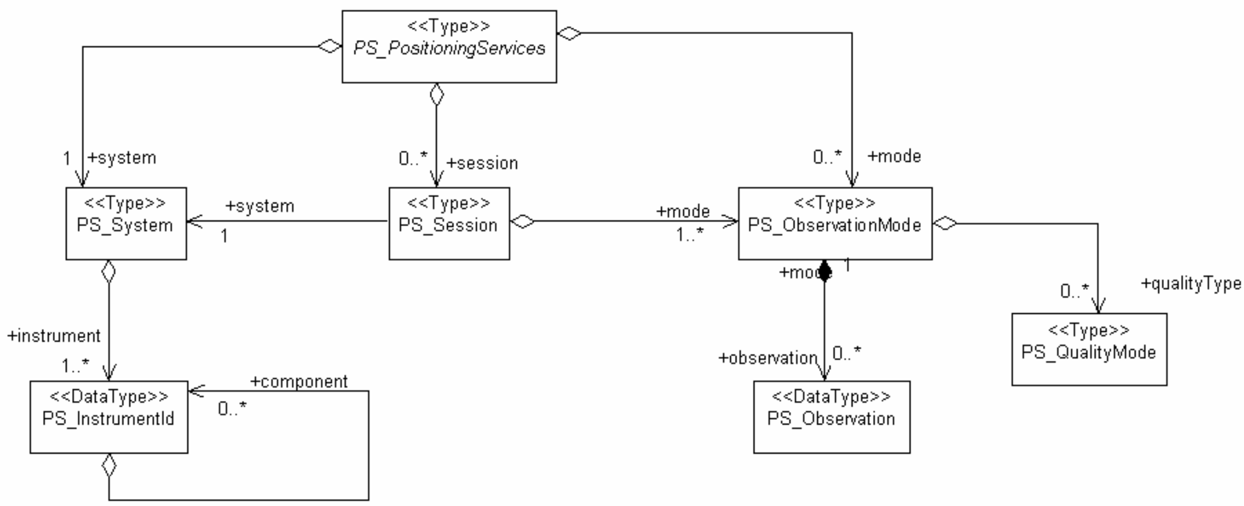


A coordinate operation through which the output coordinates are referenced to the **same datum** as are the input coordinates. The best-known example of a coordinate conversion is a map projection. The parameter values describing coordinate conversions are defined rather than empirically derived.

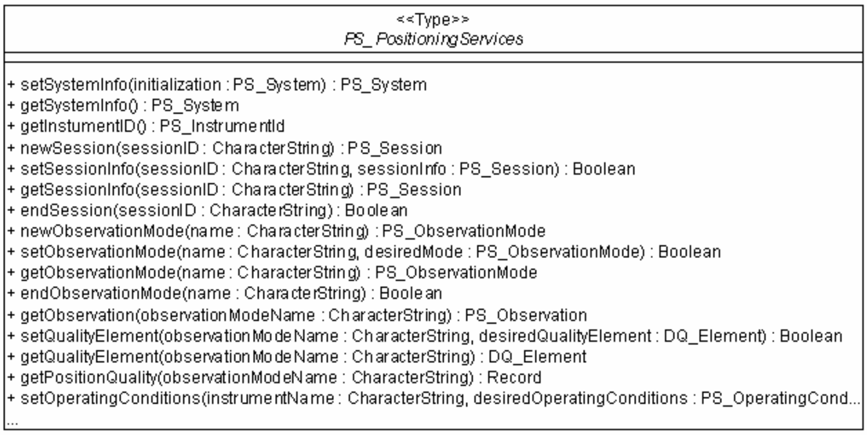
A coordinate operation through which the input and output coordinates are referenced to **different datums**. The parameters of a coordinate transformation are empirically derived from data containing the coordinates of a series of points in both coordinate reference systems. This computational process is usually "over-determined", allowing derivation of error (or accuracy) estimates for the coordinate transformation. Also, the stochastic nature of the parameters may result in multiple (different) versions of the same coordinate transformations between the same source and target CRSs.

ISO 19116 – Positioning Service : Overview

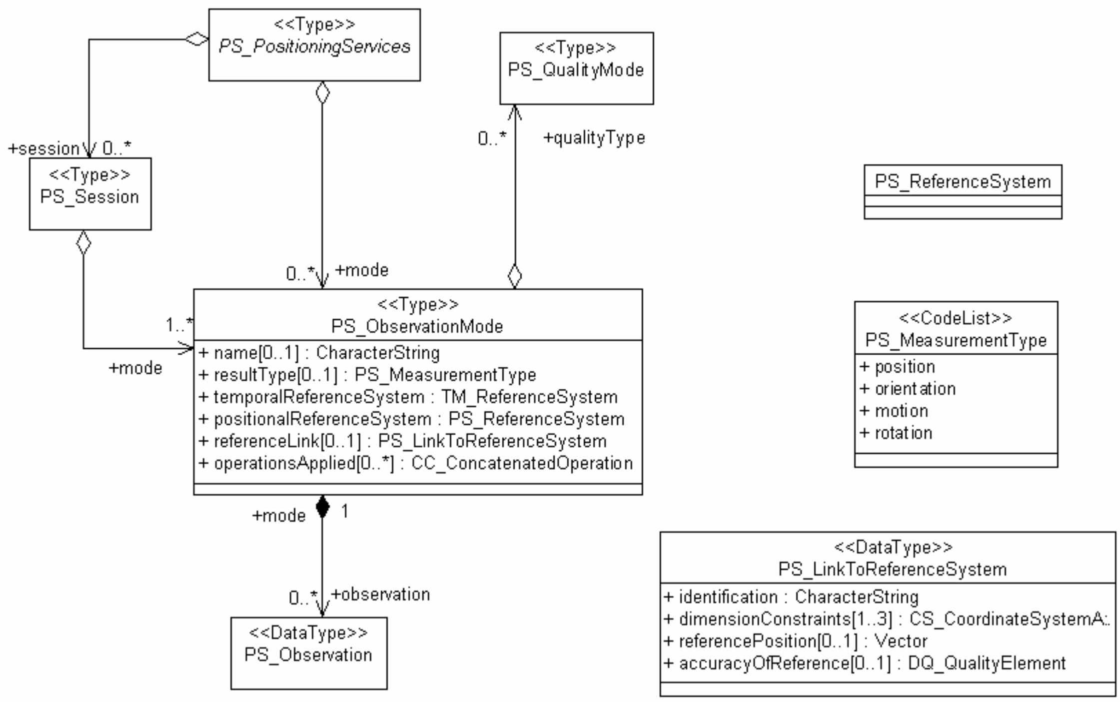
- Specifies the **data structure and content of an interface** that permits communication between position-providing device(s) and position-using device(s) so that the position-using device(s) can obtain and unambiguously interpret position information and determine whether the results meet the requirements of the use.
- Allows the integration of positional information from a variety of positioning technologies into a variety of geographic information applications



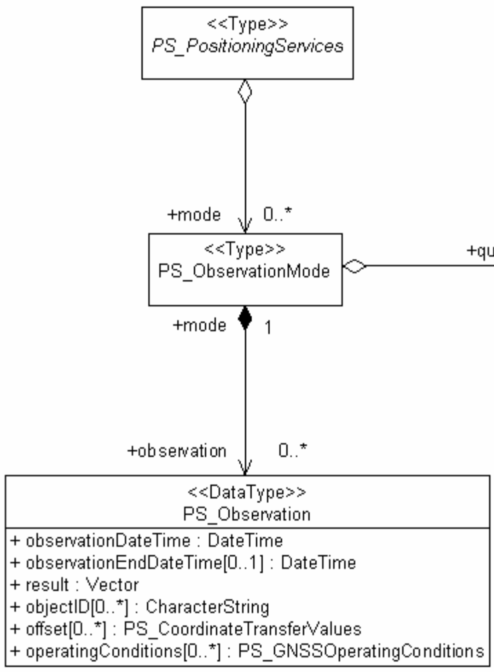
ISO 19116 – Positioning Service : Operations



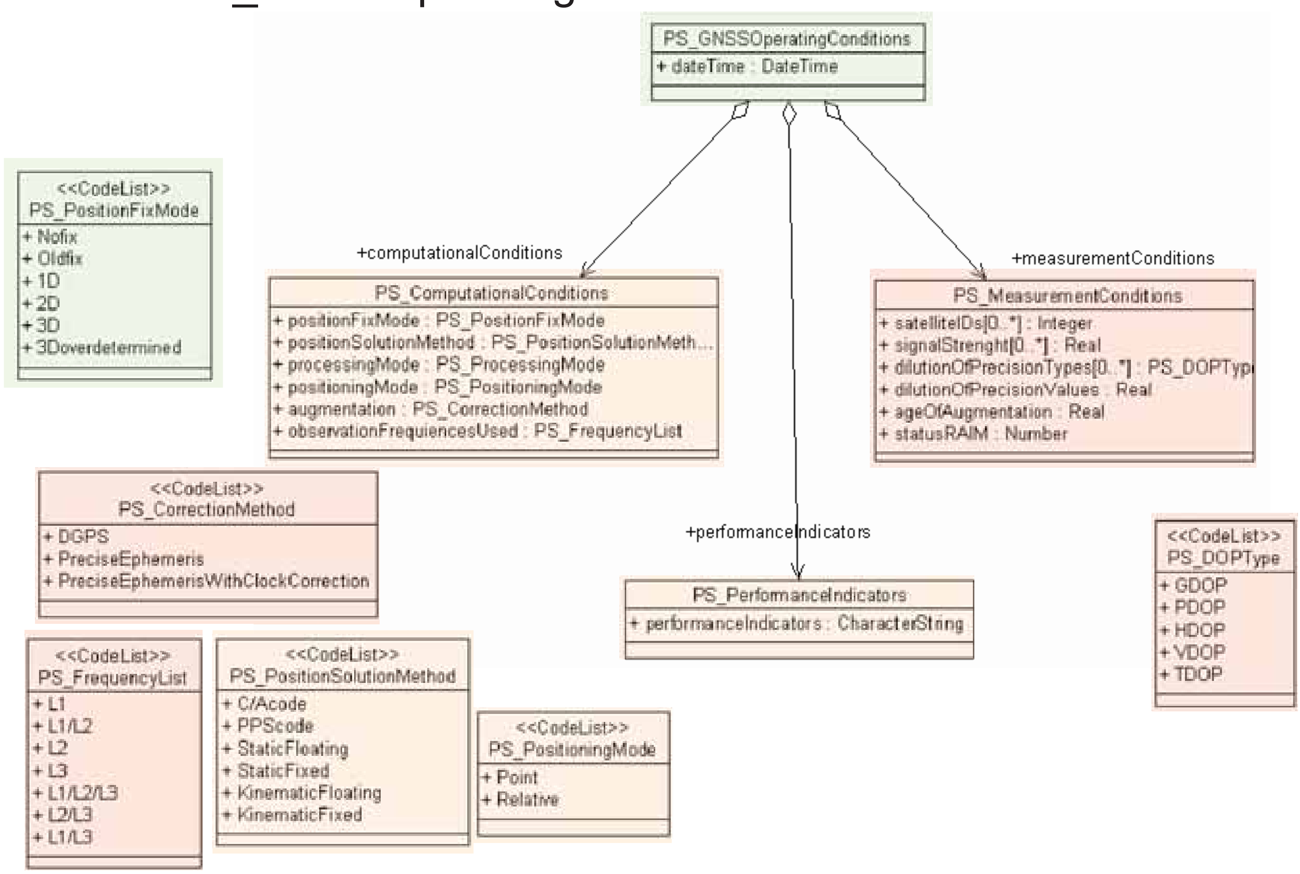
ISO 19116 – Positioning Service : Observation Modes



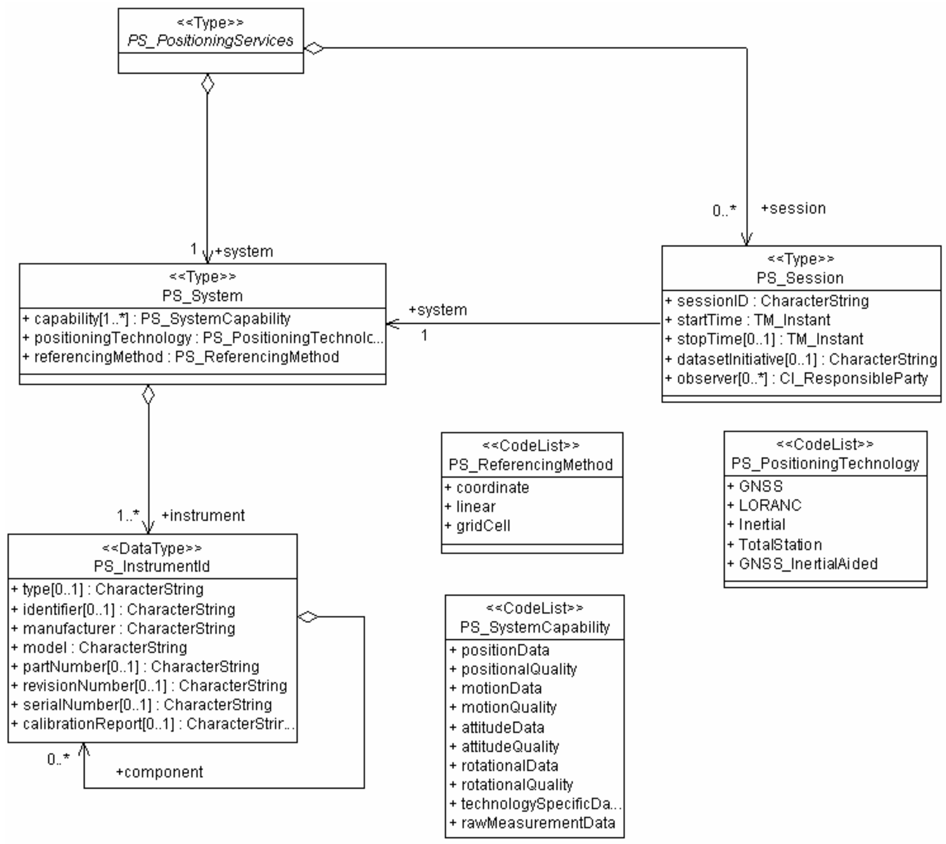
ISO 19116 – Positioning Service : Observation



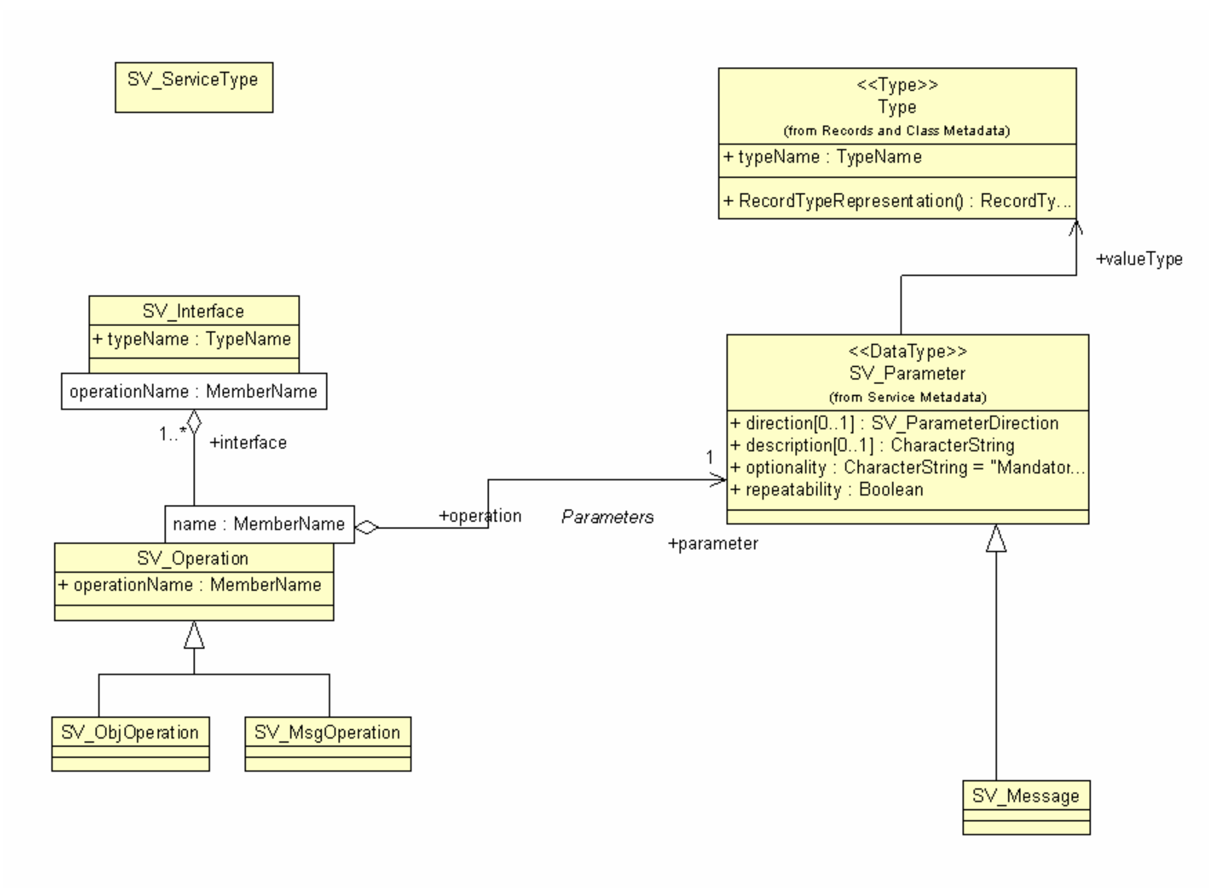
ISO 19116 – Positioning Service : PS_GNSSOperatingConditions with its attributes



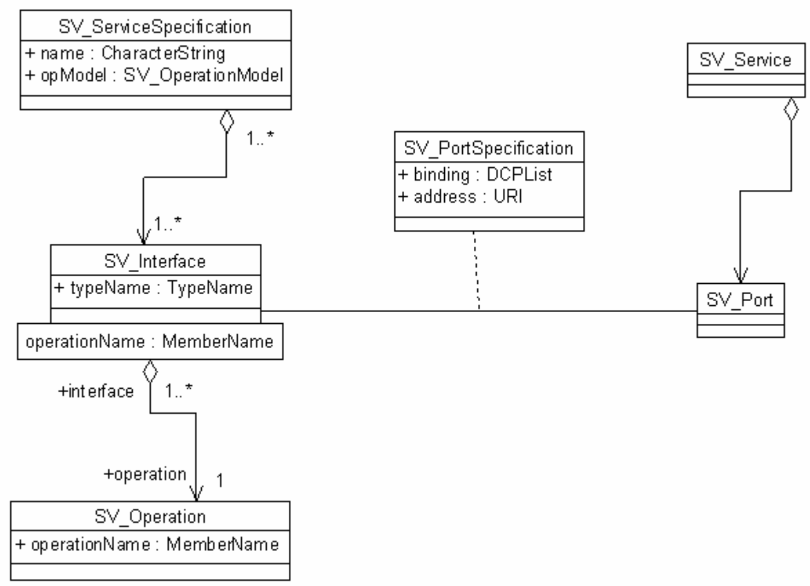
ISO 19116 – Positioning Service : System and Instrument Information



ISO 19119 – Services : SV_Interface



ISO 19119 – Services



Conclusion

- ISO 19100 covers many aspects of location related information, mostly high-level information distribution and map management.
- A lot of the concepts defined seem to be applicable to Robotics (although some extensions would certainly be necessary) and especially :
  - Spatial and Temporal Schema (Geometry & Topology)
  - Map Feature Definition and Distribution
  - Position referencing by Coordinate (need extension)
  - Coordinate System Management (need extension)
  - Positioning Service (need extension and redefinition)
- A prototype robot localization system based on this standard should be developed in order to fully assert the applicability and insufficiency of the ISO19100 Standards
- ISO19100 does not deal much with low level position estimation (assume use of GPS)
  - For OMG standardization, we should focus on alternative to GPS for location data production / calculation.

Where to find more info

- ISO/TC 211 Webpage
  - http://www.isotc211.org/
  - http://www.isotc211.org/hmmg/
  - http://www.isotc211.org/hmmg/HTML/root.html
- Open Geospatial Consortium
  - http://www.opengeospatial.org

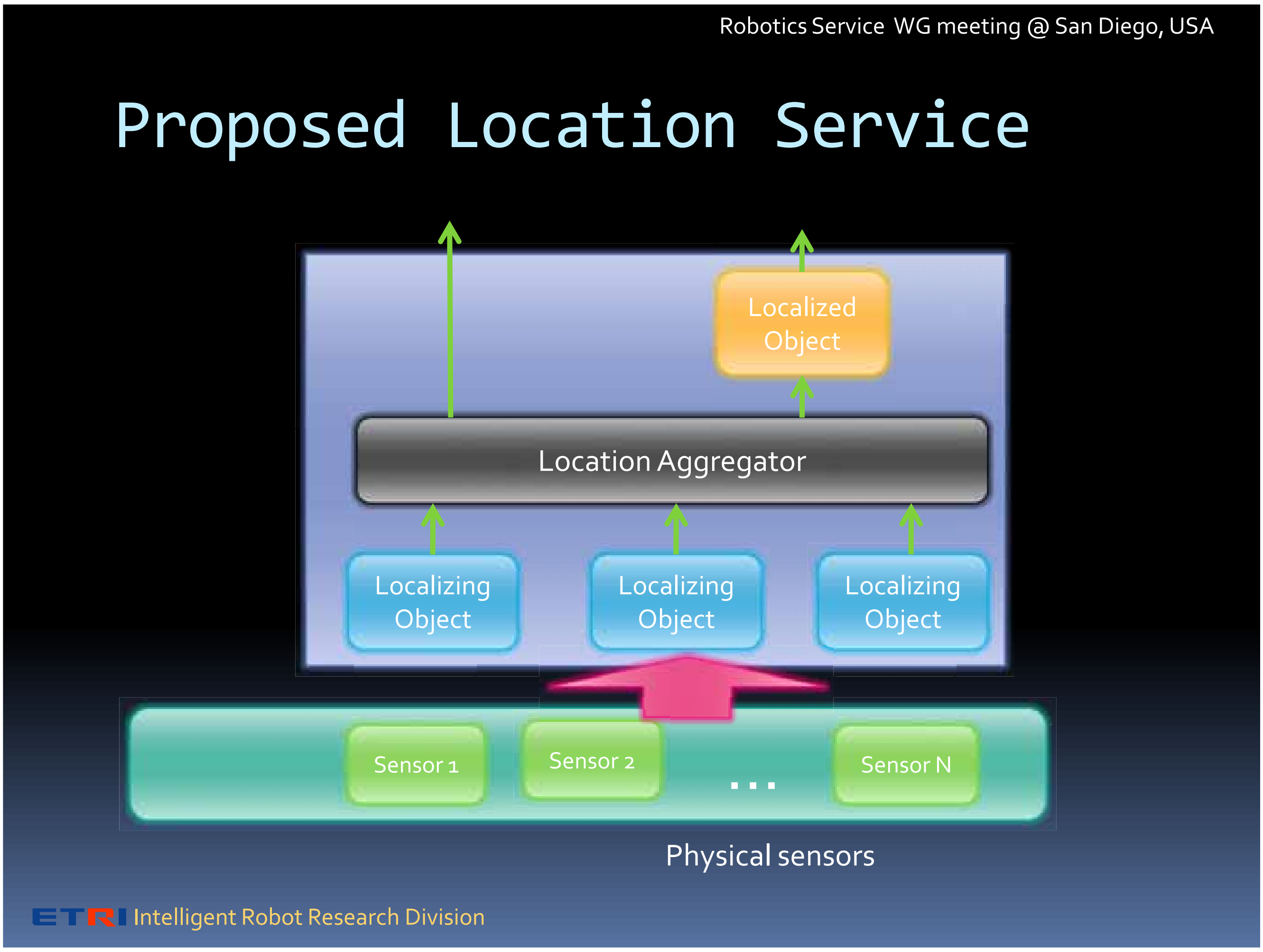
A Brief Report for ISO 19116 Positioning Service Standard

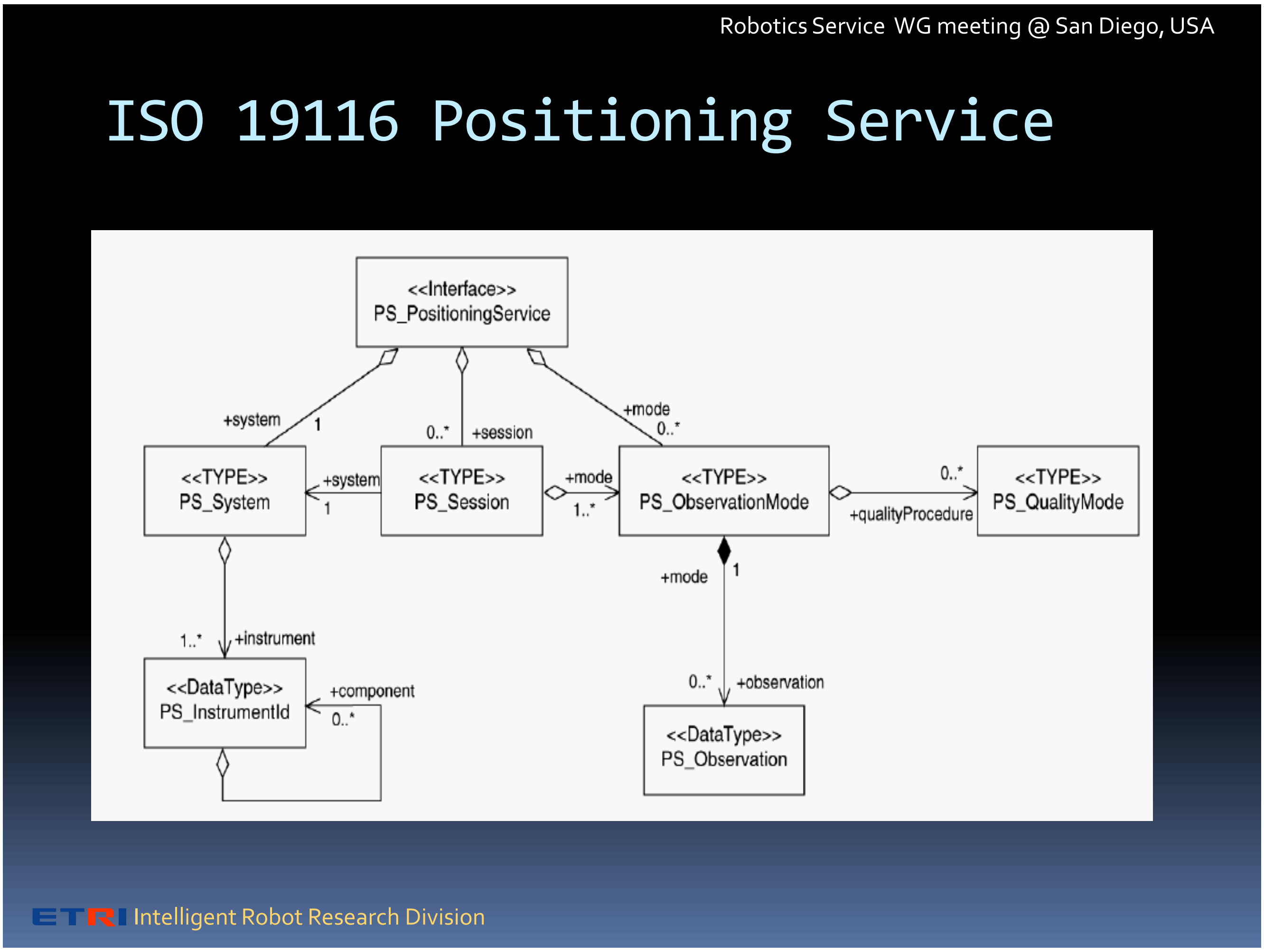
2007.3.26
Kyuseo Han, Wonpil You
ETRI, Korea

robotics/2007-03-08

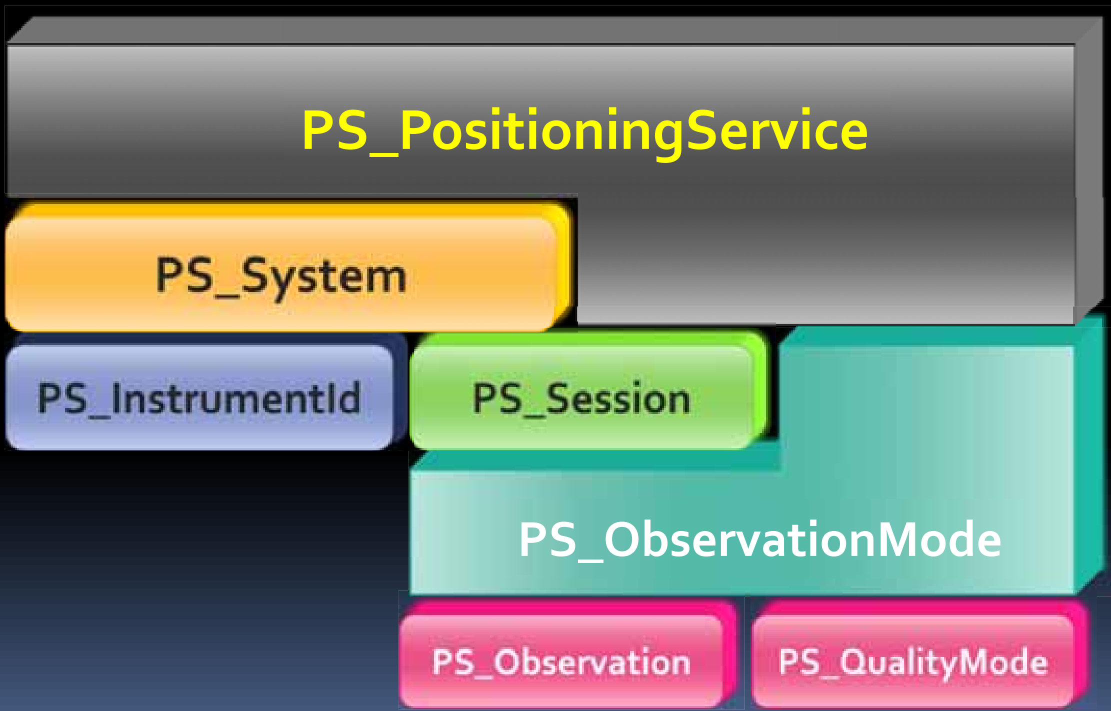
Objectives

- Explaining core structure of ISO 19116
- Comparing between *our hopeful Location Service standard* and *ISO 19116 Positioning Service standard*
- Future works


Robotics Service WG meeting @ San Diego, USA
Proposed Location Service
Localized Object
Location Aggregator
Localizing Object
Localizing Object
Localizing Object
Sensor 1
Sensor 2
...
Sensor N
Physical sensors
ETRI Intelligent Robot Research Division


Robotics Service WG meeting @ San Diego, USA
ISO 19116 Positioning Service
<<Interface>>
PS_PositioningService
+system
1
0..*
+session
+mode
0..*
<<TYPE>>
PS_System
+system
1
<<TYPE>>
PS_Session
+mode
1..*
<<TYPE>>
PS_ObservationMode
0..*
+qualityProcedure
<<TYPE>>
PS_QualityMode
+mode
1
1..*
+instrument
<<DataType>>
PS_InstrumentId
+component
0..*
0..*
+observation
<<DataType>>
PS_Observation
ETRI Intelligent Robot Research Division

Block Diagram of ISO 19116



Functionalities (I)

- PS_PositioningService
  - The operations of the positioning service interface
- PS_System
  - Identifying the positioning data source, the type of technology applied, and its capabilities
- PS_InstrumentId
  - Providing details about the equipment employed by the positioning service

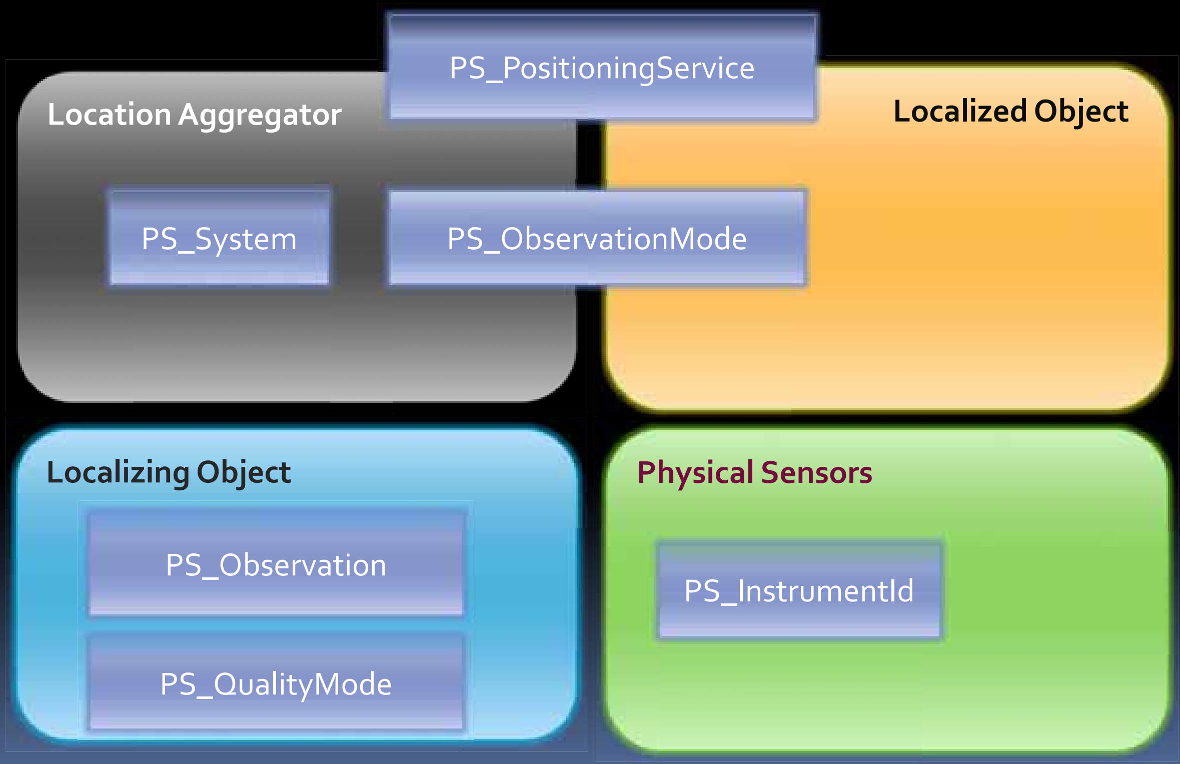
Functionalities (II)

- PS_ObservationMode
  - Holding information about the configuration of a PS to provide a particular type of positioning result
- PS_Observation
  - Reporting results of positioning observations
  - Including mode, the identification of objects, and any offset between sensors and objects…
- PS_QualityMode
  - Optionally providing quality information

Shortcomings

- No Aggregator in ISO 19116
  - Users should properly aggregate positioning data for their own purposes
  - No unifying way to handle data
- Focus on GPS
  - Sensors used in ISO specification are GPS receivers (Can it cover other location sensors?)

Overlaying functions



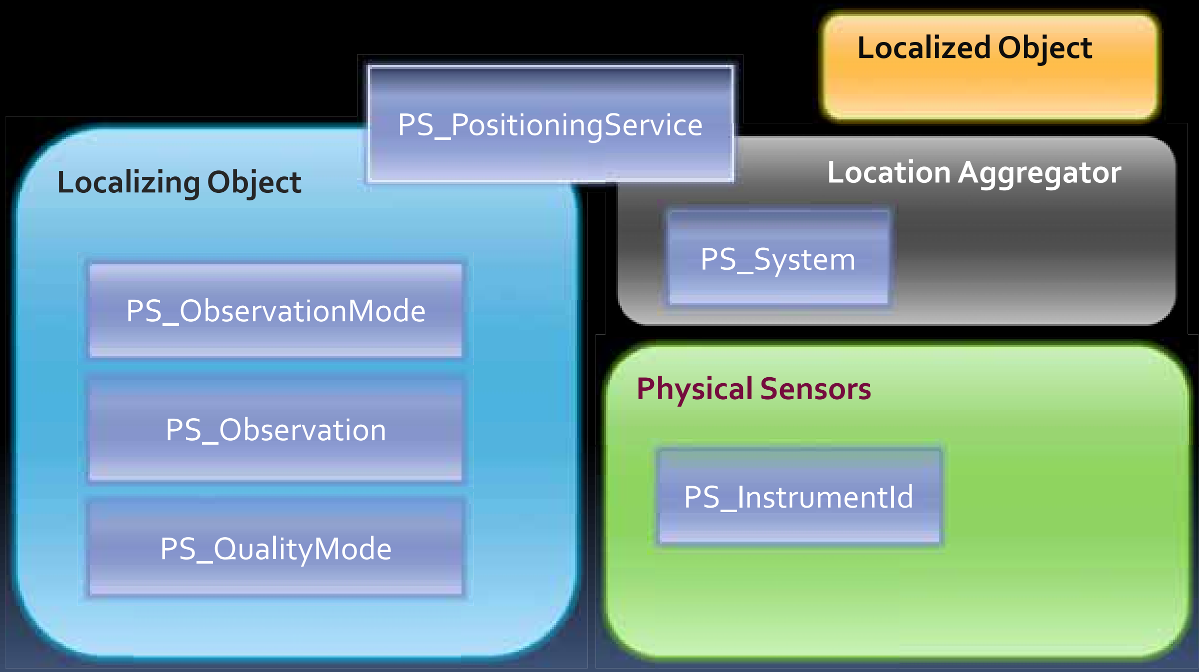
Robotics Service WG meeting @ San Diego, USA

Is it correct overlaying?

- In ISO 19116,PS_ObservationMode and PS_Observation are tightly-coupled in terms of handling positioning data
- It is more likely to consider one-to-one connection between PS_ObservationMode and PS_Observation in "Localizing Object"

ETRI Intelligent Robot Research Division

Revised overlaying functions



Conclusion

- Considering ISO 19116 standard as OMG Location service standard?
- If we take further step to set up a new standard, we should have in mind with
  - How to adapt present standards, such as ISO 19100 series and OpenLS
  - What are newly provided in an advance standard as representing robot-specific characteristics?

robotics/2007-03-09
OMG Technical meeting 2007.3.26

Positioning data quality indication for Agricultural Robots

Yoshisada Nagasaka
Hidefumi Saito
Kyo Kobayashi
National Agricultural Research Center, Japan

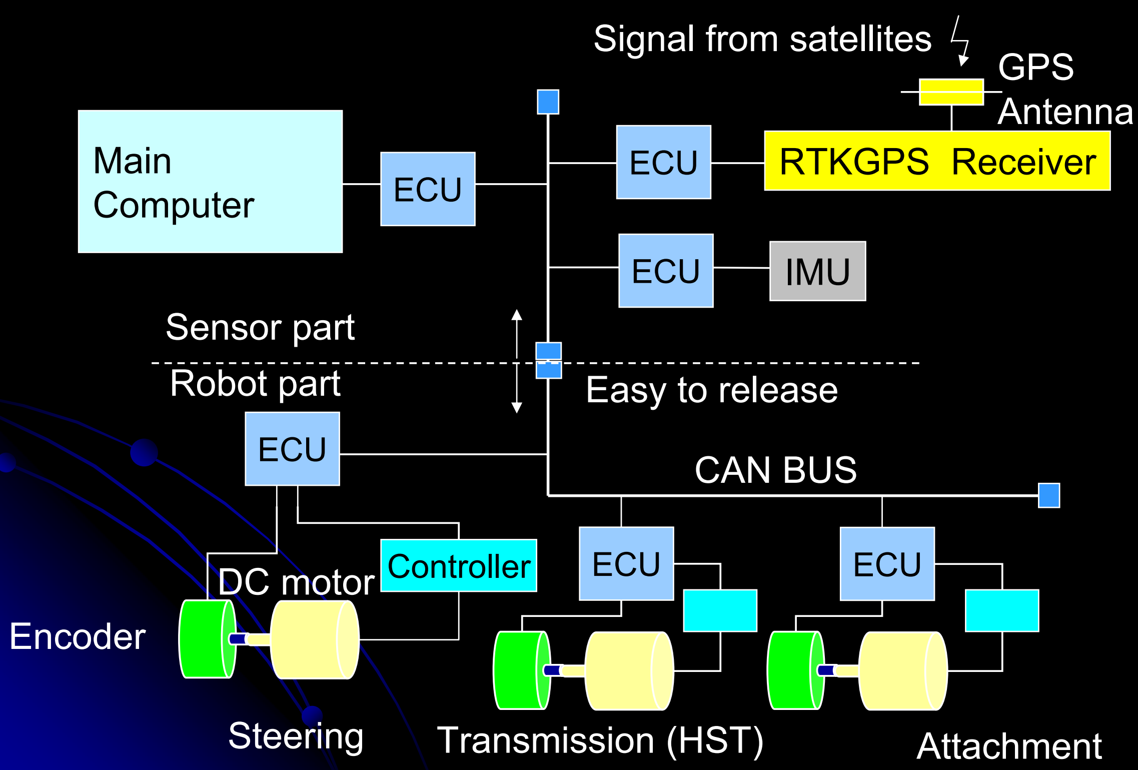
This presentation

- Introduce an automated rice transplanter we developed.
- How we locate the transplanter in a paddy field.
- How we use a GPS data quality indication.
- Why we need position data quality indication

An automated rice transplanter

National Agricultural Research Center

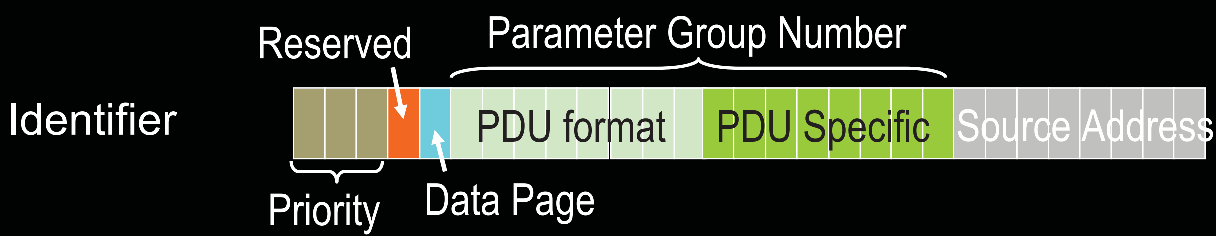
Scheme of the rice transplanter



GPS receiver

- Trimble MS750 GPS receiver (Accuracy:2cm)
- CAN bus interface
  SAE J 1939(ISO 11783) format
- RS232C interface
  NMEA 0183 format

CAN BUS output



- Based ISO11783 (SAE J 1939)
- Priority:6 Data page:0
- Parameter Group Number: FEF3
- 8byte data, 4byte Latitude, 4byte Longitude, -210 deg offset
- Data resolution: 10^{-7} degree/bit ≈ 1cm
- No data quality indication

RS232C output

- Based on NMEA0183 format

$GPGGA,055330.80,3601.41247744,N,14005.97658063,
E,4,6,1.3,13.989,M,39.086,M,1.8,0000*4B

Data quality indication:
0: fix not available
1: GPS fix
2: Differential GPS fix
4: RTK GPS fix
5: RTK GPS float

0–2: Defined in NMEA0183

4: Valid indication for operation

National Agricultural Research Center

Locate a rice transplanter

- We convert WGS-84 to local plane coordinates
- Latitude(deg), Longitude(deg), Altitude(m)
  ➔ local Easting(m), Northing(m), height(m)
- Check the indication of the GPS data

National Agricultural Research Center

Obtain data quality indication

- ISO 11783 doesn't define data quality indication.
- We receive RS232C output data and generate CAN bus output with GPS data quality indication.

This is an old one, but a new one also works like this.

GNS Client service

- Global Navigation System (GNS) Client Services
- Defined by OMG in 2004?
- They define “Figure of Merit” for estimated position error.

Figure of Merit

FOM	Value Estimated Position Error (EPE)
1	EPE < 25 meters (82 ft/ 27 yd)
2	25 meters (82 ft/ 27 yd) < EPE < 50 meters (164 ft/ 55 yd)
3	50 meters (164 ft/ 55 yd) < EPE < 75 meters (246 ft/ 82 yd)
4	75 meters (246 ft/ 82 yd) < EPE < 100 meters (328 ft/ 109 yd)
5	100 meters (328 ft/ 109 yd) < EPE < 200 meters (656 ft/ 219 yd)
6	200 meters (656 ft/ 219 yd) < EPE < 500 meters (1640 ft/ 547 yd)
7	500 meters (1640 ft/ 547 yd) < EPE < 1000 meters (3280 ft/ 1093 yd)
8	1000 meters (3280 ft/ 1093 yd) < EPE < 5000 meters (16,400 ft/ 5466 yd)
9	EPE > 5000 meters (16,400 ft/ 5466 yd)

What we need?

- We need position data quality indication in sub-inch (about 1cm) accuracy.
- When we reference this indication, we can easily judge that an automated machine can keep making precise operation or not.

NARC National Agricultural Research Center

Thank you for your attention.

robotics/2007-03-10

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Introduction to Localization related Japan Science & Technology Agency Projects at AIST

独立行政法人 科学技術振興機構 Japan Science and Technology Agency

AIST (Japan)
Intelligent Systems Institutes
Ubiquitous Functions Research Group

Tetsuo TOMIZAWA

National Institute of Advanced Industrial Science and Technology AIST

Self-introduction

Tetsuo TOMIZAWA
Japan Society for Promotion of Science (JSPS) Research Fellow
Guest Researcher
Intelligent Systems Institute, ***Ubiquitous Functions Research Group***, AIST

Key Words:
- Human dailylife support robotic system
- Novel sensors and actuation devices

冨沢 哲雄
Tomizawa Tetsuo
토미자와 테추오
Томидзава Тэтуо
توميزاوا تيتسواو
Τομιζαυα Τετσουο
โตมิซาวา เตซูโอ
तोमिज़ावा तेत्सुओ
တိုမီဇာဝါ တဲဆူအို
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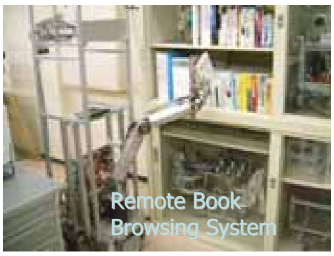

* These researches were done @ University of Tsukuba.

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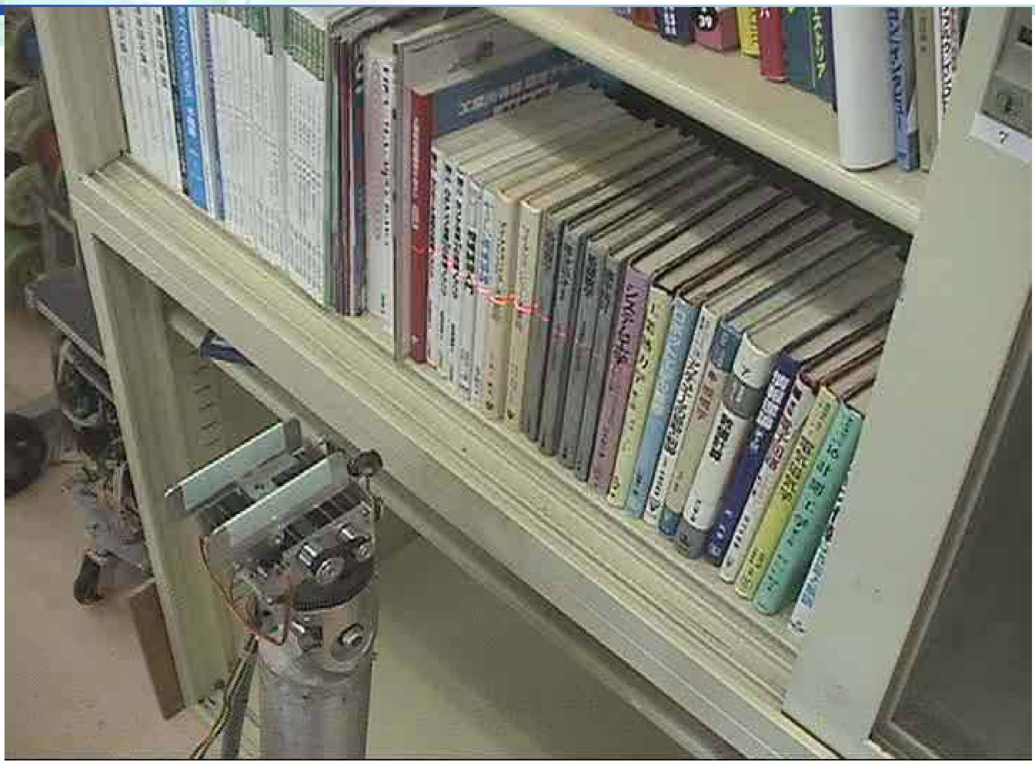
Past research: Remote book browsing system



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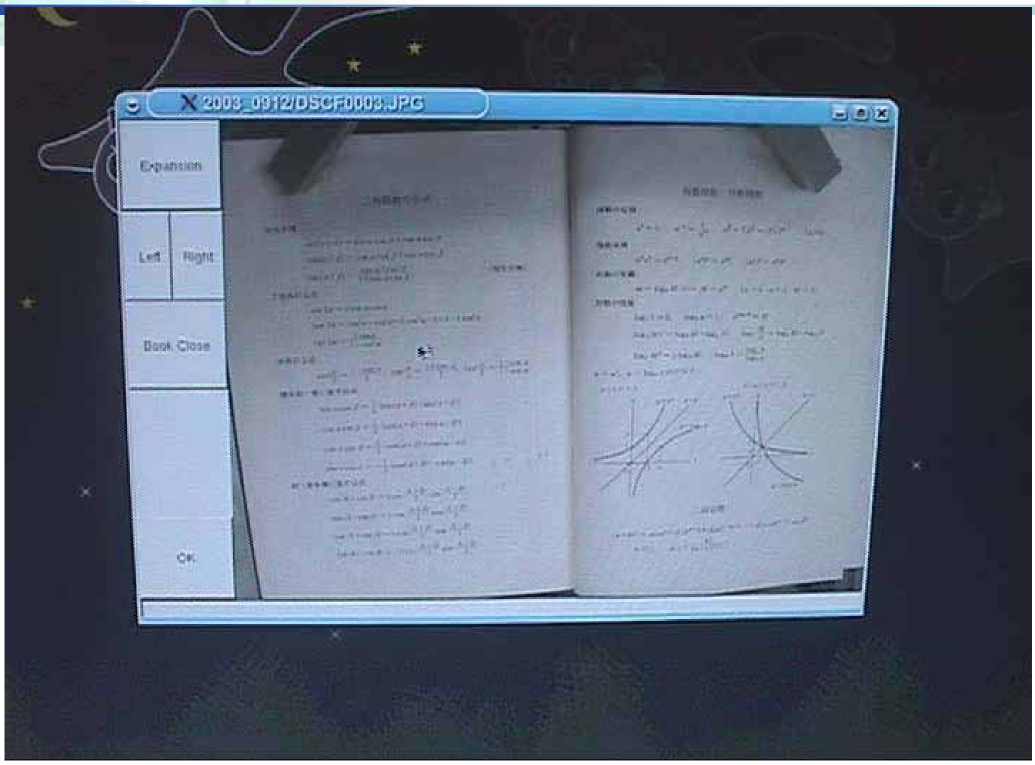
Past research: Remote book browsing system



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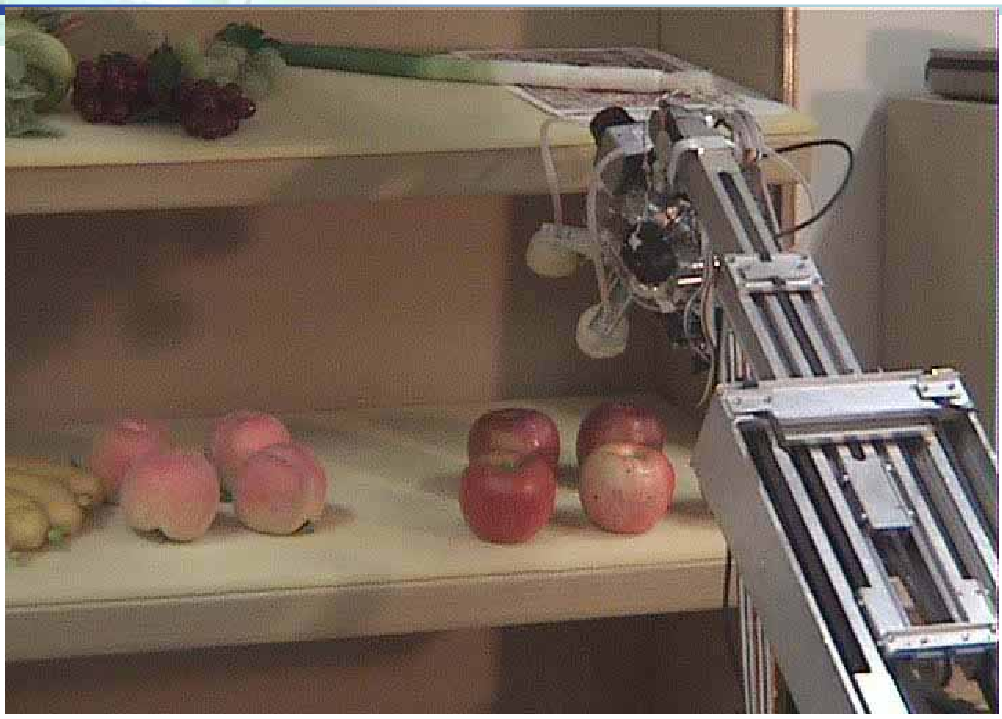
Past research: Remote foods shopping system



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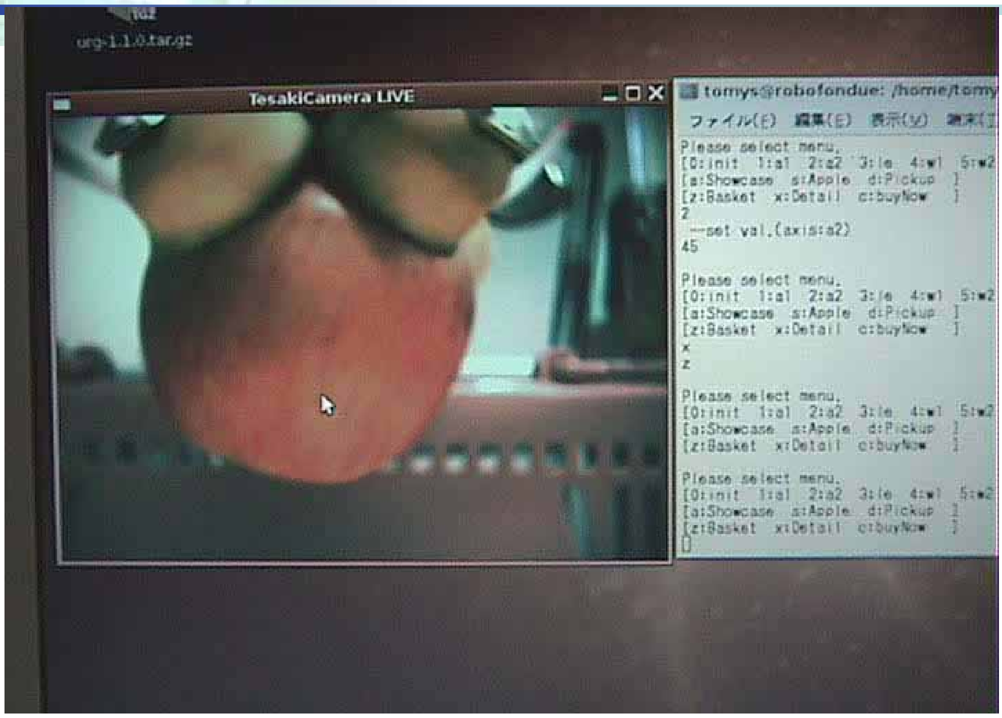
Past research: Remote foods shopping system



* These researches were done @ University of Tsukuba.

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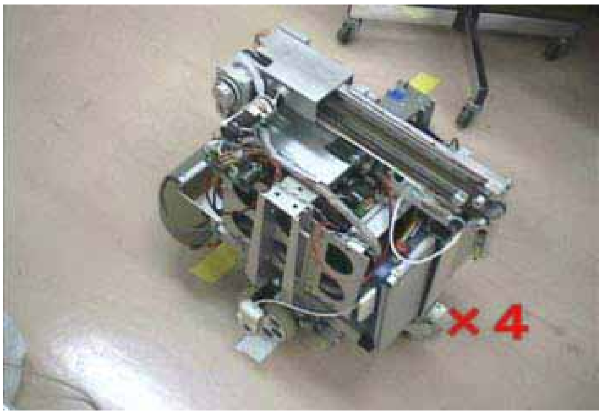
Past research: Novel actuator and sensor system

Multi-purpose expandable arm for small mobile robots

Some applications:

Navivation via an elevator



Opening/closing a mail box

* These researches were done @ University of Tsukuba.

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JST Destination

Universal Design of Environment Framework for Robots

Traditional mobile robots have localized using only own sensors (ex. odometry, landmark detector, etc.) and a small number of adoptive sensors which located on the environment (robot tracker, active landmarks, etc.).

Although highly efficient sensors and intelligences are stuffed into one robot, it is difficult to achieve any goals by oneself.

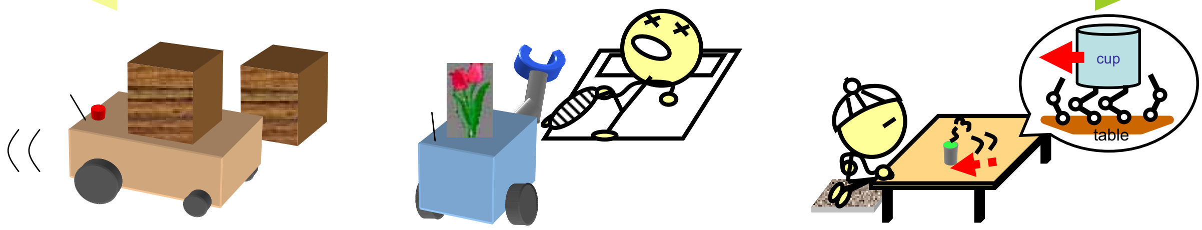
In these year, there are many type of available devices and network tools, so sensors, actuators, and intelligences (information) can distribute to whole environments. It is so-called ***"Ubiquitous Robotics"***.

Targeted Applications

Our target applications are wide-ranging:
- Scale (Huge - Small)
- Agent type (Visible - Unconscious)

Huge scale — **Small scale**

container conveyance support system in warehouse | dailylife support system in the ordinary house | spiffy services by micro robots



<u>In every cases, Localization is the most important element !!</u>

One of our objective is to propose and design the ***"Structured environment"*** for localization of all the robotized objects.

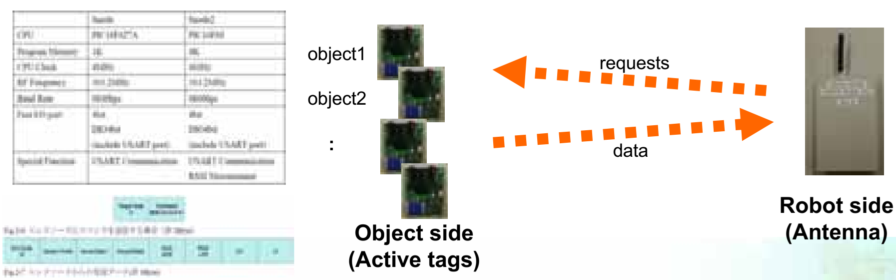
Structured Environment

If sensors and intelligence are shifted to environment, there are the following advantages:

- Position is directly acquired from environmental infrastructures
- Simplification and weight saving of the robot hardware
- Re-use of sensor devices for many kinds of systems
- Interference of sensors are avoided.

The whole efficiency is improved and the cost is reduced !!

As a communication tool, we developed small active IC-tag system.
(Ubiquitous Functions Activation Module, UFAM)
Information can be embedded in environment and sent to the robot system.



Available sensors for Localization

There are so many kinds of sensors for localization !!!

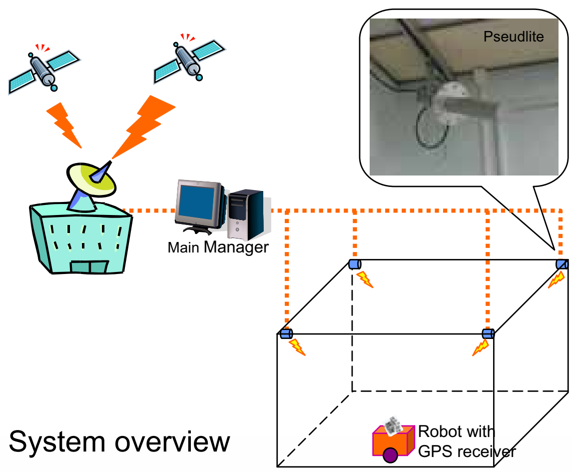
	Over View	Short Comings	Coordinate	Frequency	Price	Range	Resolution
Pseudlite	Indoor GPS system. Pseudlite is set into the corner of the room. It can measure 3D coordinate any position.	Setup cost is high price yet. Multi path problem is existed in the narrow space.	Ab.	2Hz	100,000USD	1 floor	5cm
Starlite	The camera mounted on the robot detects the infrared LED transmitter installed in the ceiling.	It is weak in disturbance light (especially sunlight). The calibration is difficult.	Ab.	10Hz	1,000 USD	View angle	3cm
LRF	Laser is projected and the reflecting points are measured. Scanned points are compared with the shape of walls.	It is weak into a transparent object, a specular surface, and a dead angle.	Ab./ Re	10Hz	1,000-5,000 USD	4m-80m	1cm
Odometry	The position is presu the speed of each fundamental meth				-	On floor	1mm
IMU	The position and from acceleration Miniaturization an realized with MEM				100-10,000 USD	Every where	0.001G
Camera	The feature tracki With IR camera, possible.				100-3,000 USD	View angle	5cm
US	The distance of a reflecting point is presumed by the reflective time of sound waves.	Interference of sensors. Directivity is low.	Ab./ Re	30Hz	-	5m	5cm
Intelligent floor	The unique pattern drawn on the floor is read.	It is difficult to draw a pattern all over a floor. Pattern disappearance by dirt.	Ab.	30Hz	-	On floor	1mm

Every Profiles (Frequency, Range, Resolution, Accuracy, and etc.) are DIFFERENT !!

Indoor-GPS

The Indoor-GPS (iGPS) is developed by common lab.

- Pseudlites are set into the corner of the room.
- Receiver is mounted on a robot.
- The robot can know its 3D position (NMEA GPGGA format: latitude, longitude and height) every 0.5 sec.
- The prototype works only off-line, but next model can be used on real time.



System overview

Which sensors should I select ?

When the target specification is given,

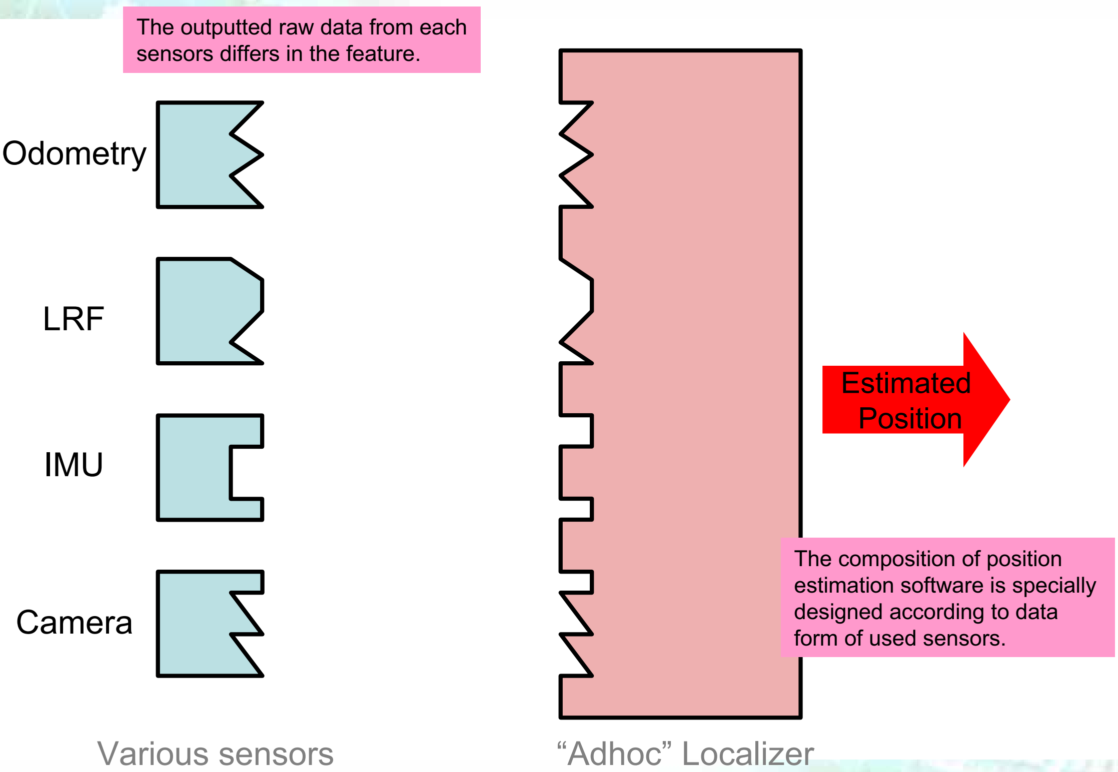
- Which sensors are used?
- Where is the sensor installed?
- Which algorisms are used?

Generally,

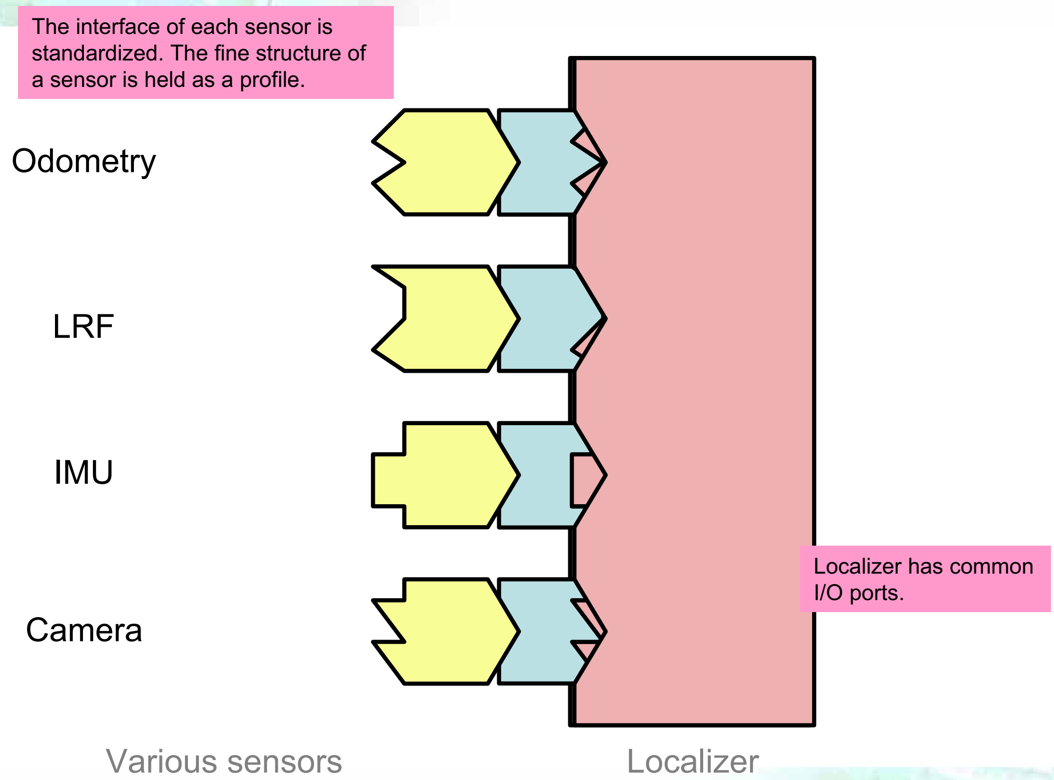
- Engineers will decide devices and method based on his/her experiences.
- If the system doesn't realize desired performance, we may add or modify by try and error.

Is it the best way to realize the optimal performance?

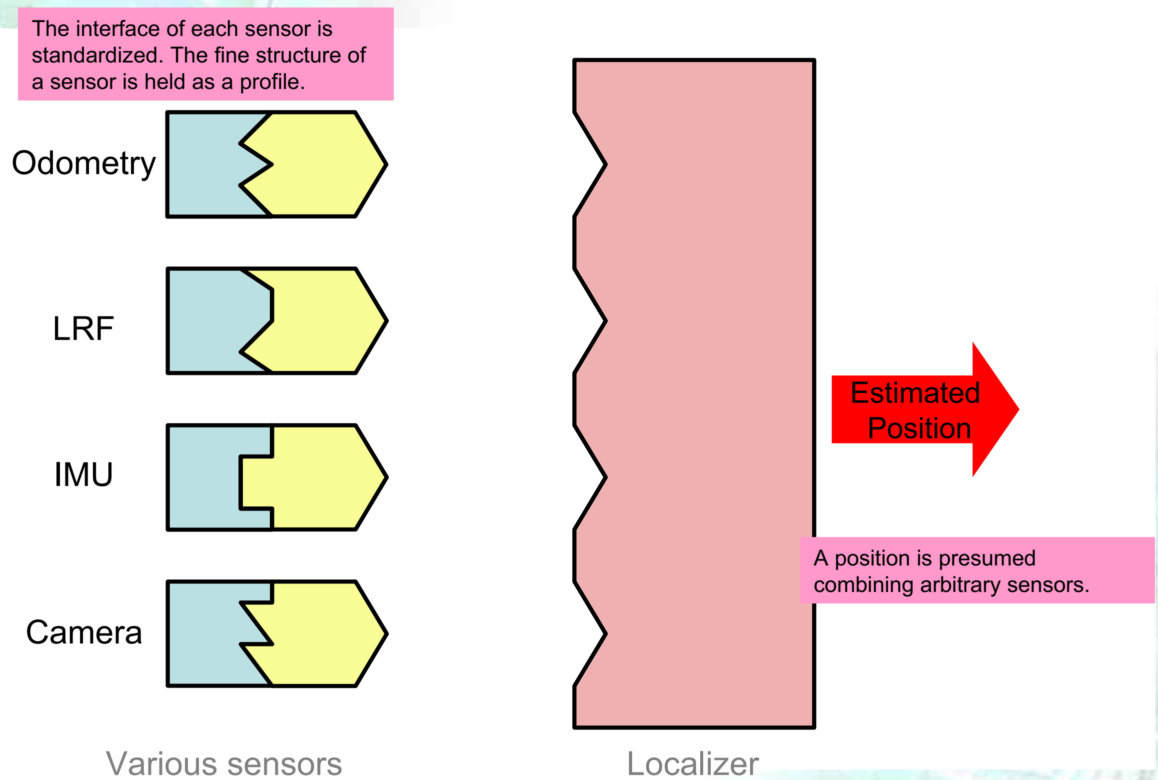
Traditional Localization



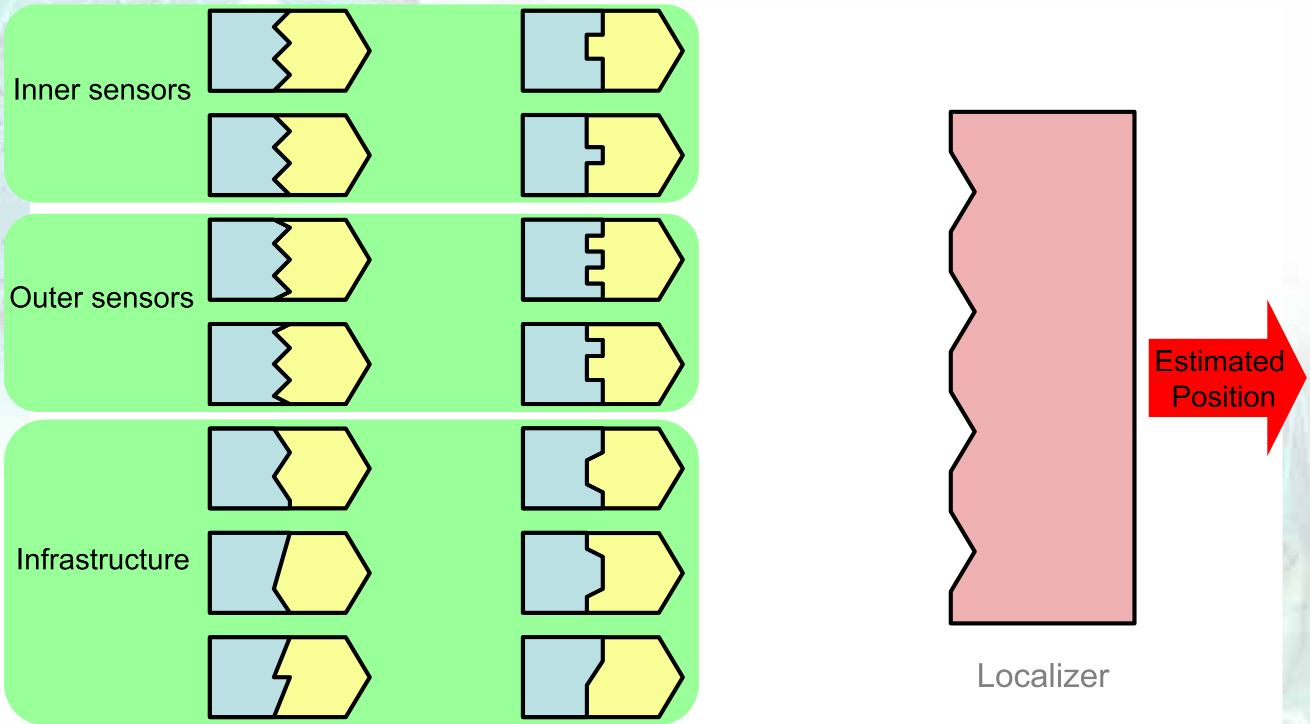
Localization using RTC



Localization using RTC



Localization using RTC



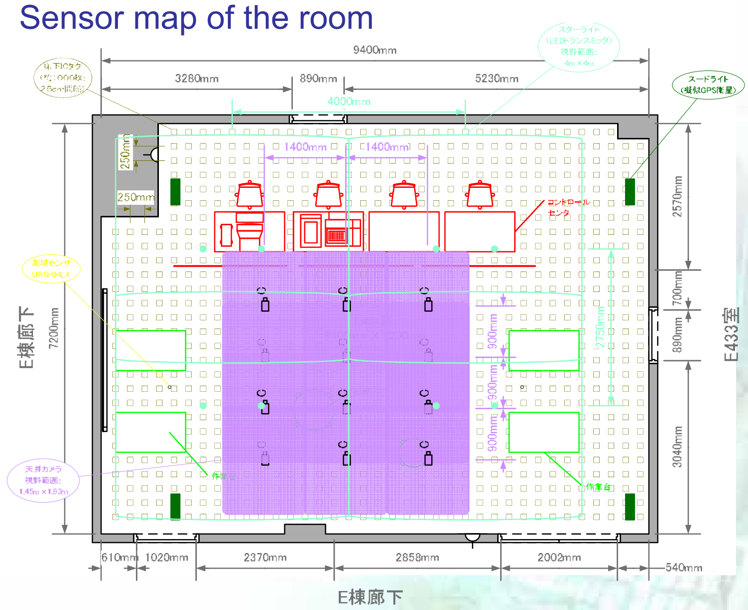
Experimental Room

In order to show the advantage by structured environment and to prove sensor combinations, the experimental room was built.

List of installed devices

- Robot Platform
  - Omni directional robot
  - Differential 2 wheel robot with RFID reader, IMU
- Infrastructures
  - Pseudlite (GNSS)
  - Starlite (ETRI)
  - RFID
  - LRF (Hokuyo)
  - Checked floor
  - Ceiling camera
- Surveying instrument
  - Total-Station (Leica)

Sensor map of the room



Experimental Room

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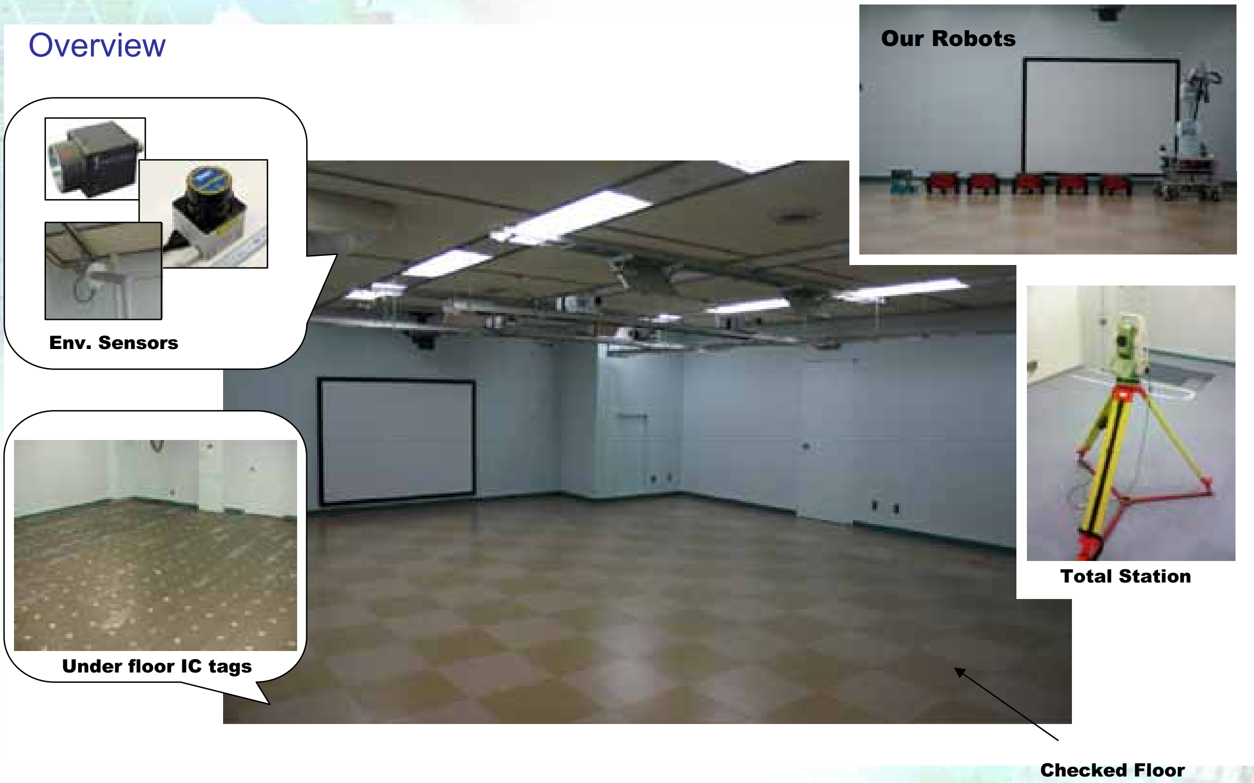
Overview



Sensor structure for Localization

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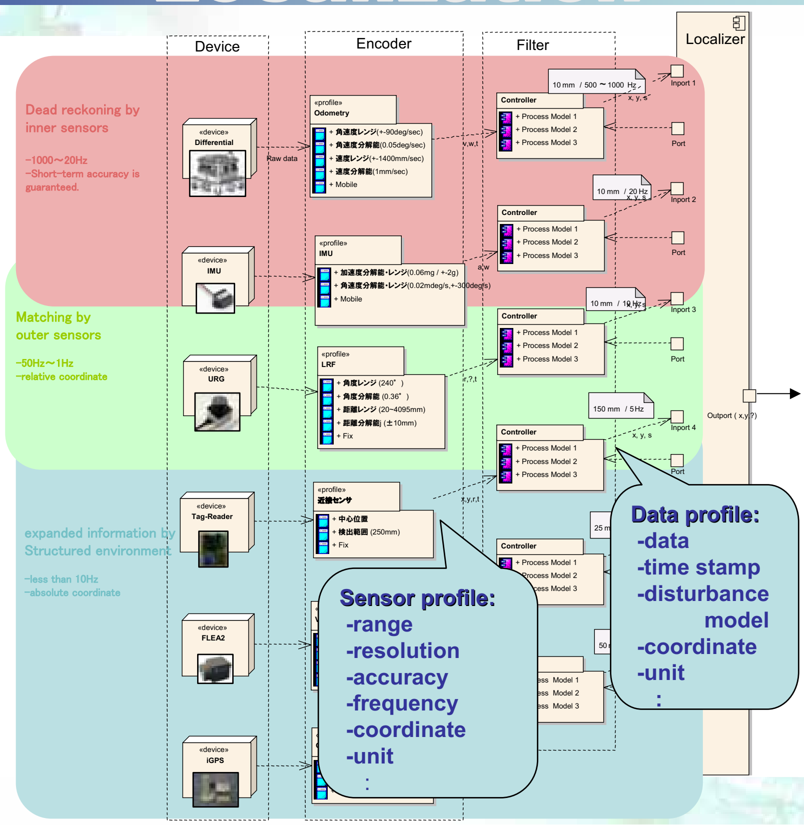
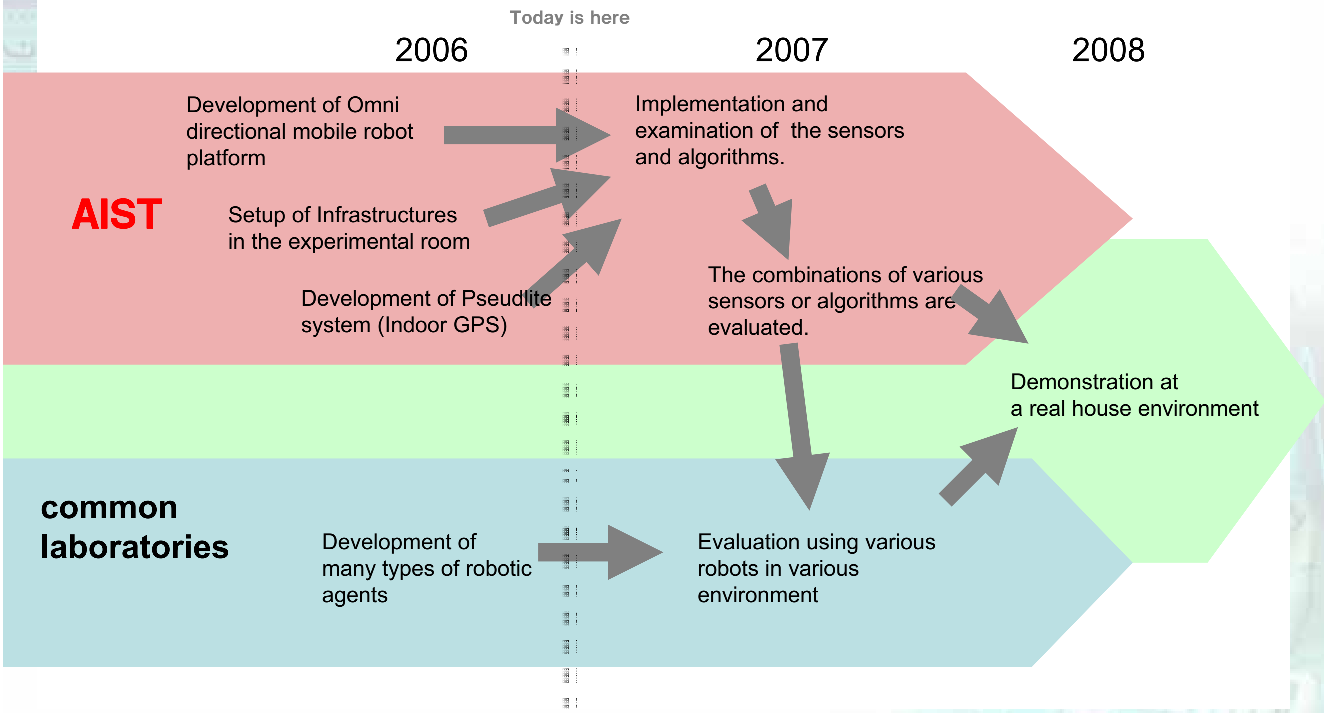


Plan for the Future



Summary

Be summarized as follows :

(1) We want to make “Universal Design for robots (structured environment)”, and define the sensor structure.
(2) We want to establish the method of selecting suitable sensors and suitable algorithms according to environment, demand specification, and capacity of the robot.
- In order to make a combination change of sensors or localization algorithms easy, “RT-middleware” is used.
- The combination is verified by the simulator. (by Open-HRP, Matlab ?)

(3) We will show a demonstration in a real home environment.

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Thank you for your attention !!

e-mail : t.tomizawa@aist.go.jp

robotics/2007-03-11

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Digital Human Research Center

Ultrasonic 3D tag system for robot localization

Toshio Hori

Digital Human Research Center (DHRC), AIST.

Digital Human Research Center

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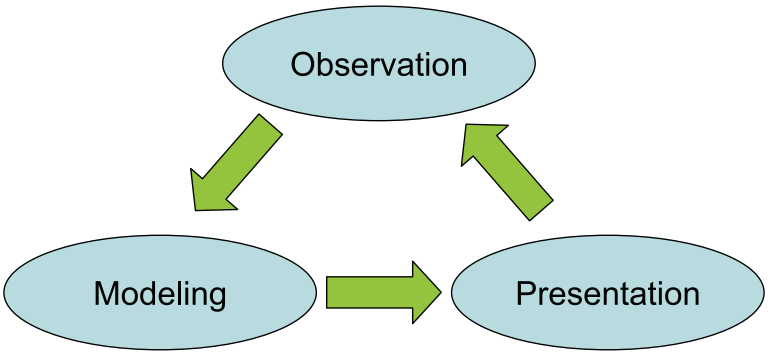
Outline

- Introduction
- Overview of the system
- Applications : ongoing research projects
- Summary

Introduction

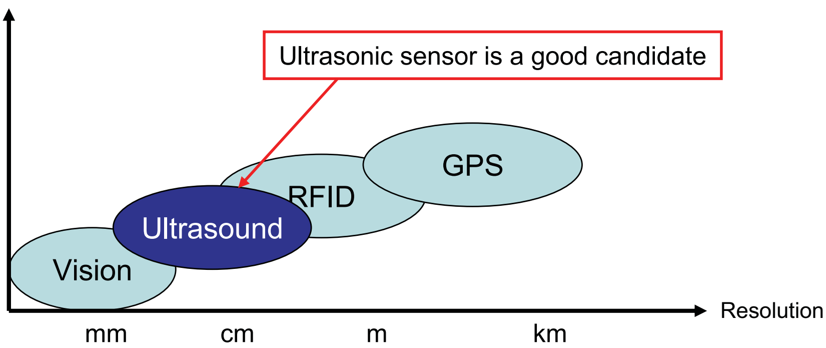
- My primary mission (as a researcher in DHRC)
  - Development of human "behavior" model (Digital Human)
    - To understand human in daily environment,
    - To simulate human behavior in virtual environment, and
    - To support human in daily environment.



Prof. Kanade (CMU)
Director of DHRC.

Introduction (cont.)

- Initial goal
  - Development of an observation system for human behaviors in daily environment
    - The system must detect human daily behaviors precisely
      - Resolution required: mm to cm
      - Sampling rate required: 1 to 10Hz
    - It must be embedded into (real) living environment
    - It must be cost effective (the cheaper, the better ☺)



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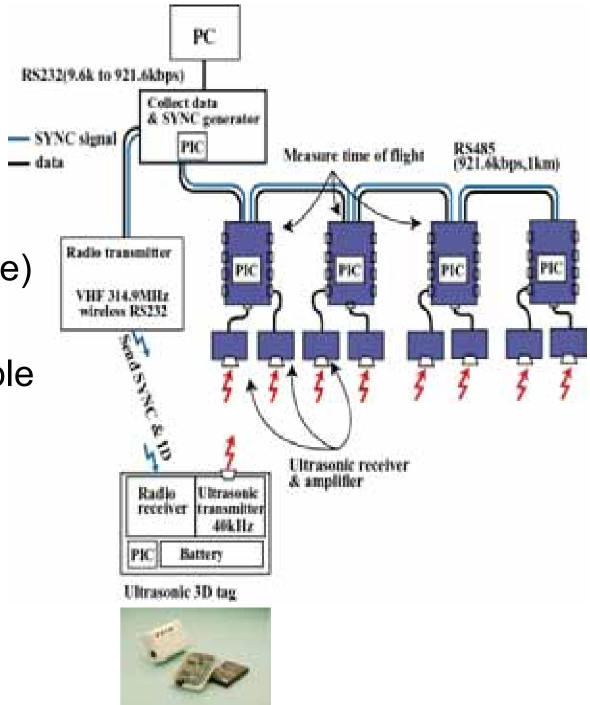
Ultrasonic 3D tag system

- System overview
  - Ultrasonic emitter/receiver
    - Frequency: 40kHz
    - S.P.L.: 51dB
  - Ultrasonic 3D tag (normal type)
    - Size: 65x44x20mm
    - Battery: Li-Ion rechargeable (for mobile phones)
    - Battery duration: 2weeks
  - Sampling rate: 50Hz (in total)
  - Error: 20-80mm (in lab.)
  - Resolution: 15mm



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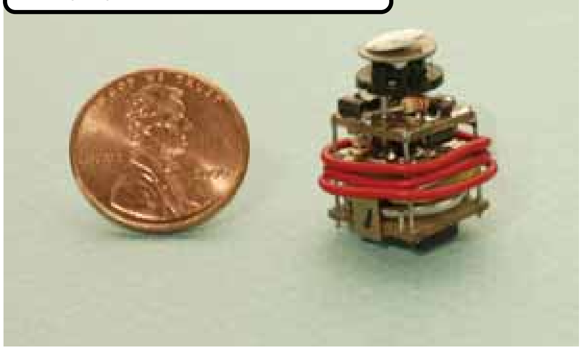
Various Ultrasonic 3D tags developed

Small type: 10x22x25mm

Normal type: 65x44x20mm

Tiny type: 12x12x20mm



Button battery

Rechargeable battery

System installed in our sensor room

Living room

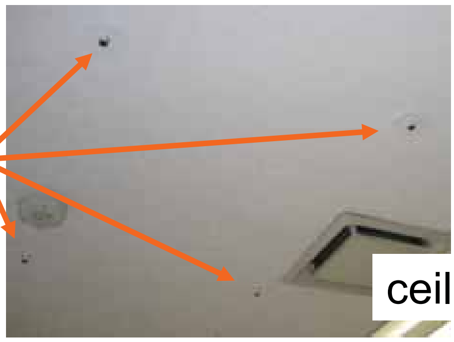
Playing room for children

Bed room

More than 1200 ultrasonic receivers (and 10 cameras) are embedded on the ceiling.

System installed in a nursing home

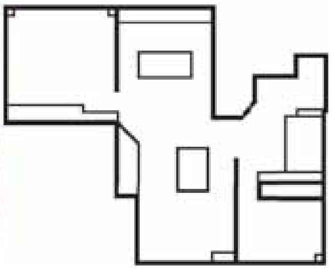
Ultrasonic receivers



ceiling

Ultrasonic emitter

System installed in an experimental house



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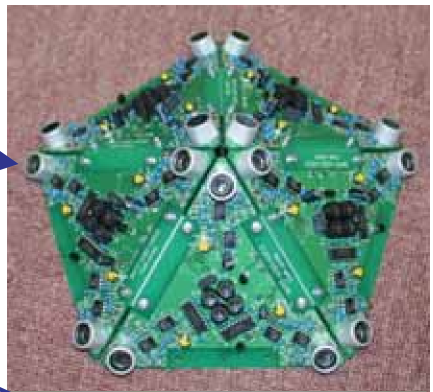
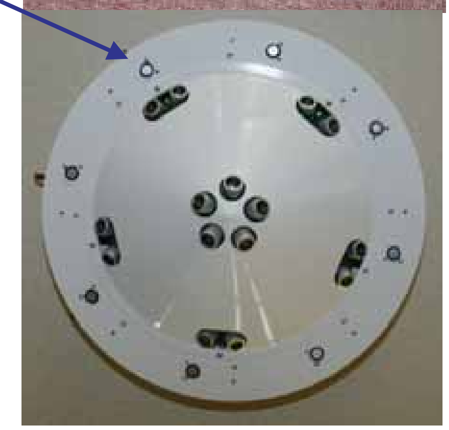
Ceiling Ultrasonic + Microphone Unit

- 15 ultrasonic receivers
- 8 Circular microphones





Ultrasonic Transmitter

Microphone Unit

Applications

- Currently, we are using the system for several research projects:
  - Behavior monitoring of children for preventing injuries
  - Behavior monitoring of old persons for nursing care support
  - Indoor GPS for autonomous robot localization
    - In houses
    - In public facilities

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U3D tag system as an In-door GPS

Concentrate on responsive tasks

Information processing on mobile robots

Information processing of environment-side system

Concentrate on global/universal tasks

Mobility control

Recognition of surroundings

Obstacle avoidance

Global map creation

Global navigation

Localization

Communication

Mobile robot

This hybrid system enables effective use of computing & power resources on mobile robots

Ultrasonic 3D tag system (In-door GPS)

Information sharing by separation of concerns

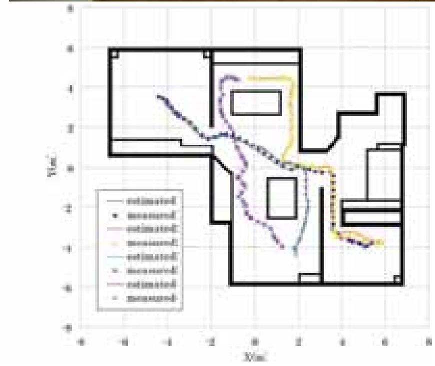
- Environmental system has global knowledge of environment where robots work:
  - Number of rooms/stories
  - Rough map of each room/hallway
  - Rooms/hallways topology
  - Position of each robot
- Each robot has local knowledge of its surroundings:
  - Precise map of a room where it exists
    - by SLAM
  - Position of obstacles around

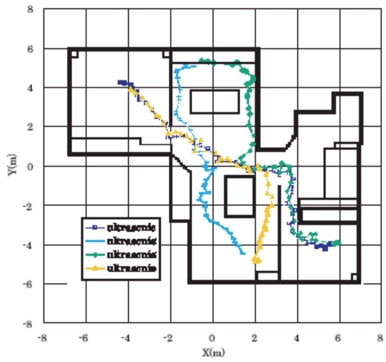
Collaboration of U3D tag system and mobile robot

- U3D tag system is installed in an experimental house which our cooperative company built
- My colleagues developed a mobile robot:
  - Cylindrical main body
    - Radius: 35cm
    - Height: 32cm
    - Weight: 15kg
  - Speed: Max. 2km/h (approx.)
  - Battery duration: About 4.5h
  - PentiumM-2GHz controller
  - Wireless LAN for communication
  - Ultrasonic 3D tag on top
  - Laser range finder in front

Localization Experiments

- Localization performance – error 5cm(ave, 14cm max)
- Estimated position versus ultra-sonic tag position





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Experiment: Go to US Tag

Note: Current system is not implemented as proposed, but the robot processes all the information including global navigation. This video shows the collaboration of a mobile robot and the ultrasonic 3D tag system only.

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Extension of a hybrid system

- The hybrid system can deploy other cooperative systems (modules) seamlessly
  - Human-Robot interaction system
    - Sound source localization module on board/in surrounding system
    - Voice recognition module on board/in surroundings
    - Speech module on board

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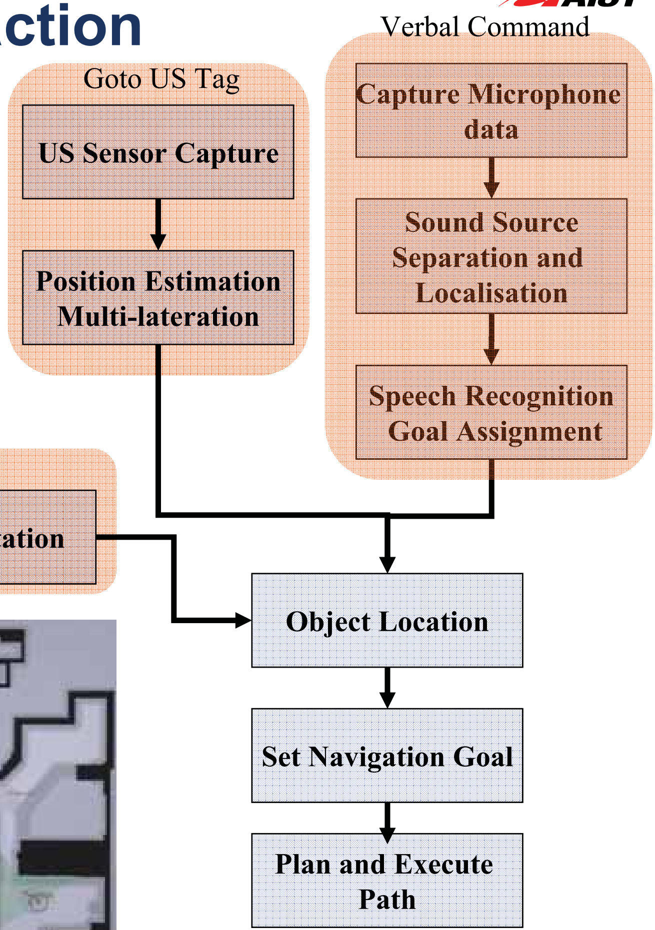
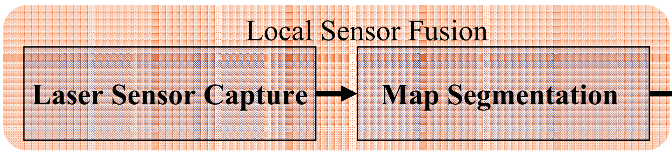
Robot Human Interaction

- Use ubiquitous sensors to facilitate interaction
  - Far-to-near communication
- Approach an ultrasonic tag (or the source of a sensed sound) from a distant location in the environment
- Obey verbal command from onboard microphone array





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Call a robot in another room by verbal command

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Summary

- Ultrasonic 3D tag system was introduced.
- Its applications for indoor GPS for mobile robots were introduced with some experimental results.

Experience of Geographical Feature Database Service

Itsuki Noda
ITRI, AIST
Japan

NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST)

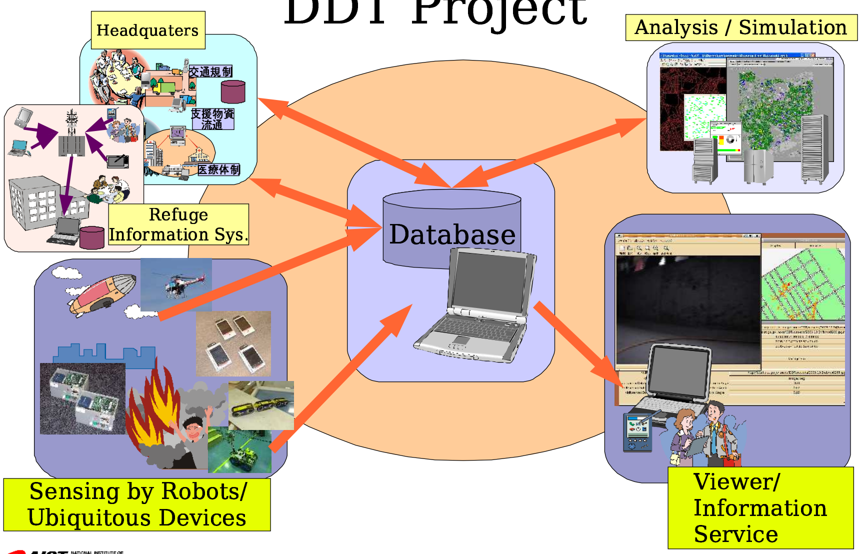
Outline

- Geographic Information and Our Projects
- MISP and DaRuMa
- Standard Format for Sensing Information
- Summary and Open Issues

Geographical Information and Robots

- Robots: a device to provide location-related information service.
  - Ex.1) Rescue Robot
    - moves around disaster area and gets sensing information at a certain location.
  - Ex.2) Guide Robot
    - brings people to a certain location and provides them information about the location.

System Overview of DDT Project



Rescue Robots

Rescue Devices

Rescue Communicator (Platform of Sensing Network)	Ad-hoc Networking Terminal

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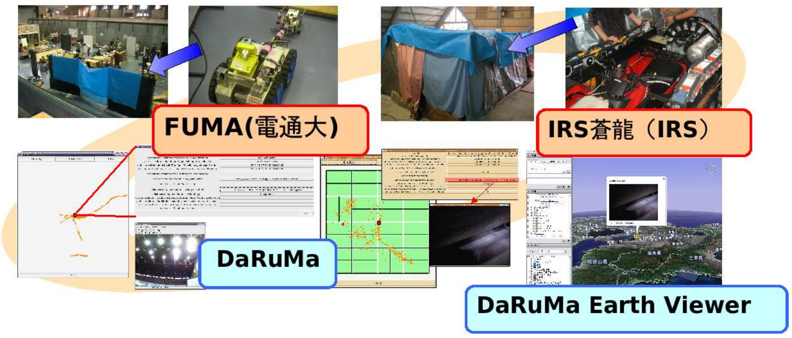
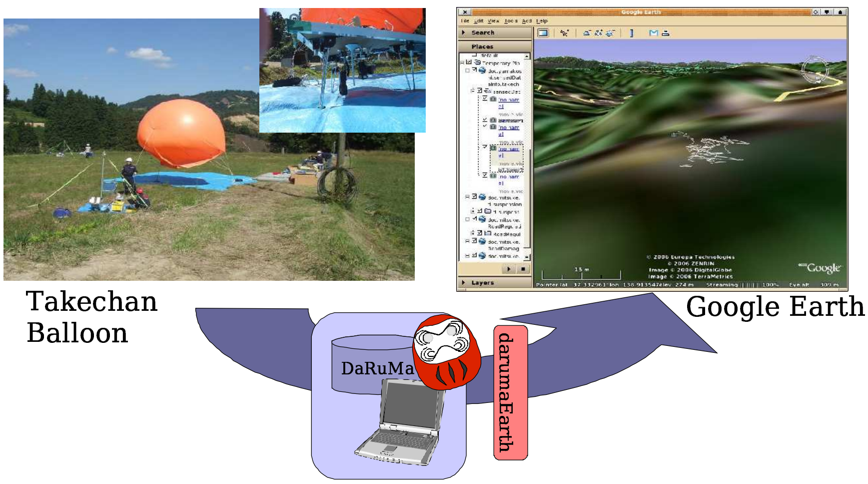
Integration of Sensing Data by DaRuMa

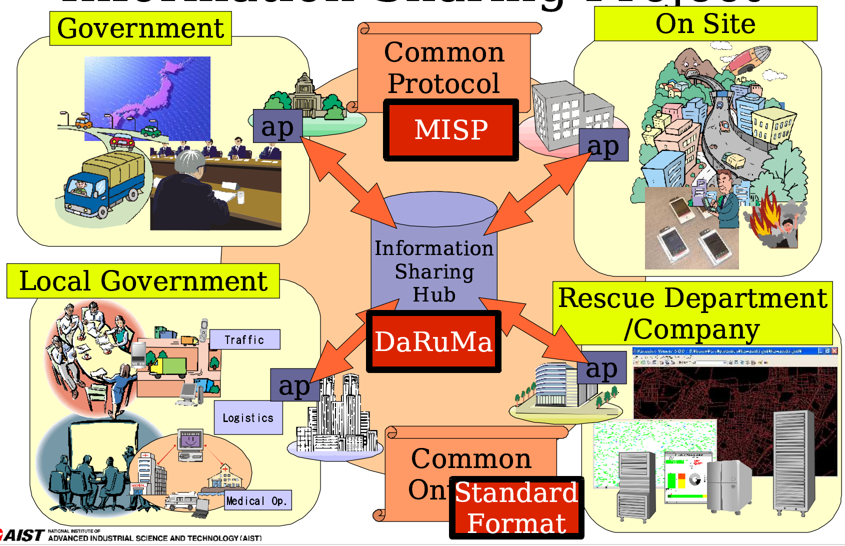
- Sensing Data taken by robots can be utilized effectively by sharing on geometrical databases.



Viewing Sensed Data by darumaEarth



Disaster Mitigation Information Sharing Project



Types of Geographical Information Service

- Feature Service
  - handles a structured information with location.
    - ex.) a picture data with meta information that includes location taken by rescue robots.
- Coverage Service
  - handles a set of values on a certain grid (map).
    - ex.) a temperature distribution in a certain area.

XML Standards

- to represent geographical information
  - GML (Geography Markup Language) ISO/DIS 19136
- to serve features
  - WFS (Web Feature Service) ISO/CD 19142
    - Filter Encoding ISO/CD 19143
  - XQuery with some spatial extensions
- to serve coverage ISO/WD TS 19129 ?
  - WCS (Web Coverage Service)
  - WMS (Web Map Service)

WFS vs XQuery

- WFS
  - Pros
    - need only XML parser/handler
    - simple (easy to implement)
    - easy to map SQL
  - Cons
    - no XML translation mechanism
- XQuery/XPath
  - Pros
    - flexible and powerful
    - widely used in XML databases
  - Cons
    - no standards to handle spacial information.

MISP: Mitigation Information Sharing Protocol

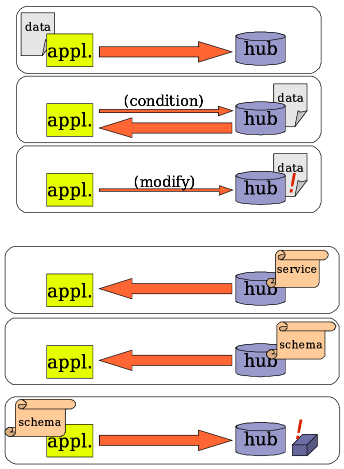
- Based on WFS (Web Feature Service)
  - GML (Geography Markup Language)
    - for geograhpic representation.
  - wrapped by SOAP
    - for flexible web service
  - using MIME encoding
    - to handle various data type.

Why MISP? not WFS?

- Original Extension:
  - register new feature types (RegisterFeatureType)
    - for online-registration of feature type
  - response forms (follow SOAP standards)
  - timestamp handling
  - logical expression (True/False)
  - query options
    - count/bbox result
    - limit of returned item

Operational Protocol in MISP

- **Database Functions**
  - Insert
  - GetFeature
  - Update/Delete
- **Meta-level Functions**
  - Web Service Capability
  - DescribeFeatureType
  - RegisterFeatureType



Protocol: Insert New Data

```
<misp:Transaction>
  <misp:Insert>
    <Building>
      <gml:geometryProperty>
        <gml:Polygon>
          <gml:outerBoundaryIs>
           <gml:LinearRing>
             <gml:coordinates>-13022.000000,-52682.000000 -13025.000000,-
52680.000000 -13018.000000,-52671.000000 -13015.000000,-52673.000000
-13017.000000,-52676.000000 -13017.000000,-52676.000000 -13022.000000,-
52682.000000</gml:coordinates>
           </gml:LinearRing>
          </gml:outerBoundaryIs>
        </gml:Polygon>
      </gml:geometryProperty>
      <id>18</id>
      ...
    </Building>
    <Building> ... </Building>
    ...
  </misp:Insert>
</misp:Transaction>
```

New Data

AIST NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST)

Protocol: Query

```
<misp:GetFeature>
 <misp:Query typeName="RoadLink">
  <misp:Filter>
   <misp:And>
    <misp:BBox>
     <misp:PropertyName>gml:geometryProperty</misp:PropertyName>
     <gml:Box srsName="...">
      <gml:coordinates>
        -11200.0,-51200.0 -11000.0,-51000.0
      </gml:coordinates>
     </gml:Box>
    </misp:Bbox>
    <misp:PropertyIsGreaterThan>
     <misp:PropertyName>width</misp:PropertyName>
     <misp:Literal>2.0</misp:Literal>
    </misp:PropertyIsGreaterThan>
   </misp:And>
  </misp:Filter>
 </misp:Query>
</misp:GetFeature>
```

Type of Data Entry

Query Condition

Protocol: Query Results

```
<misp:GetFeatureResponse>
 <gml:featureMember>
  <RoadLink>
   <gml:geometryProperty>
    <gml:LineString srsName="...">
     <gml:coordinates>
     -11178.713929,-51127.3582 -11240.947082,-51109.789681
     </gml:coordinates>
    </gml:LineString>
   </gml:geometryProperty>
   <id>2144</id>
   <representativePoint>
     <gml:Point srsName="...">
    <gml:coordinates>-11178.713929,-51127.3582</gml:coordinates>
     </gml:Point>
   </representativePoint>
   <nodeList>...</nodeList> ...
  </RoadLink>
 </gml:featureMember>
 <gml:featureMember>... </gml:featureMember>
 <gml:featureMember>... </gml:featureMember>
 ...
</misp:GetFeatureResponse>
```

Retrieved Data

Protocol: Update Data

```
<misp:Transaction>
  <misp:Update typeName="Building">
    <misp:Property>
      <misp:Name>damage/grade</misp:Name>
      <misp:Value>8</misp:Value>
    </misp:Property>
    <misp:Filter>
      <misp:And>
      <misp:BBox>
          <misp:PropertyName>gml:geometryProperty</misp:PropertyName>
          <gml:Box srsName=”...”>
            <gml:coordinates>
             -12200.0,-55100.0 -12000.0,-55000.0
            </gml:coordinates>
          </gml:Box>
      </misp:BBox>
      <misp:PropertyIsEqualTo>
          <misp:PropertyName>nFloors</misp:PropertyName>
          <misp:Literal>0</misp:Literal>
      </misp:PropertyIsEqualTo>
      </misp:And>
    </misp:Filter>
  </misp:Update>
</misp:Transaction>
```

New Property Value

Query Condition

Protocol: RegisterFeatureType

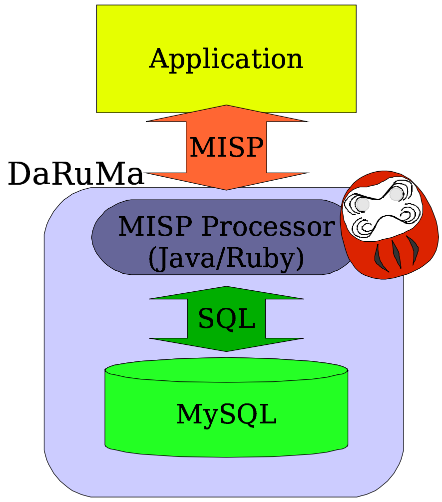
```
<misp:RegisterFeatureType uri="urn:gfs:ddt:test:Node">
 <xsd:schema misp:id=”urn:gfs:ddt:test:Node”
             targetNameSpace=”http:...”
             xmlns=”http:...”>
  <xsd:element name="RoadLink" type="RoadLinkType" />
  <xsd:complexType name="RoadLinkType">
   <xsd:complexContent>
    <xsd:extension base="misp:GeometryFeature">
     <xsd:sequence>
      <xsd:element name="representativePoint"
                   type="gml:GeometryPropertyType" />
      <xsd:element name="nodeList" type="nodeListType" />
      <xsd:element name="roadWidth" type="xsd:float" />
      <xsd:element name="nLanes" type="xsd:integer" />
      <xsd:element name="direction" type="xsd:string" />
     </xsd:sequence>
    </xsd:extension>
   </xsd:complexContent>
  </xsd:complexType>
 </xsd:schema>
</misp:RegisterFeatureType>
```

Name of Data Entry

Data Structure

DaRuMa
(DAtabase for Rescue Utility MAnagement)

- Prototype of database system for MISP.
- Written on Java with MySQL
  - Multi-platform
  - Open

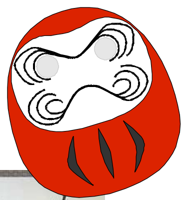


Meening of DaRuMa
(DAtabase for Rescue Utility MAnagement)

- Daruma(Dharma)
  - Natural Law or Reality, and with respect to its significance for spirituality and religion might be considered the Way of the Higher Truths.
    [from Wikipedia]
  - Bodhi Dharma:
    a founder of Zen.
  - Japanese doll which made so as to right itself when knocked over.

七倒八起

  - ultimate robustness



Features of DaRuMa (1)

- Small Requirement
  - Multi-platform
    - Linux, Windows, MacOS, FreeBSD ...
  - Open and Free Environment
    - Java, Ruby, MySQL
  - Light Weight
    - Note PC, small devices
      - Pentium III 900MHz, 512MB...
        - can be used to integrate 5-10 systems and handle over 10,000 information/30 min

Features of DaRuMa (2)

- Easy to Use
  - Simple Design
    - Small and simple set of facilities
      - Insert, Update, GetFeature
      - RegisterFeatureType
    - Client-Server
  - Open and de-fact standards
    - XML, SOAP, GML, WFS
  - Collection of tools
    - CSV tools
    - Ruby/Java tools
      - DarumaEarth
  - Open Source
    - LGPL/BSD License

Performance of DaRuMa

- tested environment
  - Dual Xeon 3.60GHz (with multi-threading)
  - Vine Linux 4.0beta (kernel 2.6.16)
  - MySQL 5.0, Java 1.5.0
  - 3GB memory

Performance of DaRuMa

- Test by simple features (RandomCity)
  - # of features: 5516
    - 890 buildings (12 properties with 2 geometries)
    - 2934 roads (8 properties with 2 geometries)
    - 1722 nodes (2 properties with 1 geometries)
  - processing time = 8 sec.
    - 0.00145 sec / features
  - CPU status

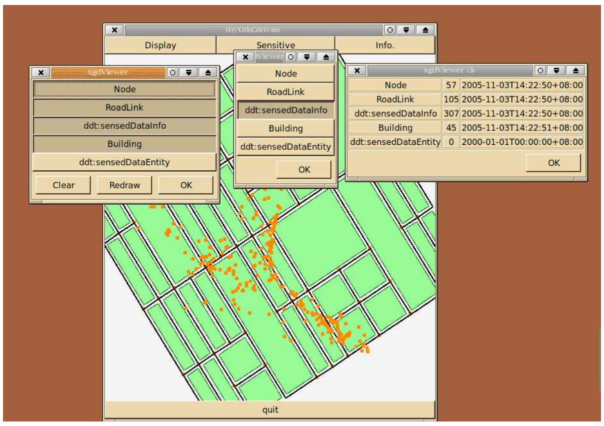
mysql	27%
java	73%
clients	25%

Performance of DaRuMa

- Test by features with image data (BMP)
  - # of features: 306 * 2
    - meta data: 14 properties with 1 geometry
    - content data: bmp file in base64 encoding
      - 640x480 pixel
      - file size = 921,654 bytes
  - results
    - processing time = 51 sec
    - 0.167 sec / image
    - CPU status

mysql	20%
java	20%
clients	48%

Random City with Image Data



Performance of DaRuMa

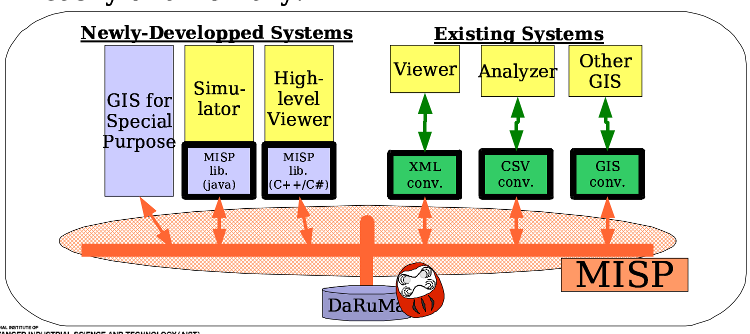
- Test by features with image data (JPG)
  - ➤ # o
    - ■ me
    - ■ co
      - ❍ 6
      - ❍ file size = 5,533 -- 59,401 bytes, (ave: 10,870 bytes)
  - ➤ results
    - ■ processing time = 8.95 sec
    - ■ 0.03 sec / image
    - ■ CPU status

mysql	25%
java	31%
clients	45%

Bottle-neck is in I/O process of clients

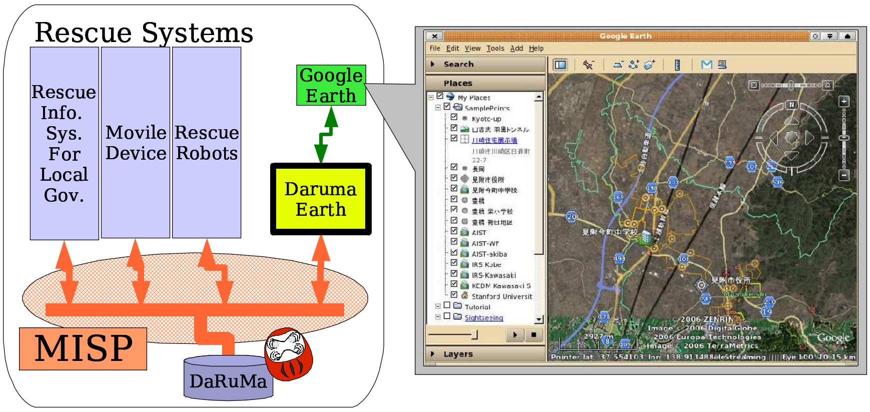
Tools for DaRuMa/MISP

- ➤ DaRuMa does not provide high-level and complex functions. Instead,
  - ■ Various systems can be combined via MISP.
  - ■ Several DaRuMa tools enable to integrate them easily and flexiblly.



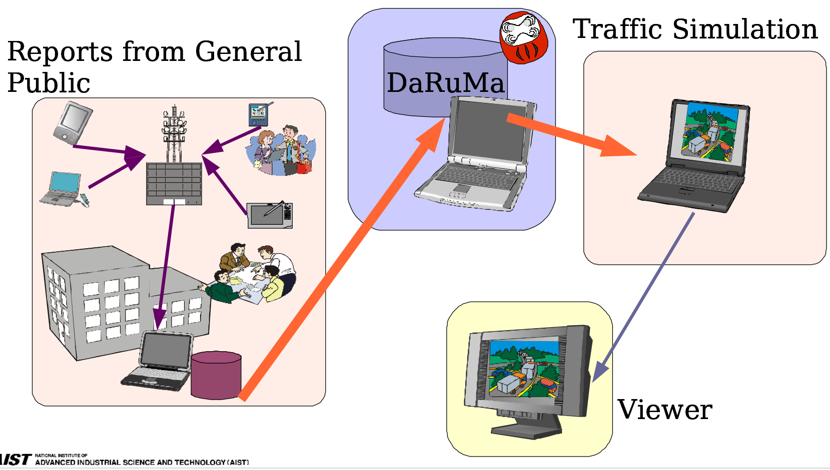
Example of Tools darumaEarth

- A bridge from DaRuMa to GoogleEarth

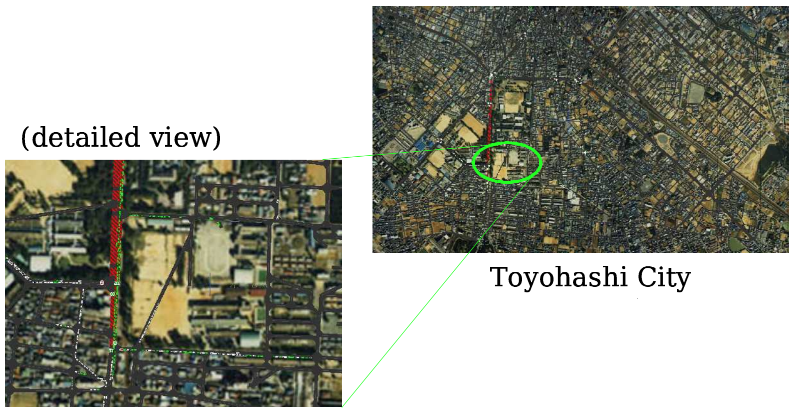


Integration by DaRuMa (2)

- Simulation based on Reported Information

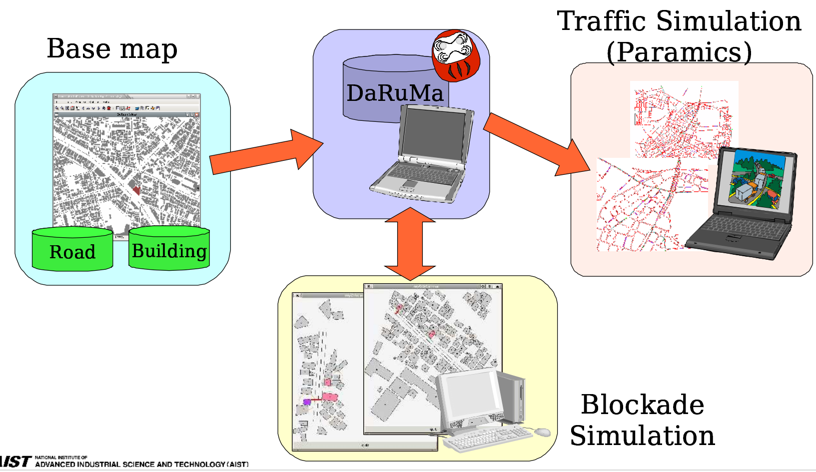


A Result of Simulation

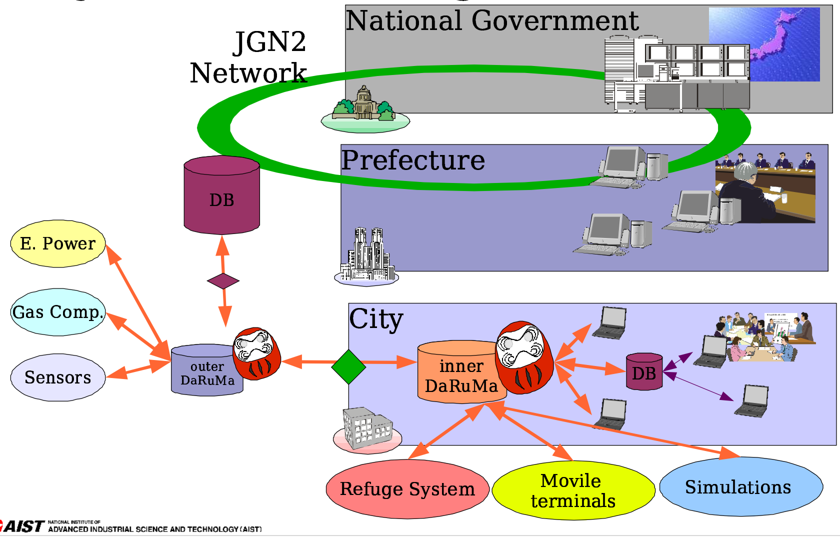


Integration by DaRuma (3)

- Integrated Simulation

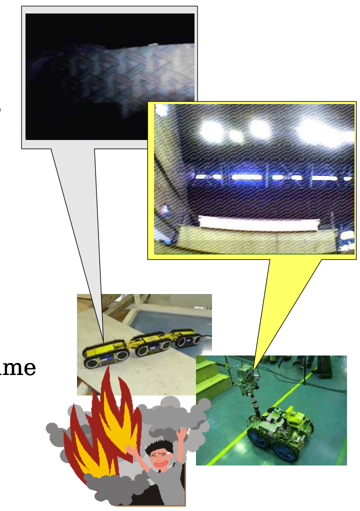


Integration of Rescue information Systems amond governments



Standard Templates

- Sensor Data
  - format for images/sounds taken by robots/sensor networks
- Requirements:
  - how to handle huge data
    - large number of data
      - camera may send images in frame ratio(1/60 sec).
    - large size of data
      - over 1MB per 1 image.



Standard Format for Sensing Information

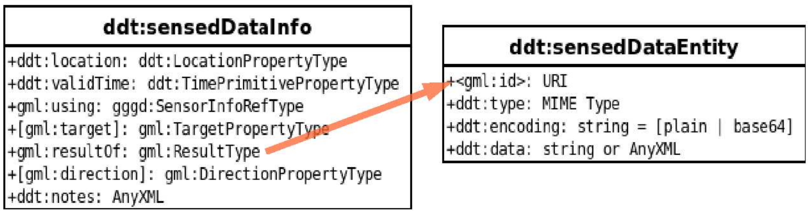
- existing standards
  - gml:Observation
    - a meta data of sensing information
      - spacial and temporal information of sensing
        - sensing location and target location is represented separately.
      - links to device information (gml:using)
      - links to acquired data entity (gml:resultOf)
  - gml:DirectedObservation
    - an extention of gml:Observation
      - can represent sensing direction instead of target

Possible Extensions to gml:Observation

- information about data type
  - MIME types
    - misp:types
- noise model
  - gml:_positionAccuracy (?)
  - temporal noise/uncertainty
    - distinguish not-found/have-not-sensed

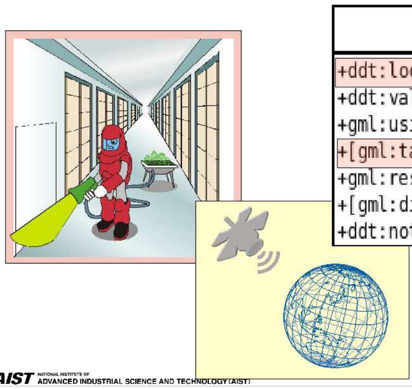
Sensed Data Format

- Separation of meta information and data entity.
  - easy to handle a large number of sensor data

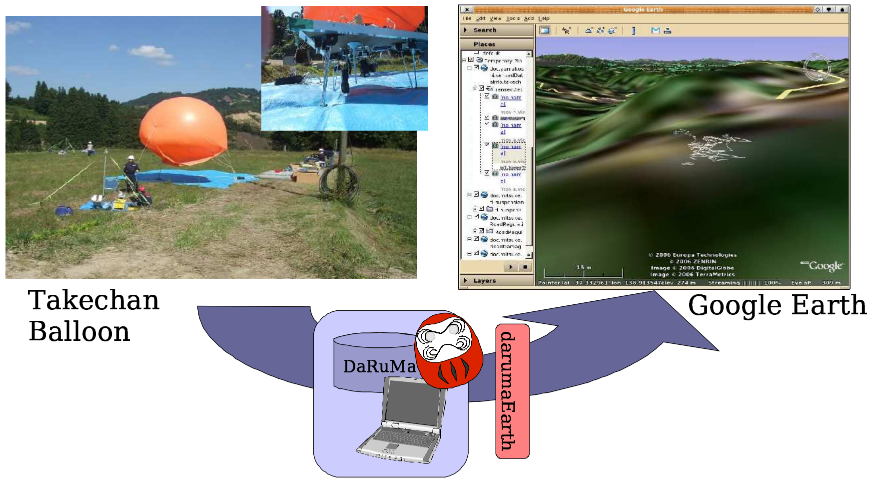


Location and Target

- Two key position index for sensed data.
  - Both positions can be not only points but also lines or area.



Viewing Sensed Data by darumaEarth



Summary

- WFS can be useful for location-base information sharing services
  - rescue information among organizations
  - multiple-robot systems
- Performance of WFS is not so bad
  - simple and easy to implementation
  - able to utilize SQL technologies
- But, we need some extensions for real application.

Open Issues (1)

- Large-sized data
  - SOAP attachment form using MIME format?
  - streaming?

- On-demand sensing?
  - WFS supposes a database.
  - Robot can provide interactive service. How to extends?

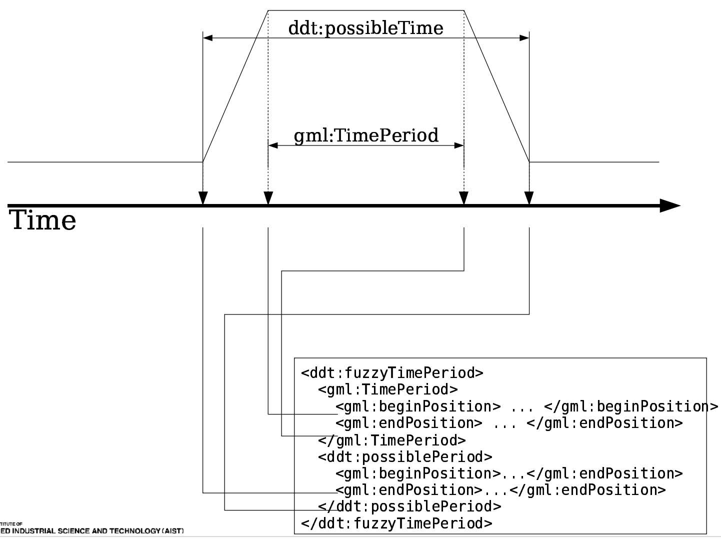
Open Issues (2)

- Fuzzy information and its disambiguation
  - Location errors
  - Flexible Coordination Reference System
  - Changes through times
  - Human factors

Open Issues (3)

- Common Ontology
  - Various Sensing Data
  - Coverage?
  - can integrate with SLAM?
- Service Description
  - WSDL?

Fuzzy Time Model



Robotics DTF

Object Management Group

JOIN US

OMG's Robotics Domain Task Force has already started laying the groundwork for a common platform-independent model of robotics software development. The first step was to issue a Request for Information (RFI) on available products, projects, theories, models and requirements to support development of Service Robotic Systems based on distributed objects.

The Robotics DTF received a number of responses to the RFI and currently has several RFIs and RFPs in the works, so now is the ideal time to get involved! The Robotics DTF will meets at each OMG Technical Meeting.

OBJECT MANAGEMENT GROUP

THE FOLLOWING ORGANIZATIONS ARE ALREADY INVOLVED

ADA Software

AIST

ETRI

Fujitsu

Hitachi

IHI, Japan

Japan Robot Association

John Deere & Co

KAIRA

Kangwon National UniversityNEDO

NIST

Objective Interface Systems

PrismTech

Raytheon

Real Time Innovations

Schlumberger

SEC

Seoul National University

Shibaura Institute of Technology

Systronix Inc.

Technologic Arts Inc.

Thales

Toshiba

UEC, Japan

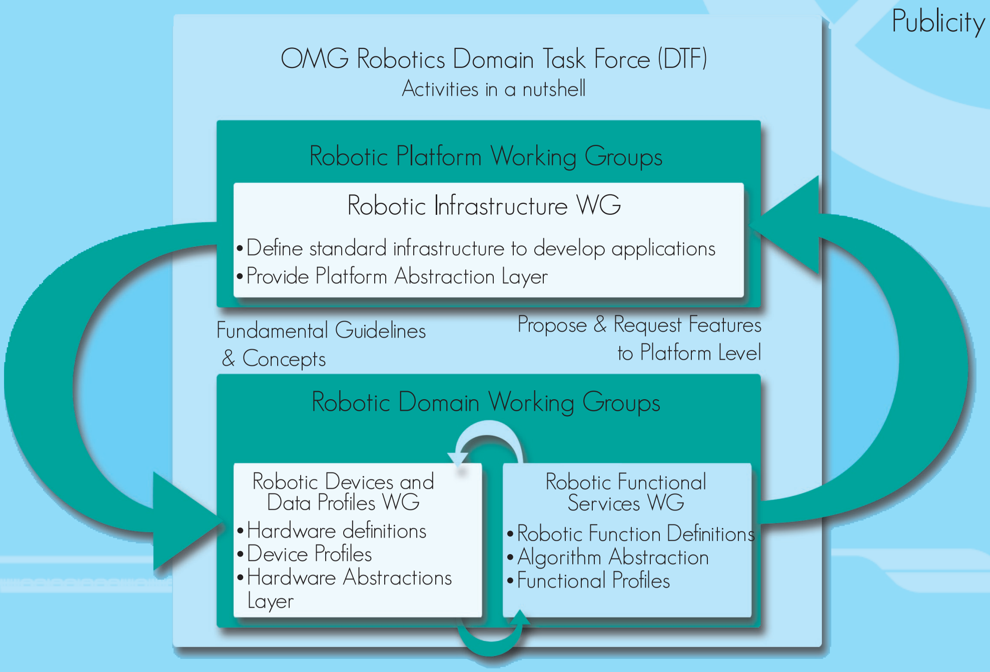
Universidad Politecnica, Madrid

Zeligsoft Inc.

About Object Management Group The Robotics DTF

The Object Management Group™ (OMG™) is an international, open membership, not-for-profit computer industry standards consortium. OMG Task Forces develop enterprise integration standards for a wide range of technologies and an even wider range of industries. OMG's modeling standards enable powerful visual, execute and maintenance of software and othe processes.

OMG's Robotics Domain Task Force (DTF) is actively working to develop standards for robotics software design and development through OMG's inclusive, open process. In the past, most robotics software initiatives have been developed independently. The Robotics DTF is talking to leading vendors, end users, researchers, robotics organizations and other interested parties to lay the groundwork for a common platform-independent model of robotics software development.



Focus and Targets

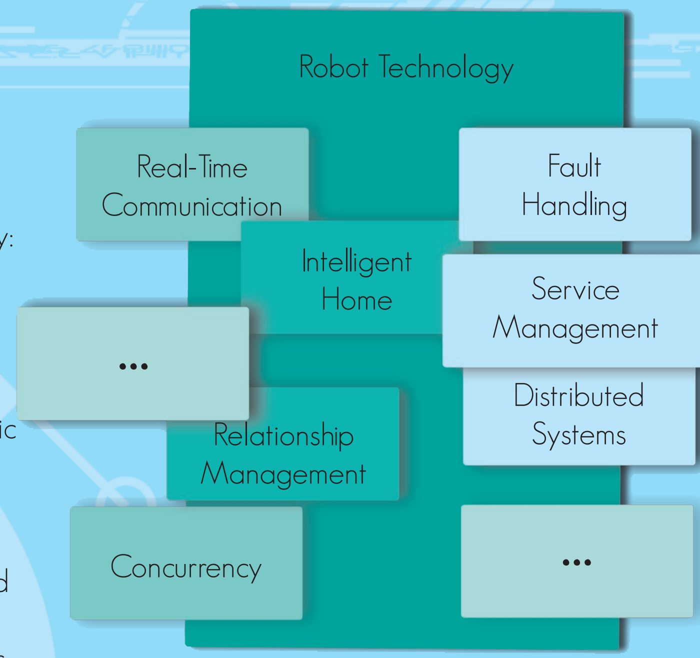
Robot Technology is a complicated mix of various domain technologies – a challenge for forming a common standard. To make things even more challenging, key industry players develop their own unique standards that act against interoperability.

The Robotics DTF is working to address these issues by:

- Adoption of existing OMG standards to the domain,
- Extending OMG technologies to robotic applications,
- Forming a bridge between OMG and Robotic communities,
- Collaborating with other similar organizations like ISO,
  IEEE, OASIS to encourage interoperability, and
- Coordinating with other task forces in OMG to develop common standards across domains.

The Robotics DTF currently has three working groups in addition to Steering, Publicity and Contacts sub-committees:

- Infrastructure
- Robotic Functional Services
- Robotic Devices and Data Profile



The Need for Standards

The difference between a robotic vacuum cleaner and a Mars rover may seem vast, but they have a lot in common. For example, both require a method of sensing their environment and relaying inf ormation to the servos that control their movement. This commonality of design and function has created both an opportunity and a need for standards. The goal of robotics standards is to increase interoperability, compatibility and reusability. This ultimately will lead to an increase in both the availability and usage of robotic systems. The OMG's Robotics DTF is spearheading the effort to develop these standards.

ROBOTICS DTF

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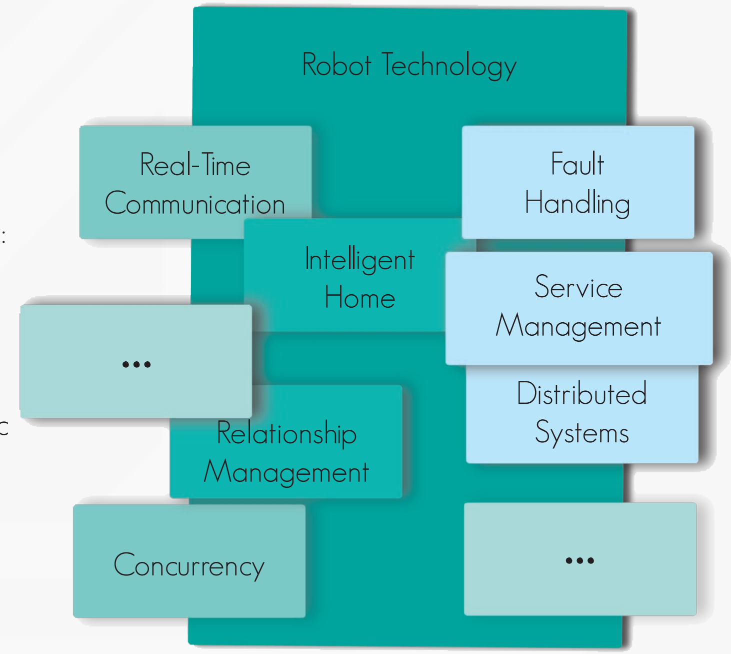

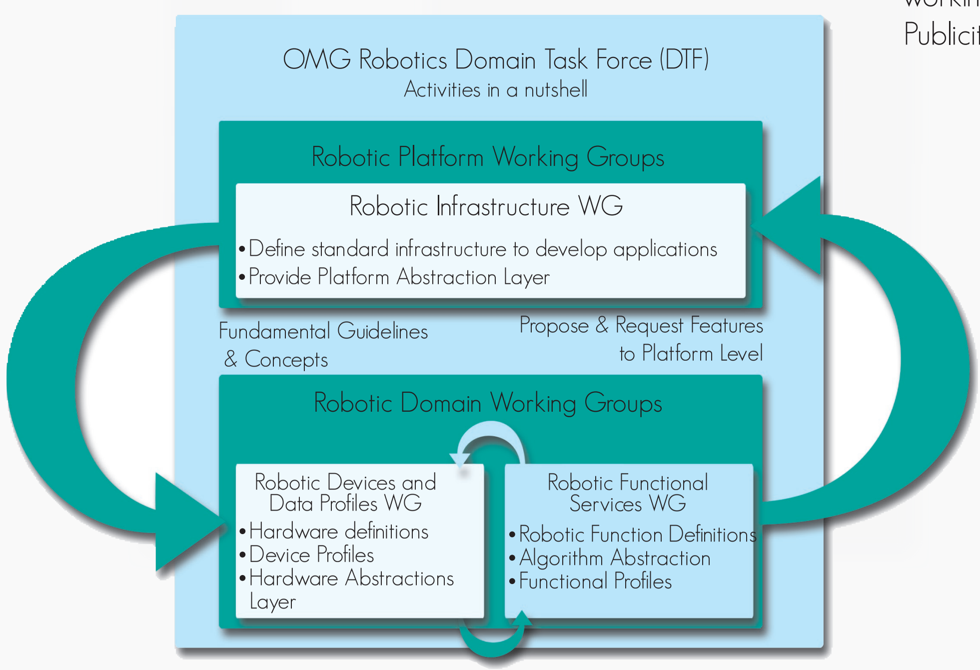

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Introduction to user identification service for intelligent service mobile robots

ETRI

Su-Young Chi, Ph.D

2007. 03. 26

IT R&D Global Leader ETRI

Required Capabilities of Intelligent Service Mobile Robots

Awareness

- of environment
  - Where am I?
  - Are there people?
  - Who are they?
  - Is my master here?
  - Am I being called?

Communication

- with world
  - Understand
    - Face and gesture recognition
    - Speech
  - Respond
    - I understand, I'm going to…
- with designer
  - Explain
  - Display
  - Trace execution

Planning

- What should I do next?
  - Move closer
  - Respond
    -Acknowledge, Ask for more information
  - Gather information

Execution

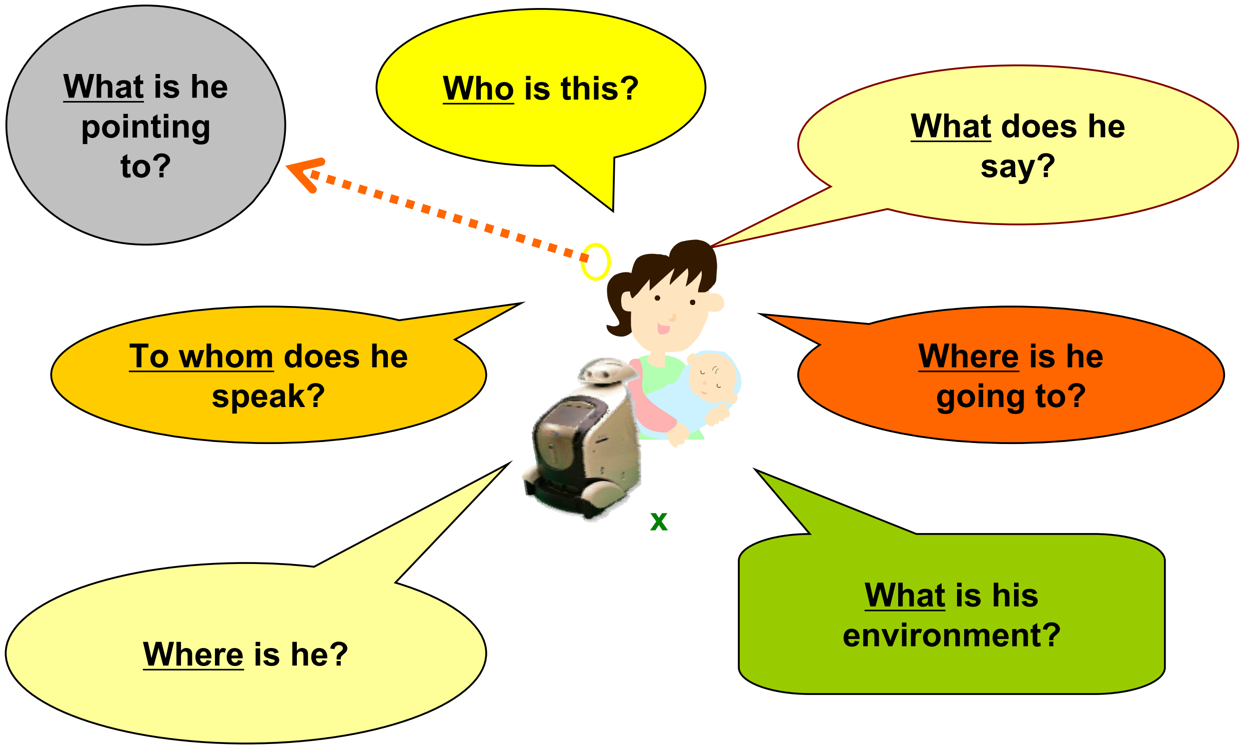
Difficulties

- **Wide sensing area**
  - Need to cover the entire domain of the home
- **Significant processing power needed on robot**
  - All tasks should be carried simultaneously and in real-time
- **Delicate navigation tasks**
  - Complex structure of the home

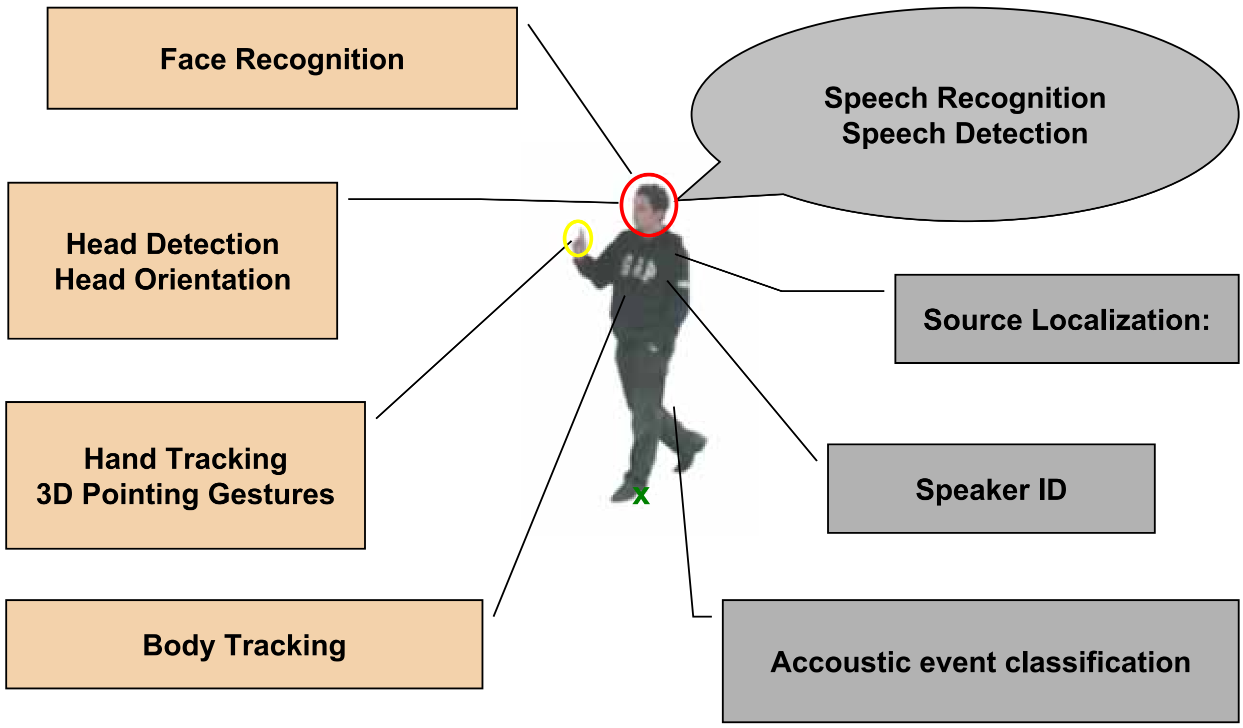
Categorization of user identification technology

- Who & Where ?
  - Audio-Visual Person Tracking
  - Tracking Hands and Faces
  - AV Person Identification
  - Head Pose / Focus of Attentio n
  - Pointing Gestures
  - Audio Activity Detection
- What ? (Input)
  - Far-field Speech Recognition
  - Far-field Audio-Visual Speech Recognition
  - Acoustic Event Classification
    - Door slam, object dropping,…
- What ? (Output)
  - Animated Social Agents
  - Steerable targeted Sound
  - Q&A Systems
  - Summarization
- Why & How ?
  - Classification of Activities
  - Emotion Recognition
  - Interaction & Context Modellin g
  - Vision-based posture recognit ion
  - Topical Segmentation

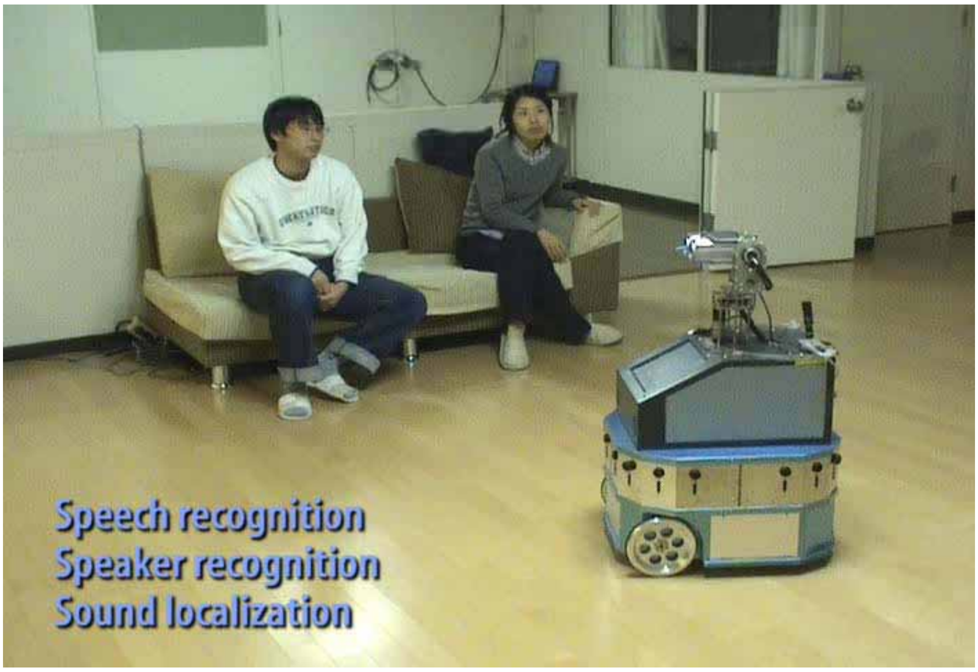
User identification technology



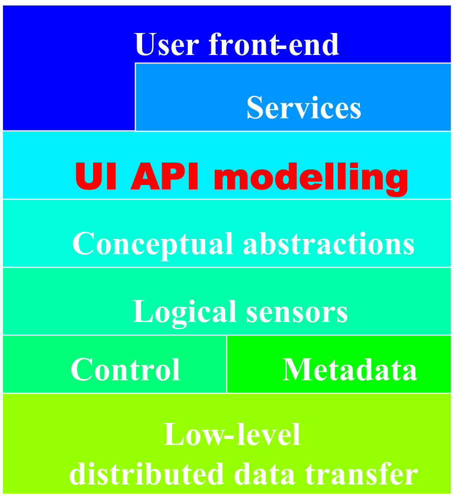
UI technology



UI Scenario Demo for URC at home



User Identification Software Infrastructure

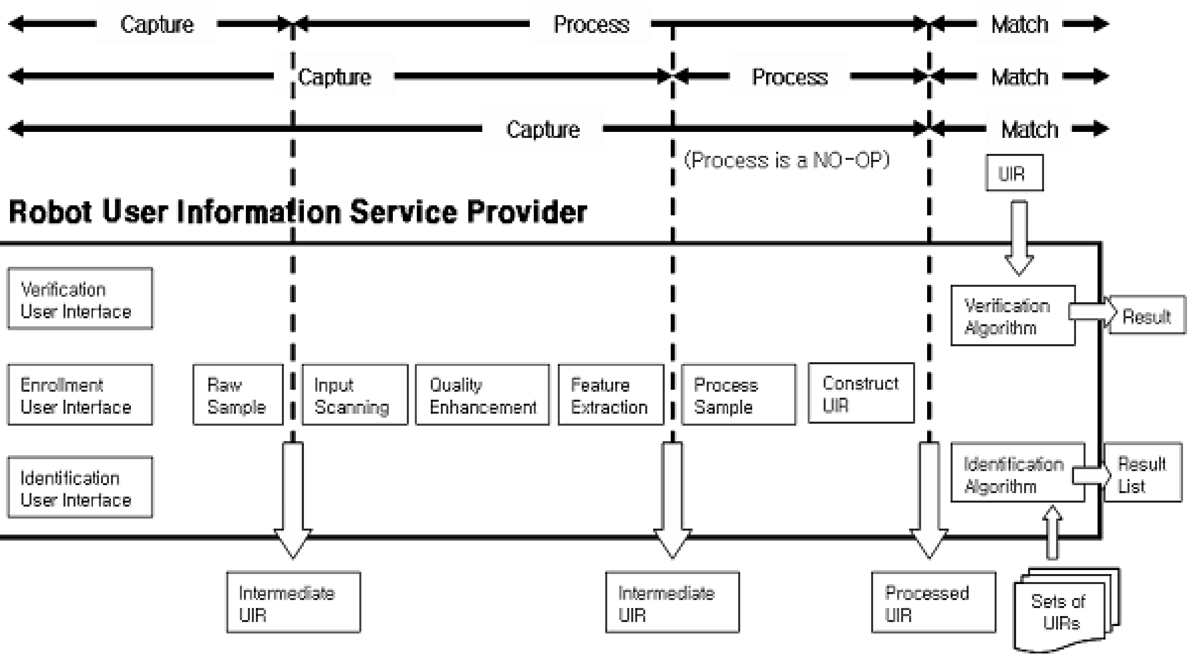


- Layers and APIs have been defined and dicussed

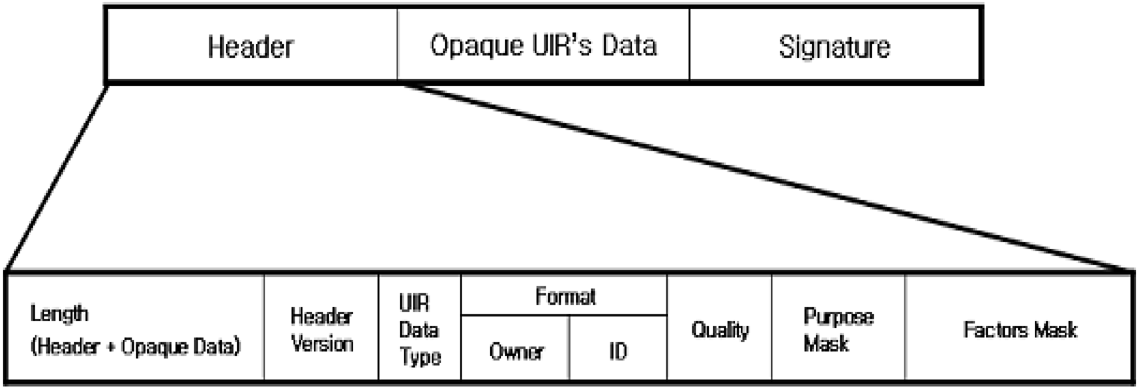
The purpose of user identification standard

This standard specifies the User Identification S/W Component API for mobile robotics Specification that provides one suited for any form of user identification for mobile technology used by user identification system and defines the application interface to cover the basic functions of Enrollment, Verification and Identification.

Propose(1): The Methodology of UI Interface Development



Propose(2): The Structure of UIR(User Identification Recoder)



[Reference] CBEFF Patron Format

The Applicable fields of industry and its effect

This standard contributes to minimize complications during the application development of User Identification S/W Component for mobile Robots. It also helps to activate application service technologies related to Enrollment, Verification and Identification of users

Conclusions

User identification S/W Component API for mobile robotics is the standard for application program interface. It includes the standard interface of basic functions – Enrollment, Verification and Identification – and the interfaces of user-friendly programs employing User Identification programs for mobile robotics

Thank you!

Welcome any comments and opinions!!!

Adaptive Service Media as Intelligent Environment

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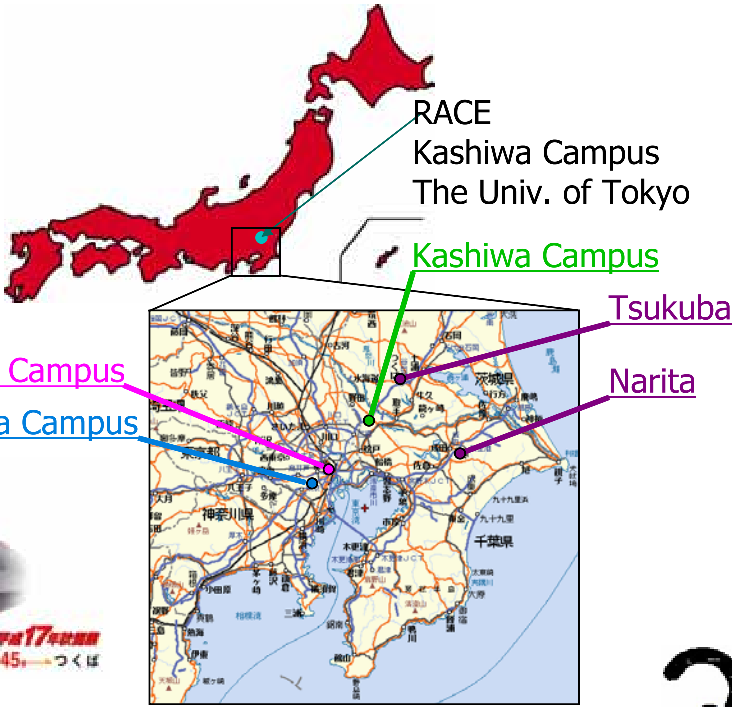
RACE

(Research into Artifacts, Center for Engineering)

The University of Tokyo

RACE, The University of Tokyo
Research into Artifacts, Center for Engineering



Hajime ASAMA
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Service Engineering and Service Media

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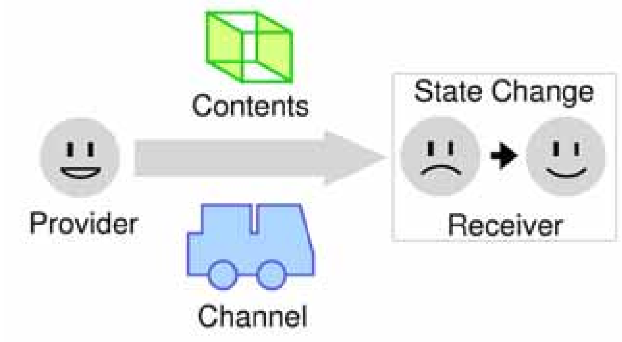
Service Engineering (Tomiyama)



- Paradigm shift from the mass production paradigm to the post mass production paradigm towards a sustainable society
- Dematerialization: Products with more added values from knowledge and service contents rather than just materialistic values
- Artifacts = Devices to deliver services

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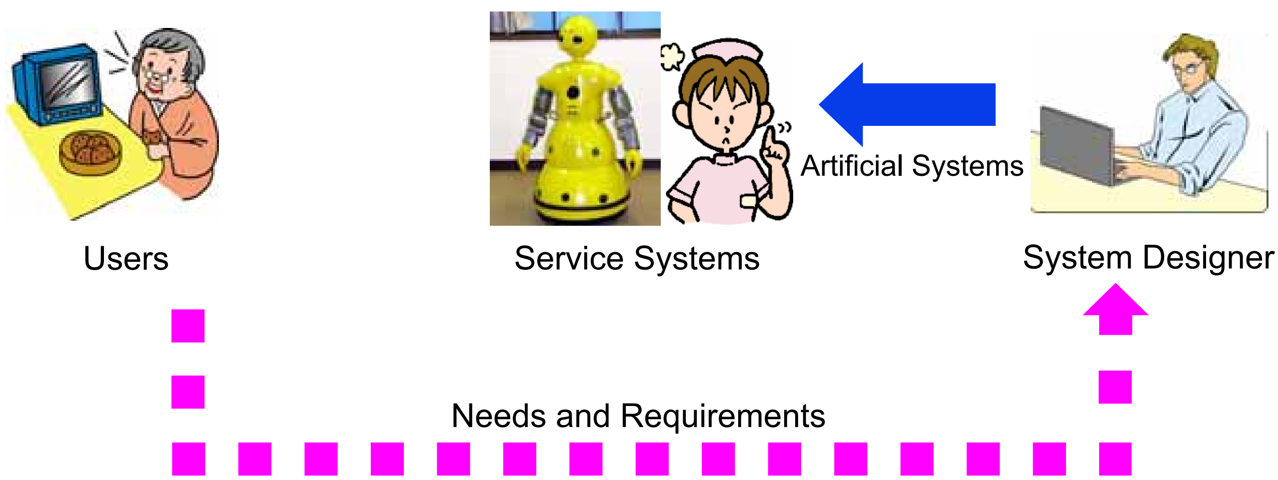
Conventional Engineering

Science on how to design and generate artificial systems to realize required function according to the users' needs and requirement



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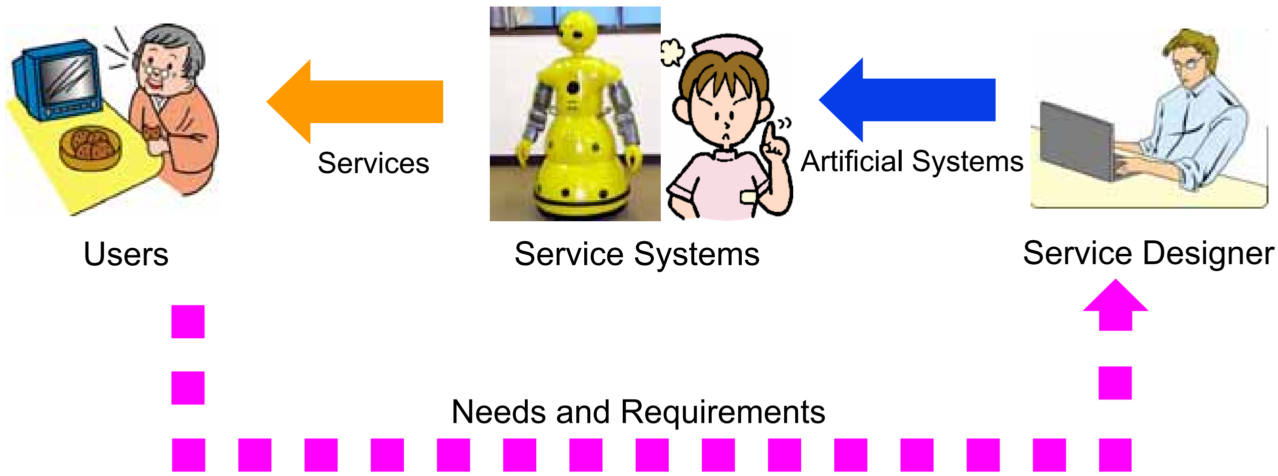
Service Engineering

Science on how artificial systems are interacted with and used by users to relish services



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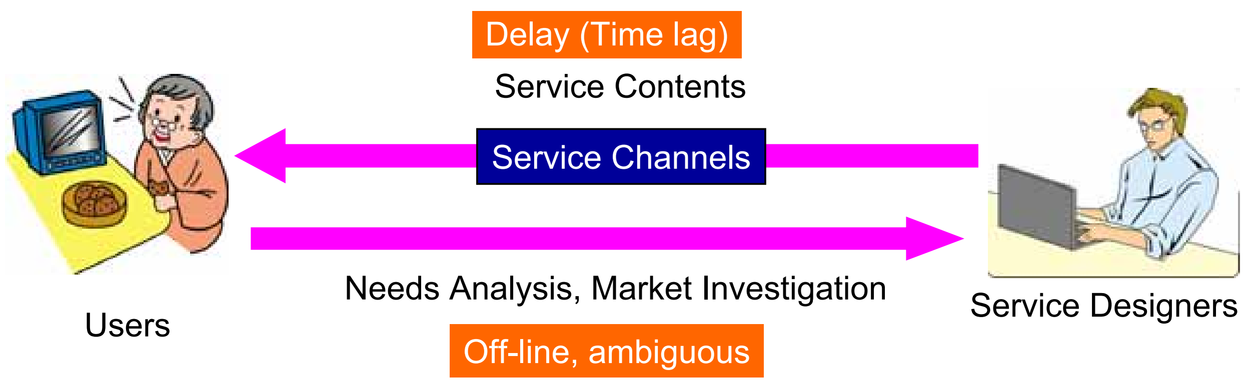
Conventional Service Systems



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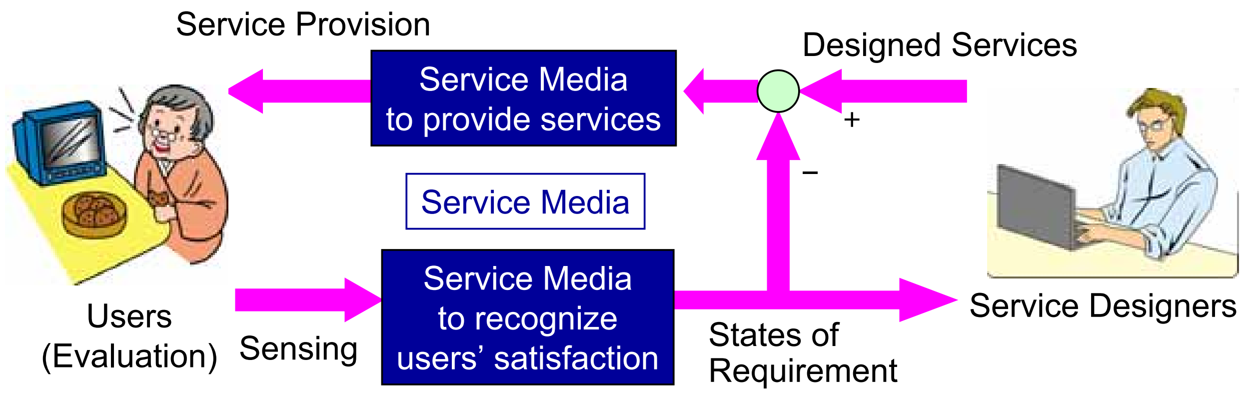
Service Media in a service control systems



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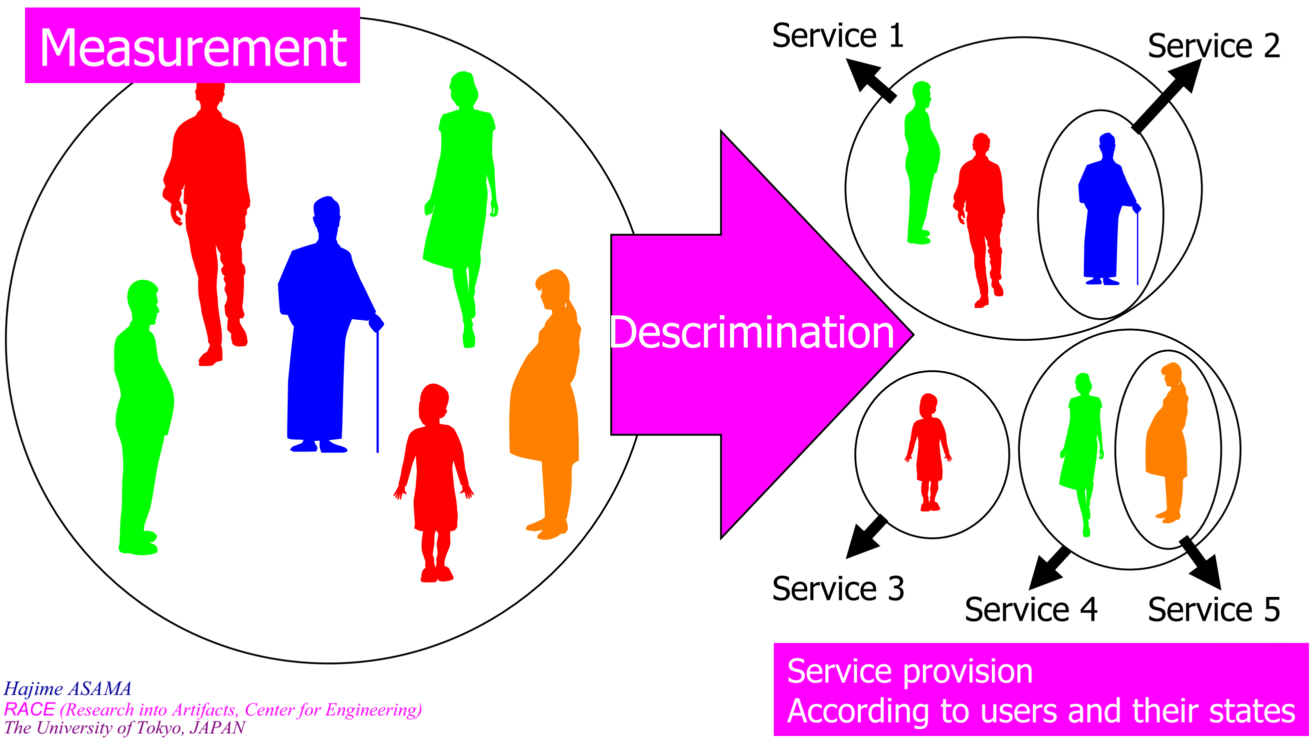
Individual Care by Service Media



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General Characteristics of Users

Service systems should cope with users'

- spatial diversity
- real time requirements or demands
- subjectivity

Realization of Service Media

RT (Robot Technology)

Ubiquitous Computing Technology

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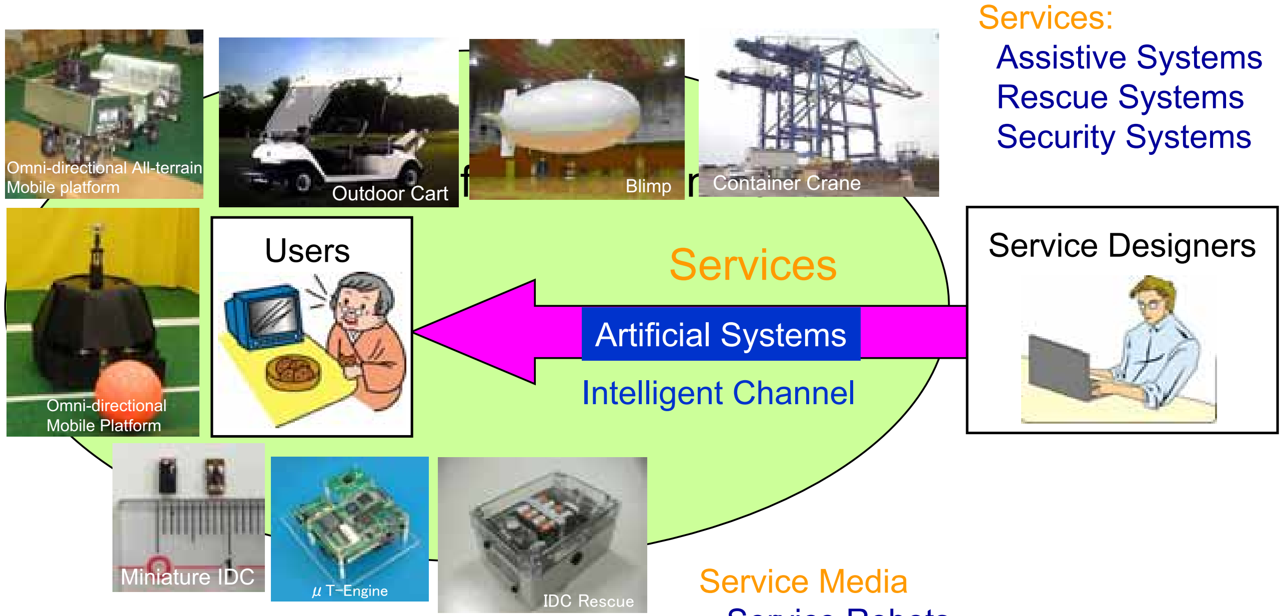
Concept of Service Media

Services:

Assistive Systems
Rescue Systems
Security Systems



Service Media

Service Robots,
Ubiquitous Devices, etc.

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Multi-robot Cooperation

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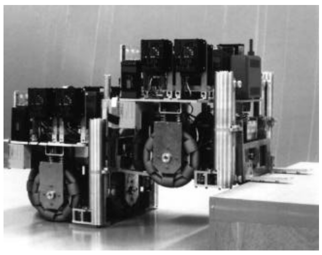
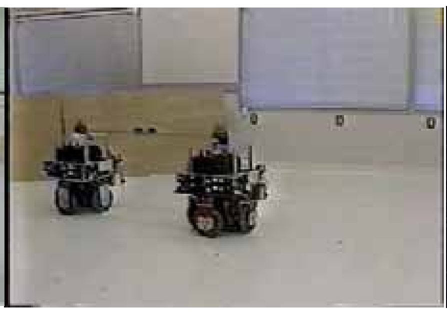
Cooperative motion by multiple mobile robots

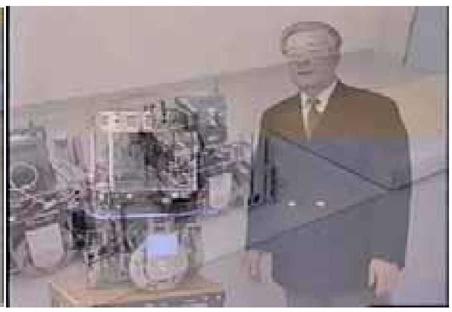
Object pushing with task assignment & team organization

Large object transportation motion

Cooperative step climbing by mutual handling

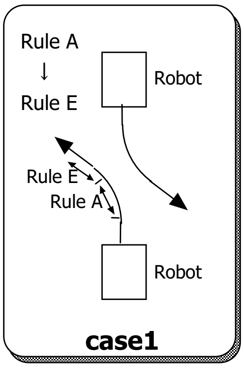


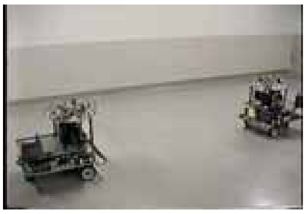


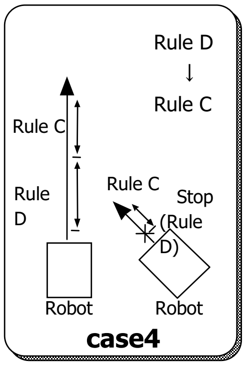


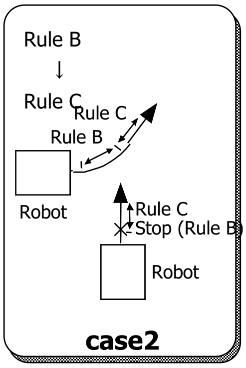
Cooperative motion by multiple mobile robots

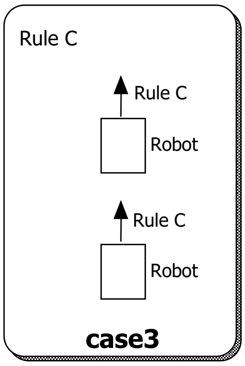
Collision avoidance

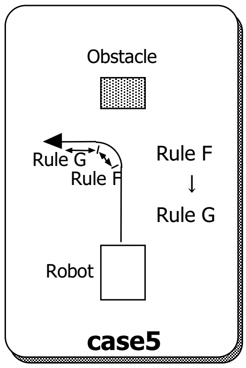






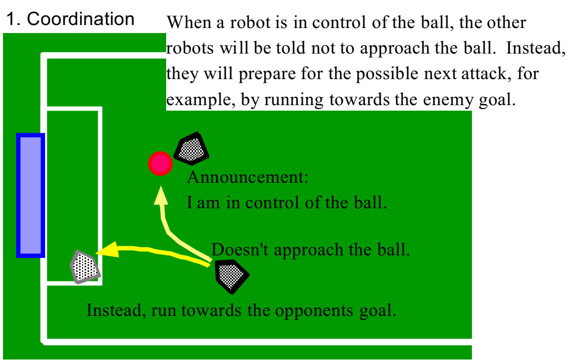




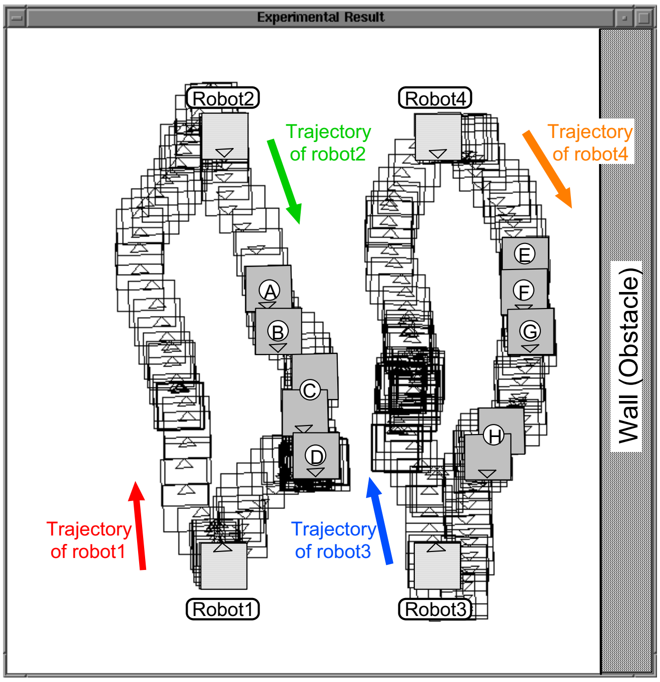


Cooperative motion by multiple mobile robots

RoboCup: Robot Soccer



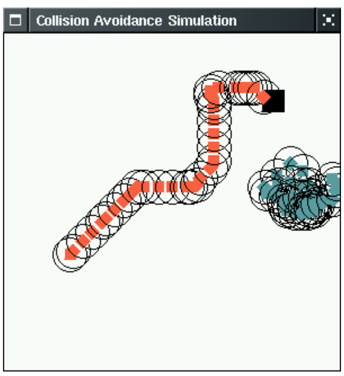
Mutual collision avoidance



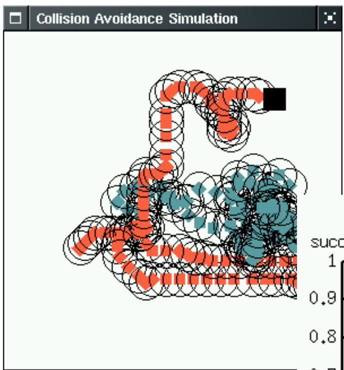
Emergence of Communication

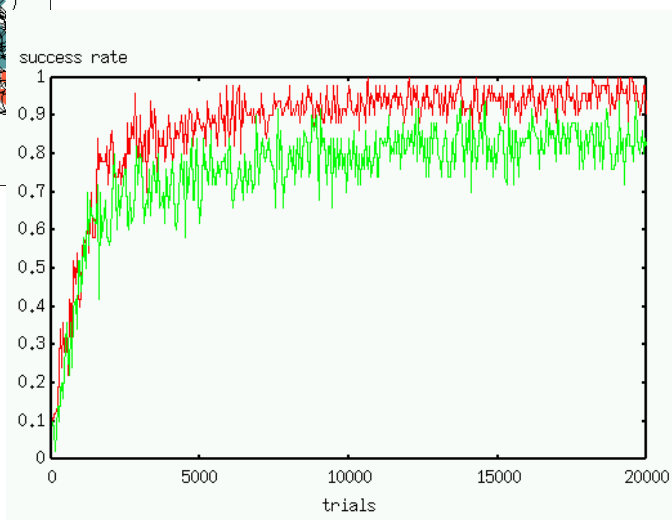
Behaviors: Motion + Message transmission

With Mes. Trans.

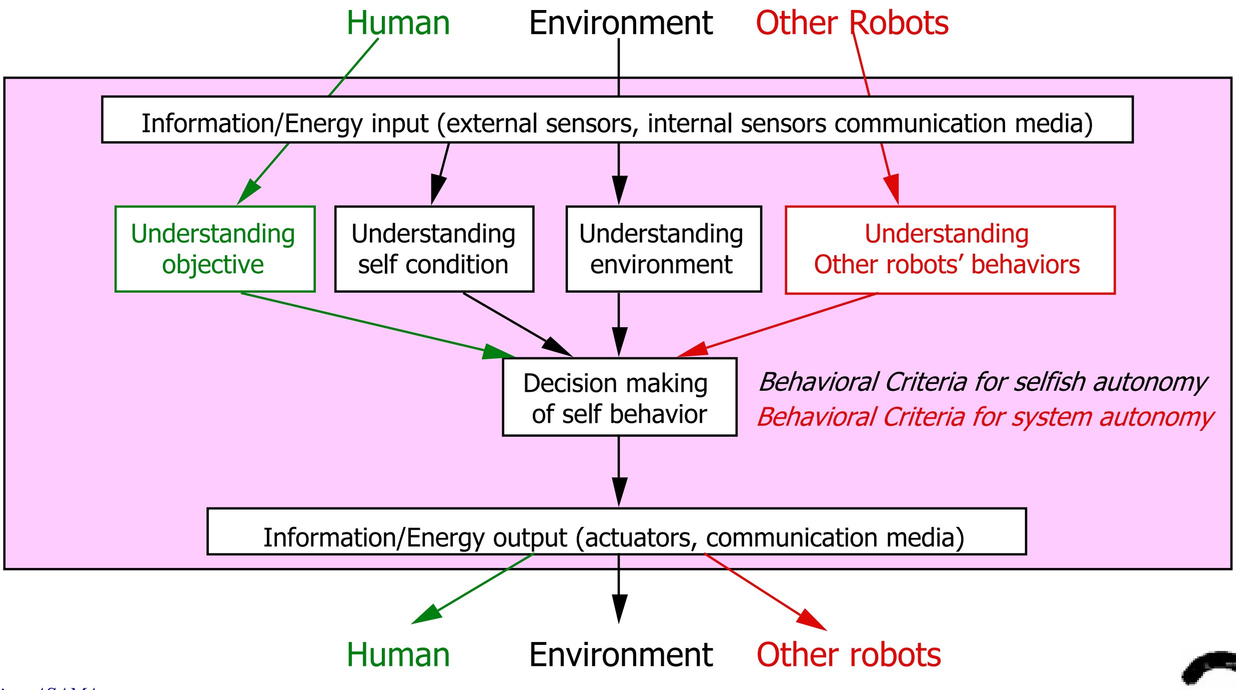


Without Mes. Trans.





Autonomous Function in Multi-robot Environment



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Technologies for Intelligent Environment

Hajime Asama
Service Engineering
RACE, the Univ. Tokyo

What is Ubiquitous?

- Computers everywhere (Distributed agents)
- Embedded in objects, animals, humans, environment
- Can be connected to network

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RF-ID System Technology

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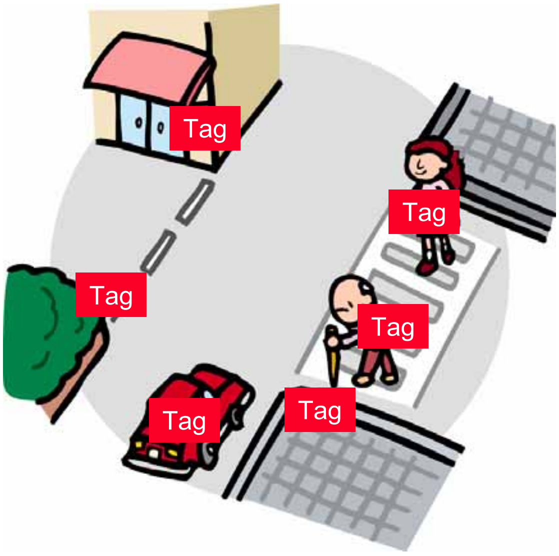
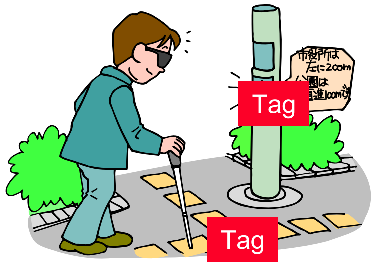
Ubiquitous Environment with Tags





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Variety of Configuration of UD

Service Robot

Environment

User

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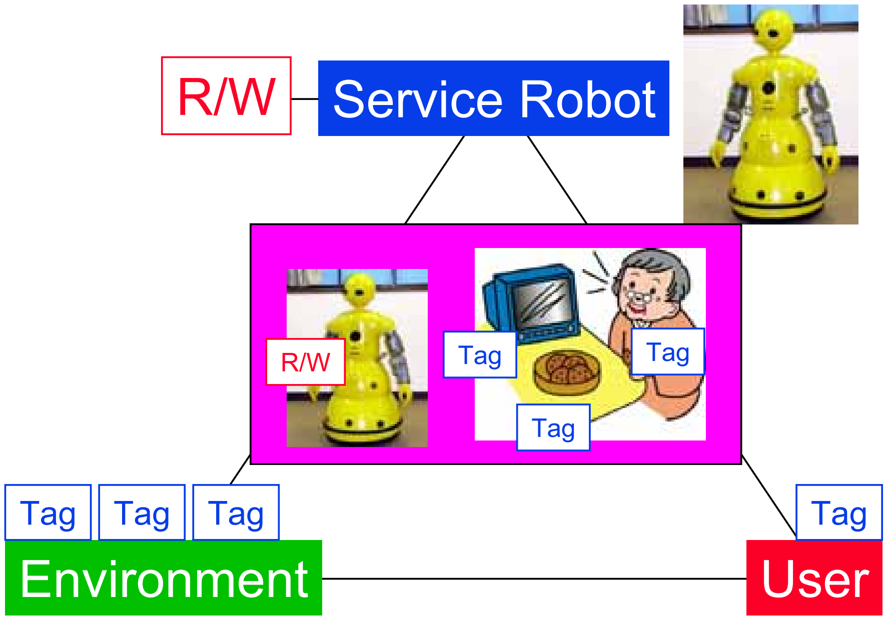
Variety of Configuration of UD



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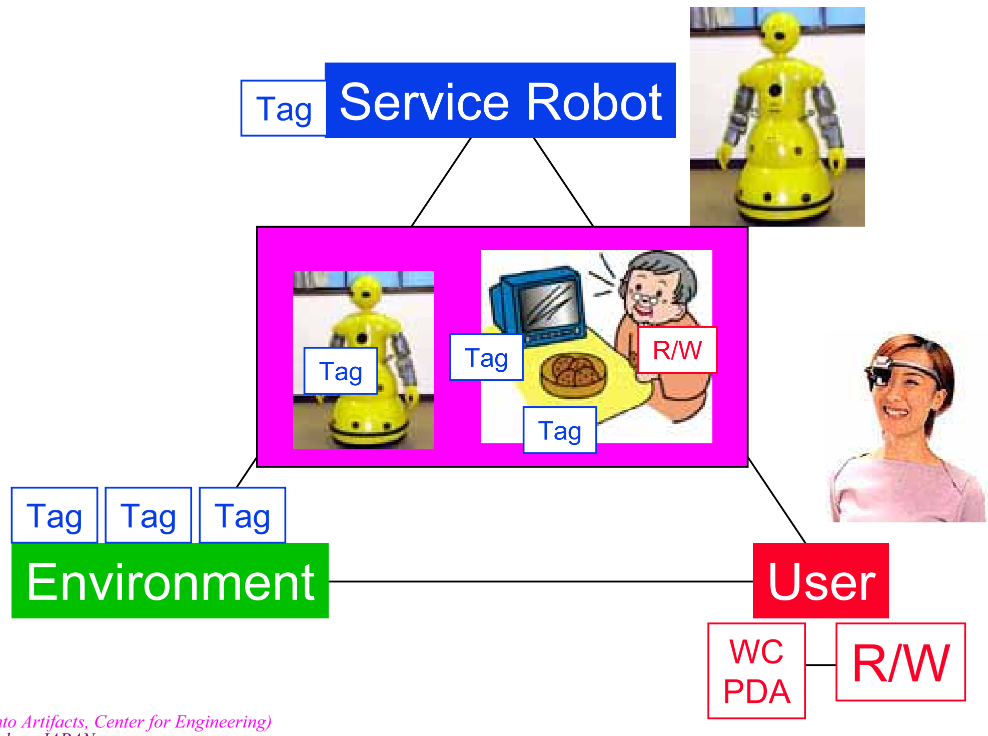
Variety of Configuration of UD



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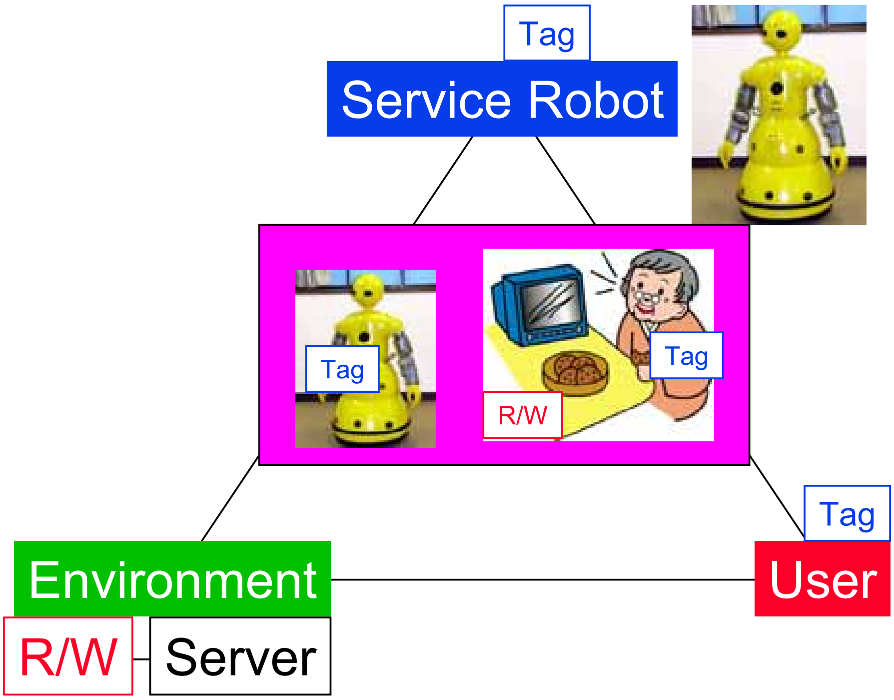
Variety of Configuration of UD



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Structure of IDC (Intelligent Data Carrier)

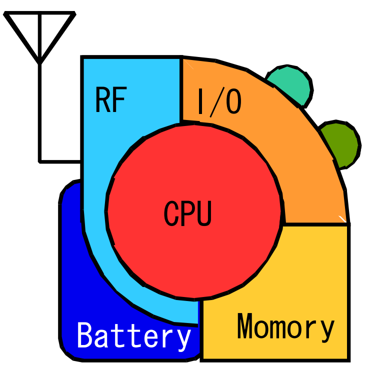
CPU
Programmable intelligent information processing such as communication control, sensory signal processing, security coding/decoding

Memory
Re-writable memory EEPROM

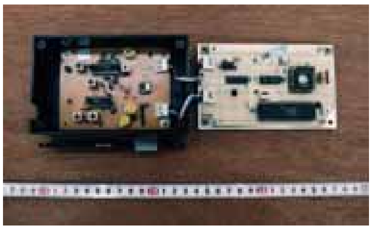
RF
Radio frequency contactless communication, weak power supply by electro-magnetic induction

Battery (Option)
Strong power supply by battery

I/O (Option)
Interface for sensors and actuators



Intelligent Data Carriers



IDC ver. 1

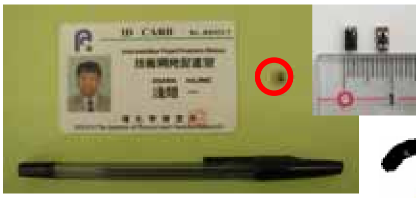
IDC ver. 2

IDC ver. 3

IDC Unit (ver. 1)

IDC units handled by a robot

IDC ver. 4



Mini-IDC

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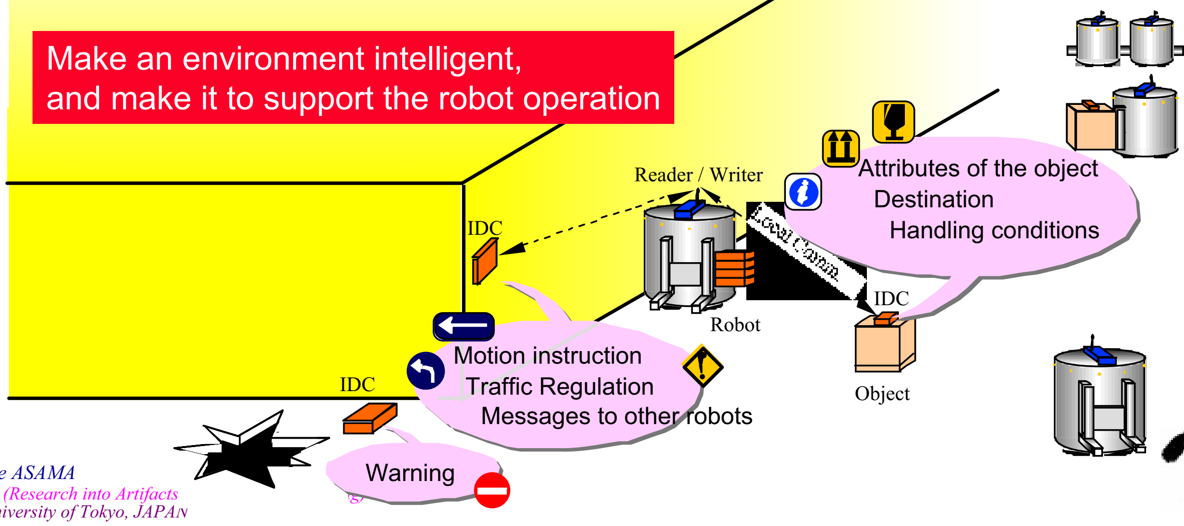
Concept of an Intelligent Data Carrier

IDC: A portable electric device as an agent for local information management
(placed on objects in an environment or carried by robots)

Reader/Writer: A device to read or write information in IDCs
(connected to robots)

Communication: Wireless and local communication



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Applications of Ubiquitous Device Utilization for Service

Robot Operation in Ubiquitous Computing Infrastructure

- Landmark for Navigation
- Guidance with local information management
- Information Sharing via IDC Embedded Environment

User Adaptive System Using Ubiquitous Devices

Victim Search System for Rescue

Applications of Ubiquitous Device Utilization for Service

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User Adaptive System Using Ubiquitous Devices

Victim Search System for Rescue

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Procedure of Self-localization

(1) Trial of communicatiion with IDC

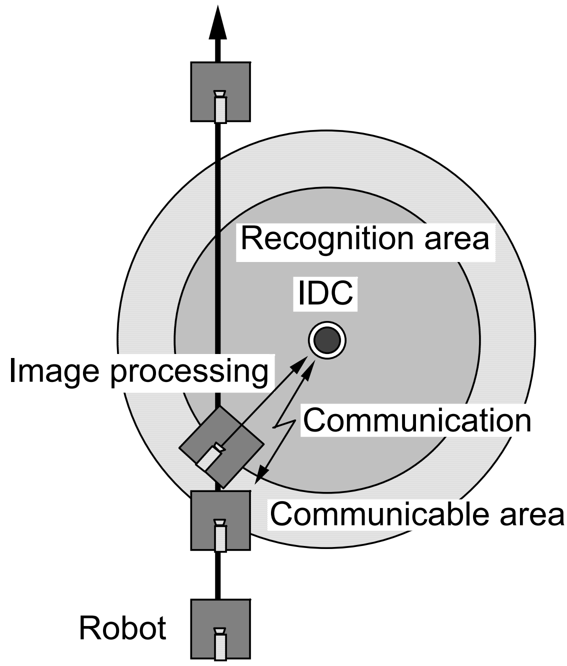
(2) Detection of IDC using RF communication

(3) Acquisition of IDC's absolute position

(4) Recognition of IDC by image processing

(5) Calculation of relative position

(6) Calculation of robot's absolute position



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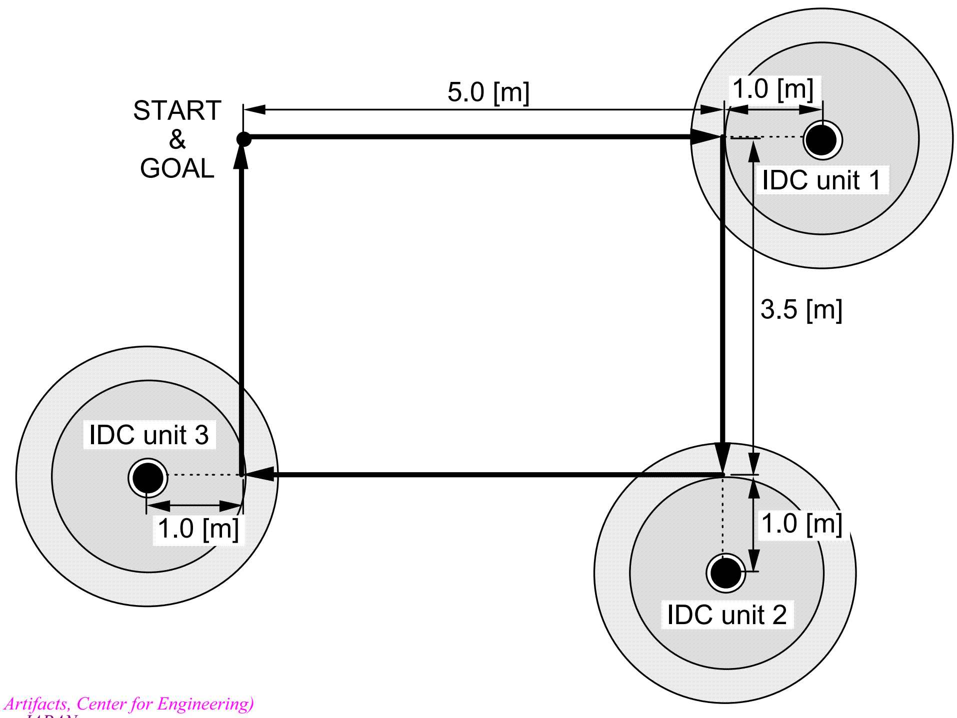
Navigation Experiment



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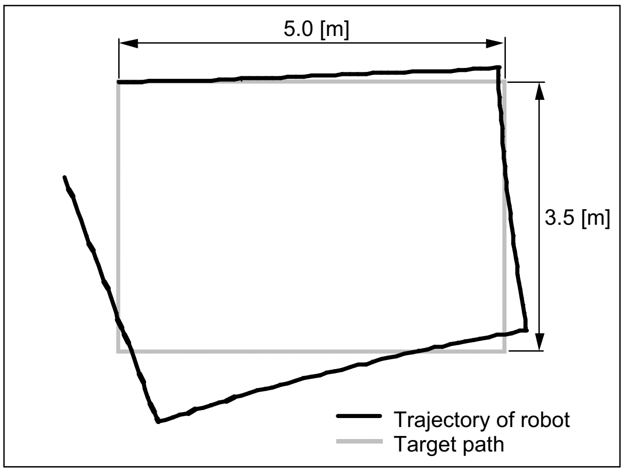
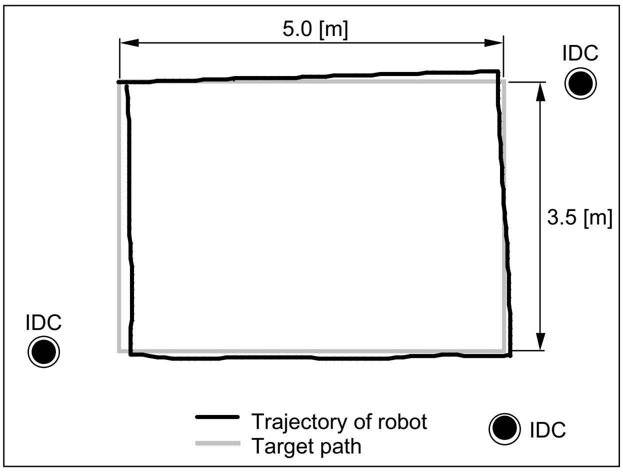
Experimental Results



Only deadreckoning with odometry



Navigation with self-localization

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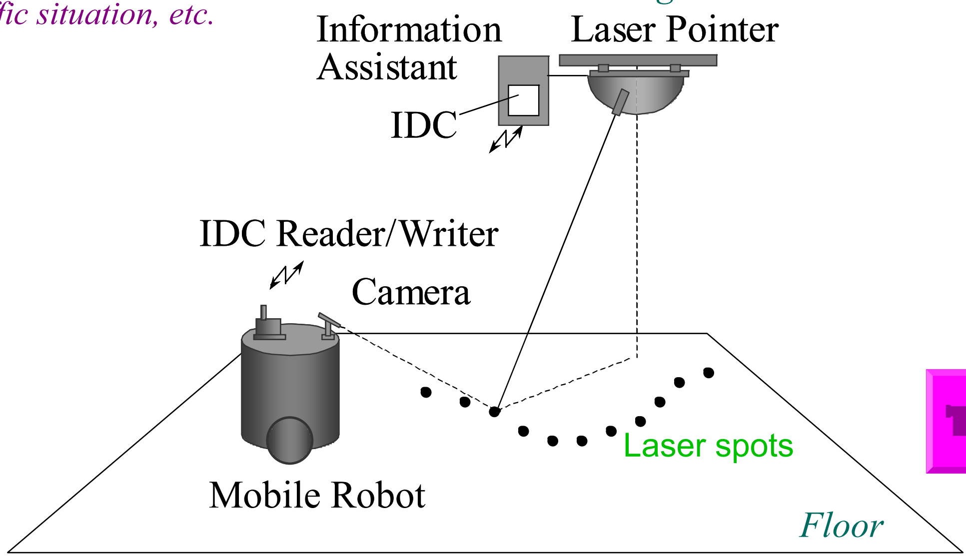
Optical guidance using information assistant

- Local information management
  Local map, etc.
- Dynamic information management
  Traffic situation, etc.

- Path planning
- Trajectory showing



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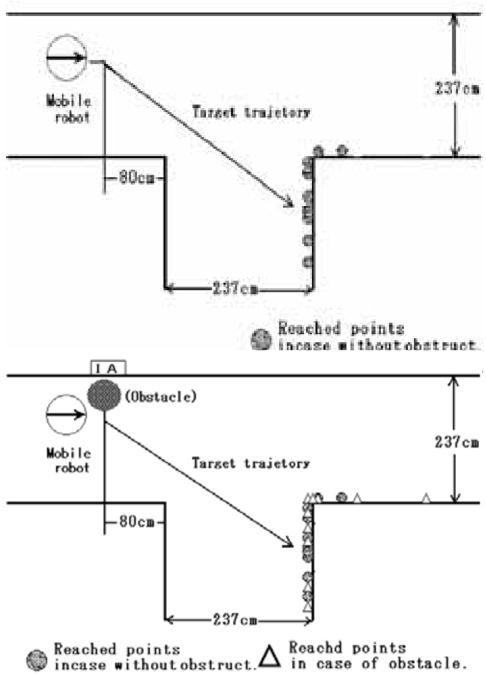
Navigation Using Only Information Assistant



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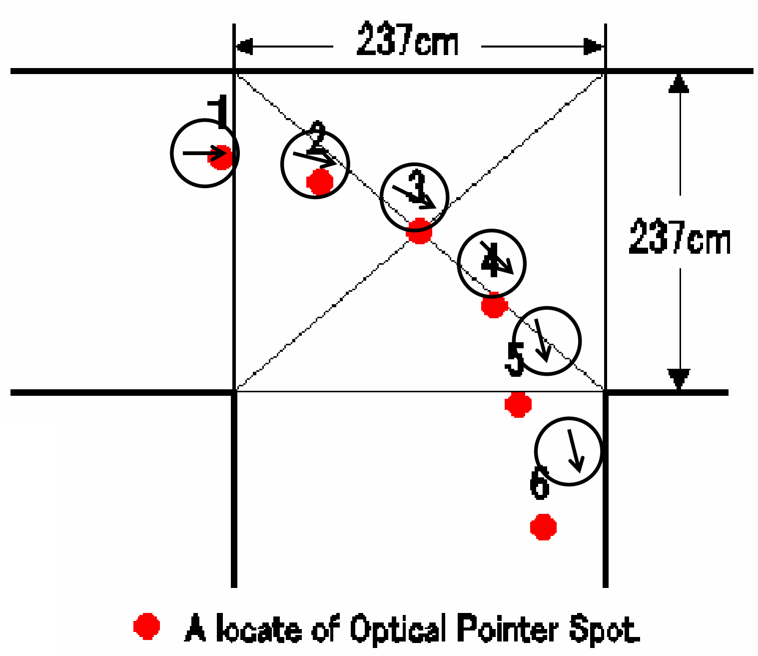
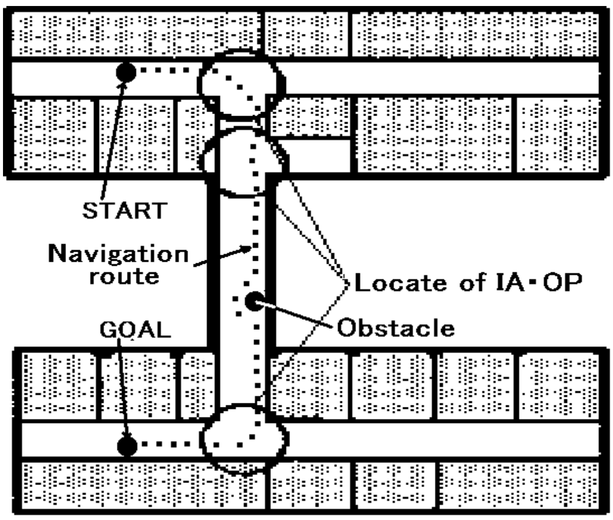
Navigation Using Optical Guidance System



Experiments



Applications of Ubiquitous Device Utilization for Service

Robot Operation in Ubiquitous Computing Infrastructure

- Landmark for Navigation
- Guidance with local information management
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User Adaptive System Using Ubiquitous Devices

Victim Search System for Rescue

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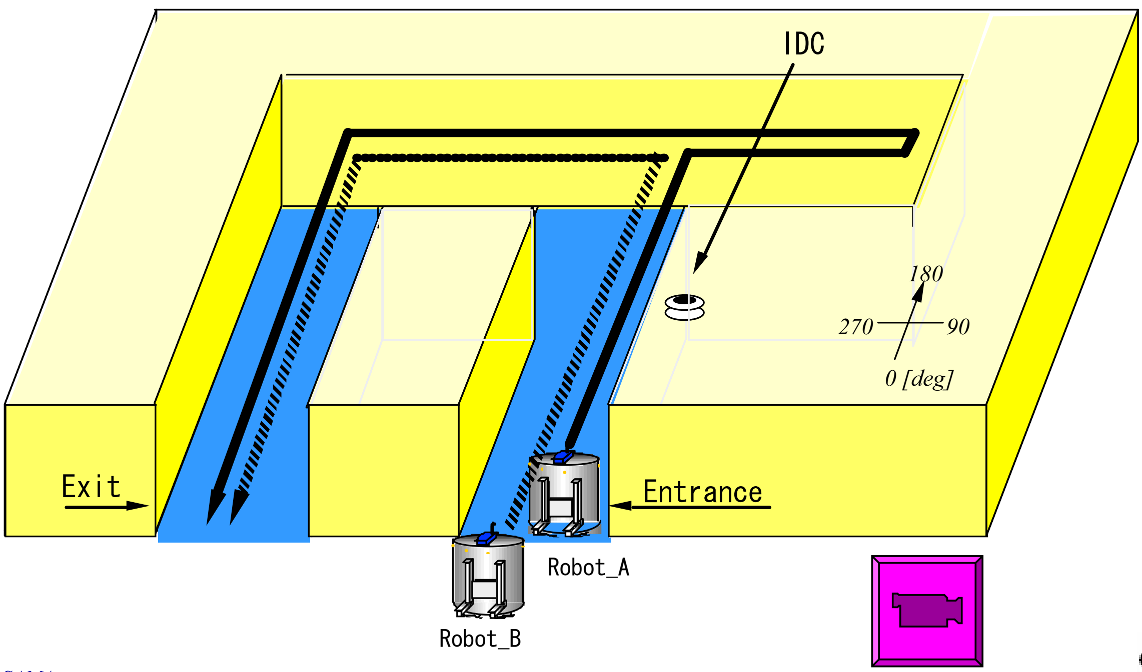
Information Sharing in Unknown Environment



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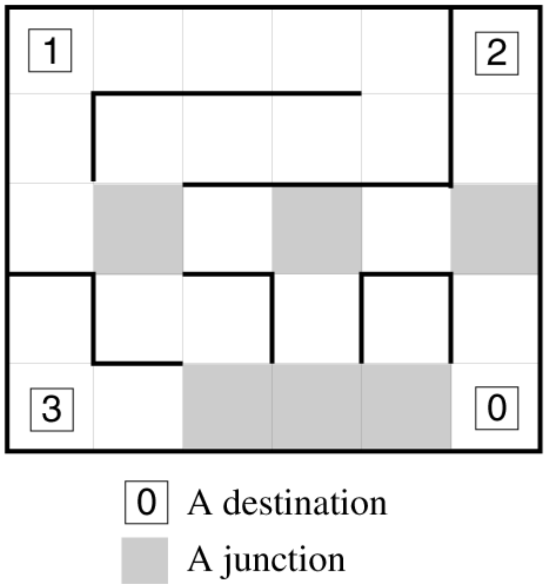
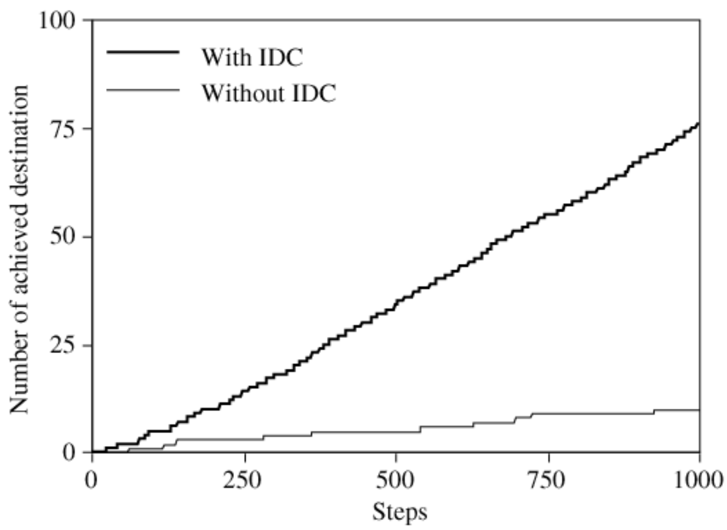
Autonomous Guidance with Local Information Management

Example of robot operating environment



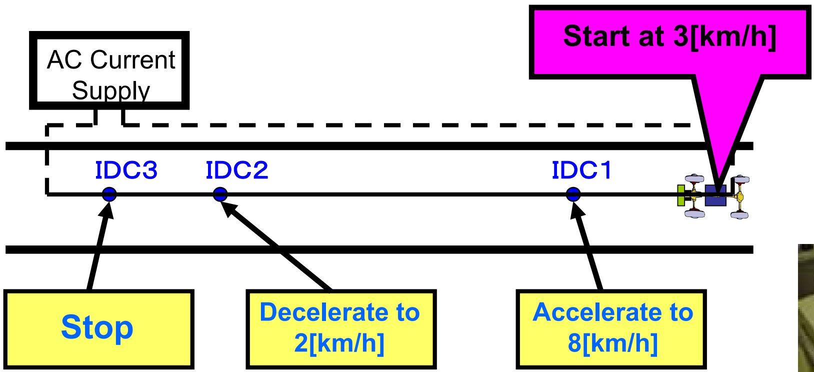
Autonomous Guidance with Local Information Management

Comparison of task execution



Environment-Driven Outdoor Cart

- Tags set on roads
- Motion commands stored in tags in advance
- Trajectory is controlled by sensing magnetic field caused by a AC current cable
- Motion commands are given by tags, which can be read by the cart when it passes on the tags.



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Applications of Ubiquitous Device Utilization for Service

Robot Operation in Ubiquitous Computing Infrastructure

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User Adaptive System Using Ubiquitous Devices

Victim Search System for Rescue

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Rescue Infrastructure for Global Information Collection

Japanese Project on
Robotics for Disaster Response, Urban Search and Rescue
(DaiDaiToku)
- Research Activity in Rescue Information Infrastructure MU-

Hajime Asama (Univ. of Tokyo), Yasushi Hada, Kuniaki Kawabata (RIKEN),
Itsuki Noda (AIST), Osamu Takizawa (NICT),
Jyunichi Meguro, Kiichiro Ishikawa, Takumi Hashizume (Waseda Univ.),
Tomowo Ohga (Asia Air Survey Co.,Ltd.), Michinori Hatayama (Kyoto Univ.)
Fumitoshi Matsuno (Univ.of Electro-Comm.), and Satoshi Tadokoro (Kobe Univ.)

In cooperation with Hiroshi Nakakomi (Mitsubishi Electric Corp.), Junichi Takiguchi (Mitsubishi Electric Corp.)

International Rescue System Institute

Motivations

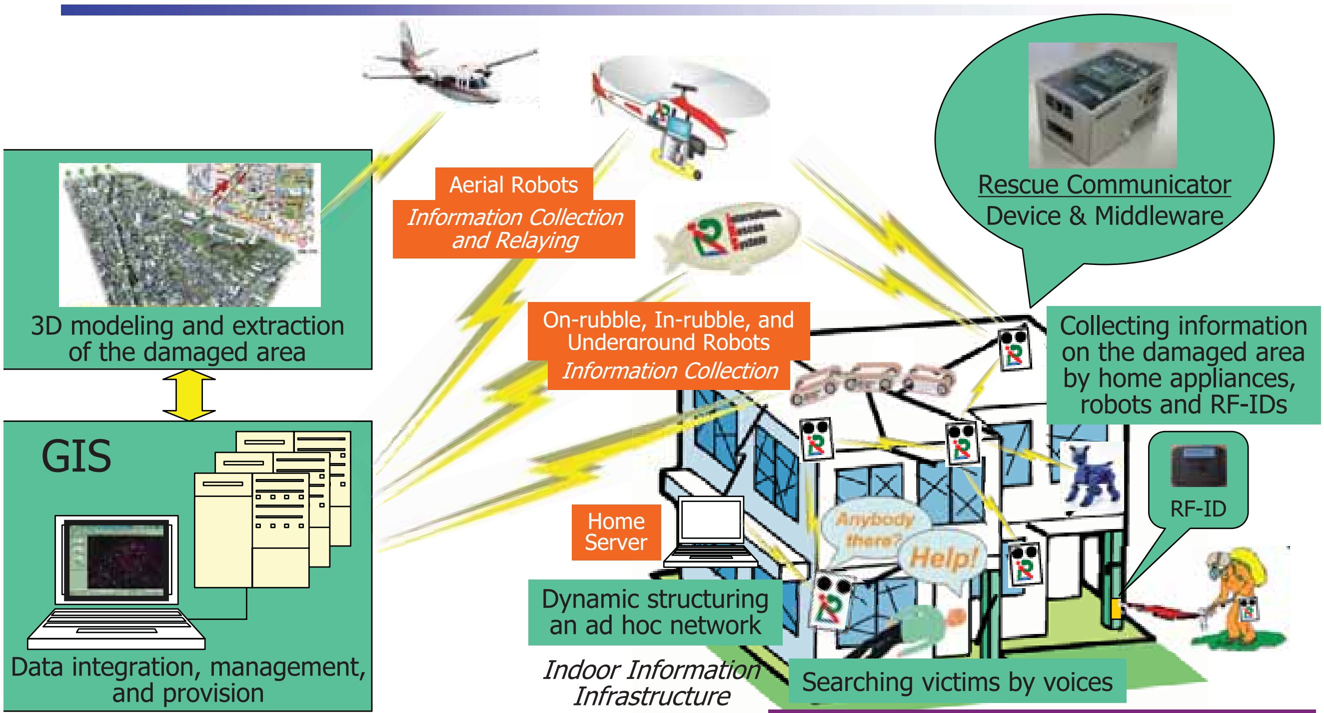
When disasters happen,

- The situation of the disaster should be recognized as soon as possible to determine the strategy for rescue
- Rescue corps, robots, and citizens need to acquire and share information on the damage, evacuation, whether the family are alive or not, where they are, etc. by any means
- The information infrastructure (networks, mobile phones, etc.) may be destructed in a disaster situation

Development of information infrastructure which can be utilized in disaster situation

International Rescue System Institute

Mission Unit for Social Infrastructure for Collecting Wide-area Disaster Information



(2) Design of communication protocols and development of a technology to integrate the collected information on the GIS system

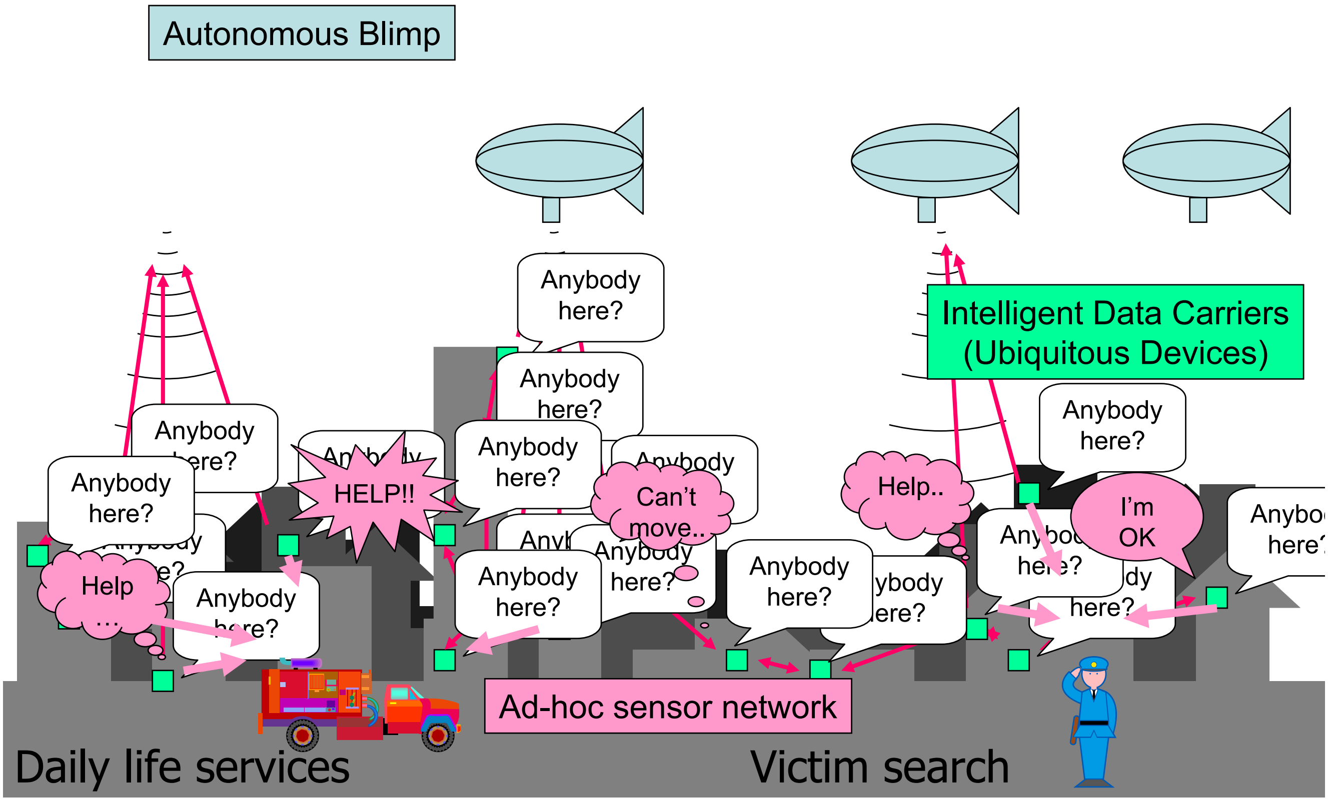
(1) Development of a ubiquitous handy terminal device (*rescue communicator)* and a technology for structuring an ad hoc wireless communication network

(1) Development of a ubiquitous handy terminal device (*rescue communicator)* and a technology for structuring an ad hoc wireless communication network

- Victim Search System using Intelligent Data Carriers for Rescue (RIKEN / Univ. of Tokyo)
- Development of Robot-Controllable Communication Device (IRS)
- RF-ID based emergency information collecting and delivery system (NICT)

Global Victims Search using Intelligent Data Carriers and Autonomous Blimp

(RIKEN/The Univ. of Tokyo)



Intelligent Data Carriers for Rescue (IDC-R)

Rescue Communicator

Improvement in com. functionality

Improvement in size, power, I/F

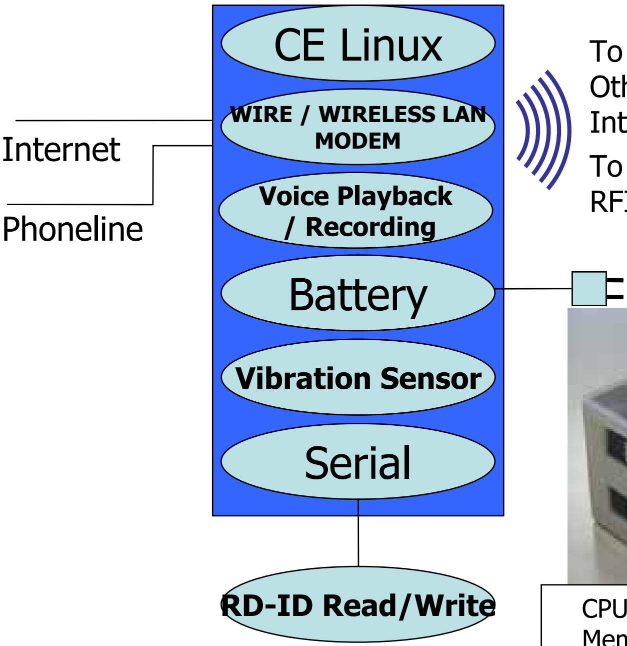
1st model (2002)
(for testing basic function)
RF communication
Voice playback and recording
Data transmission

2nd model (2003)
(for fast & distant com.)
Extension of Wireless comm.
(2800times speed , 133times distance)
Anti-shock, dust-proof

3rd model (2004)
(for common platform for research)
Downsized, long buttery life
(1/3 size, 9 times longer)
Extension of communication I/O
(LAN, waveLAN, modem)
(Ad-hoc network)
Detection of earthquake, power failure, water leak, etc.

Compact Flash, modem, LAN,waveLAN, GPS

Intelligent Sensor Node: *Rescue Communicator* (Jan. 2005)

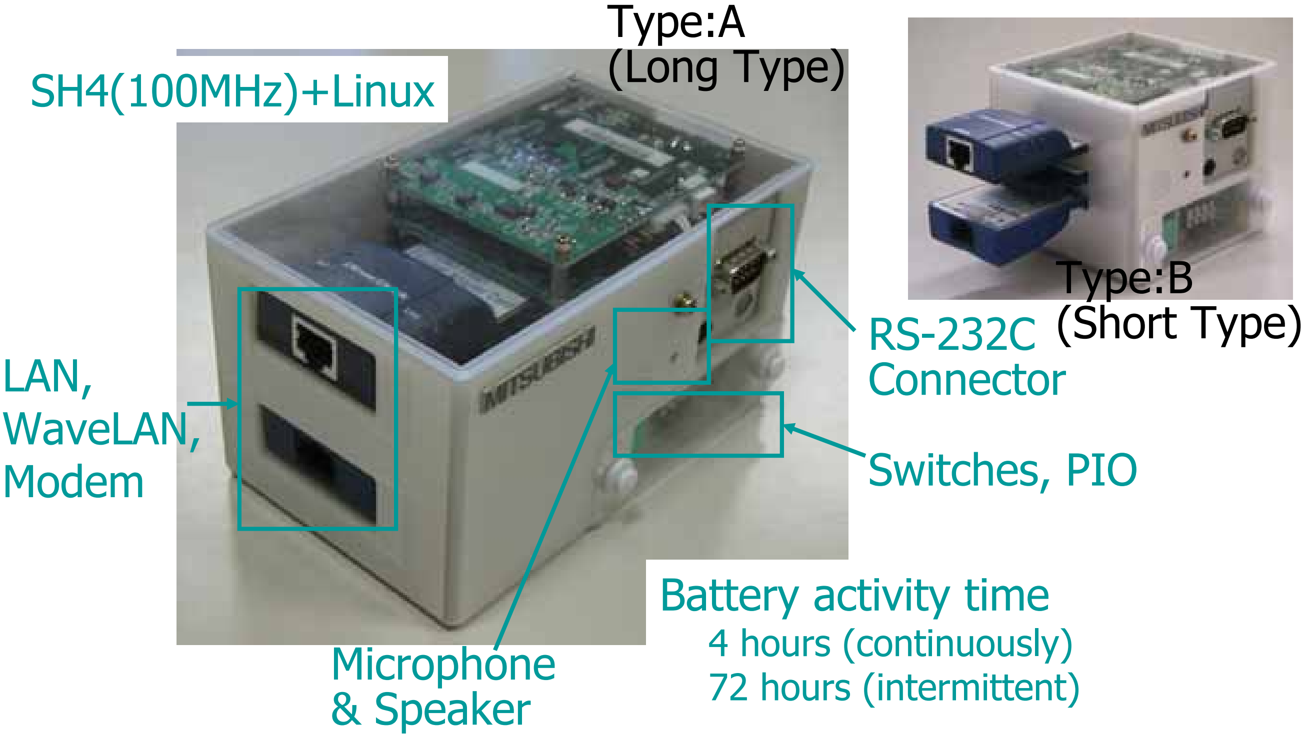


To Blimp,
Other Rescue-Communicator
Internet
To information home appliance,
RFID, PDA

Long Type | Short Type

CPU:	Renesas tech. SH4 (100MHz)
Memory:	32MB
Extension slot :	Compact Flash * 3, RS-232C * 2
Communication:	Wired/ Wireless LAN, InfraRed, Modem etc.
Other Interface:	Speaker / Microphone / Parallel, etc.
Size:	87.5x142.5x79.0(long)87.5x92.0x79.0(short)
Acting time:	4hours(continuous)
	72hours(intermittent)

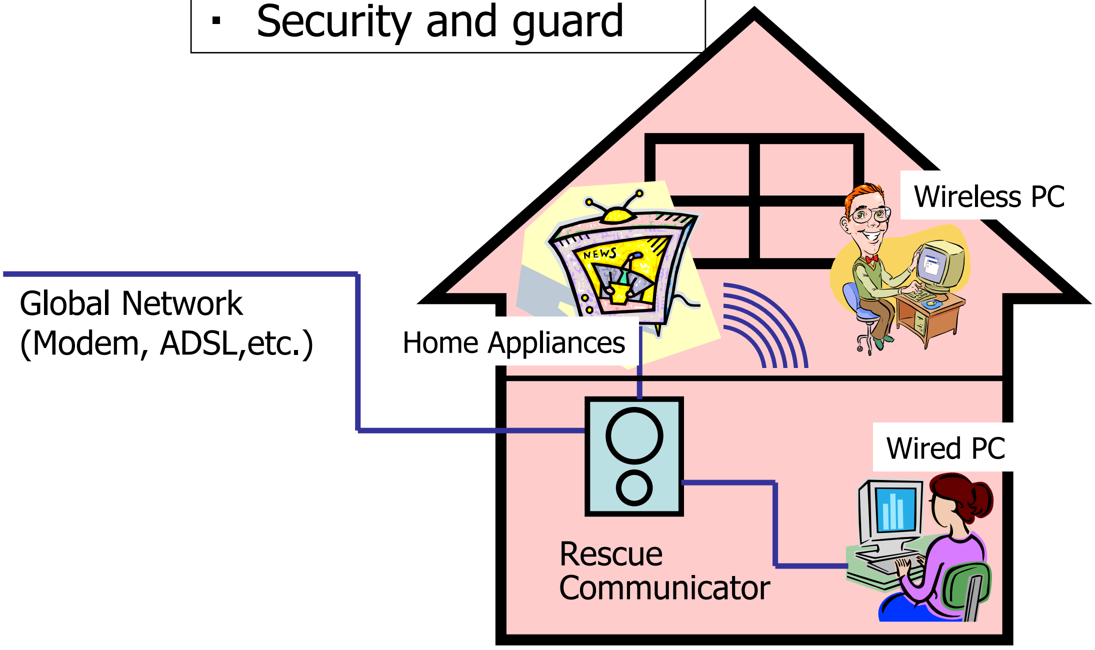
Rescue Communicator



Type(A: Long Type) 87.5(D)×142.5(W)×79.0(H), 985cc
Type(B: Short Type) 87.5(D)× 92.0(W)×79.0(H), 635cc

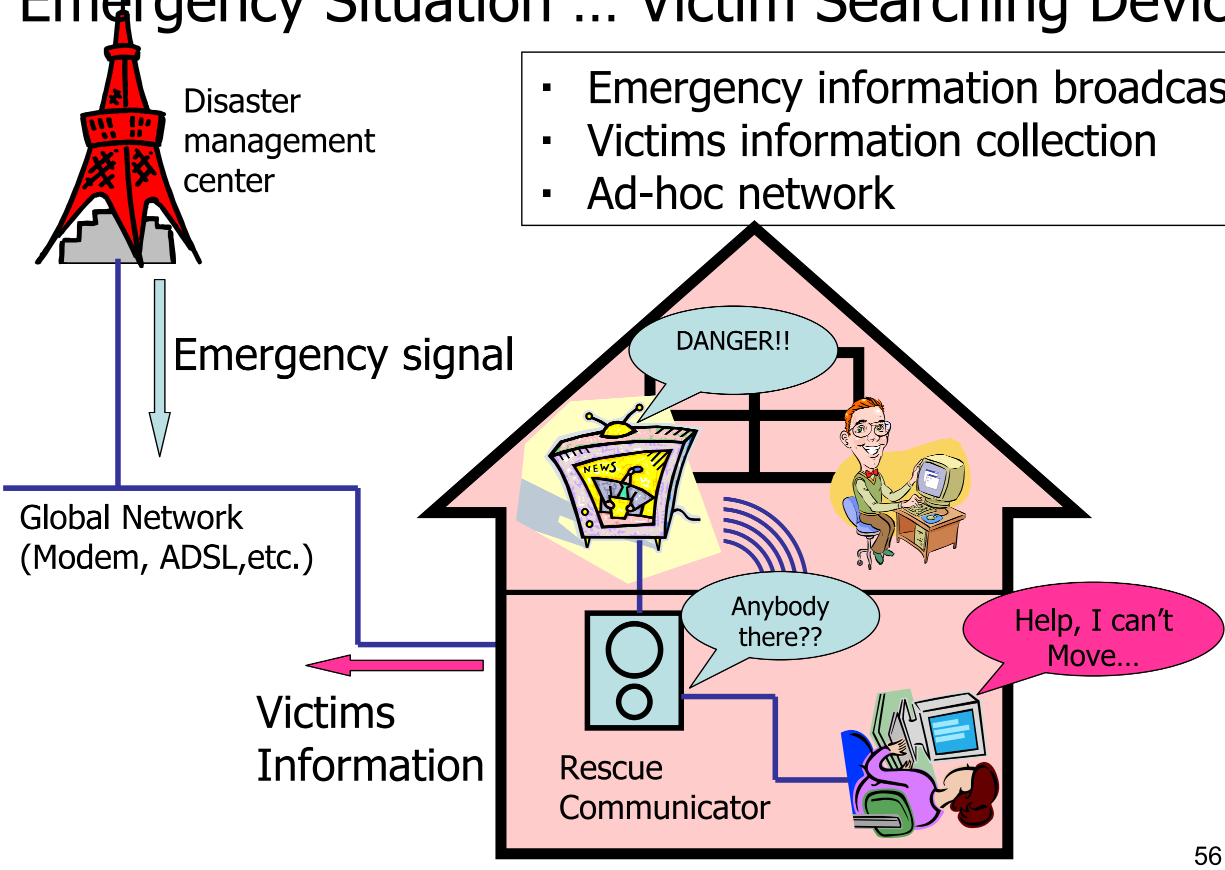
In Normal Situation … Information Appliance

- Home network server
- Nursing elderly people
- Security and guard



Emergency Situation … Victim Searching Device

- Emergency information broadcast
- Victims information collection
- Ad-hoc network



Emergency Situation … Victim Searching Device

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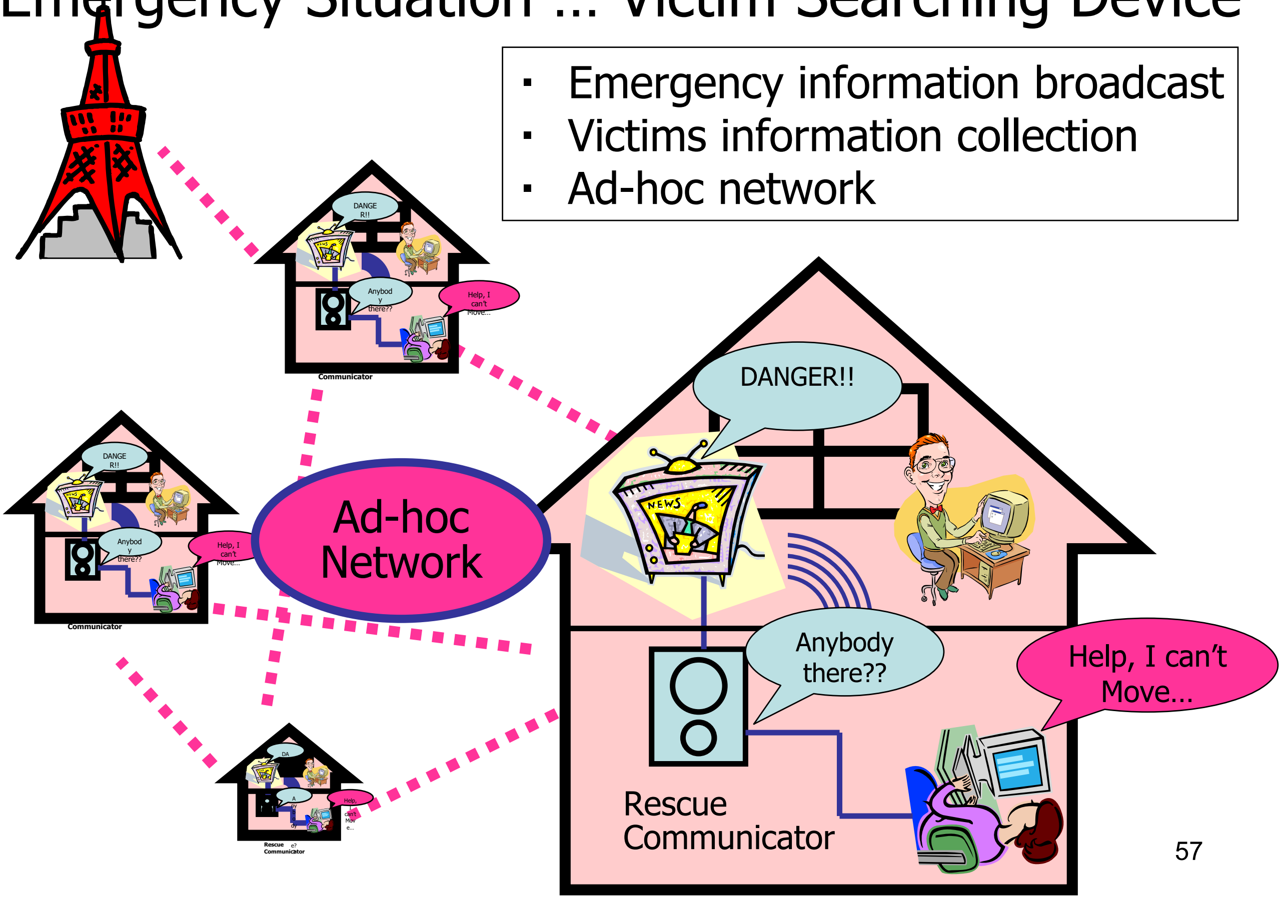
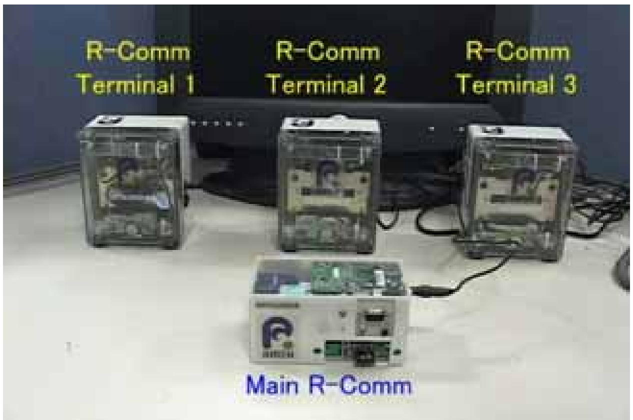
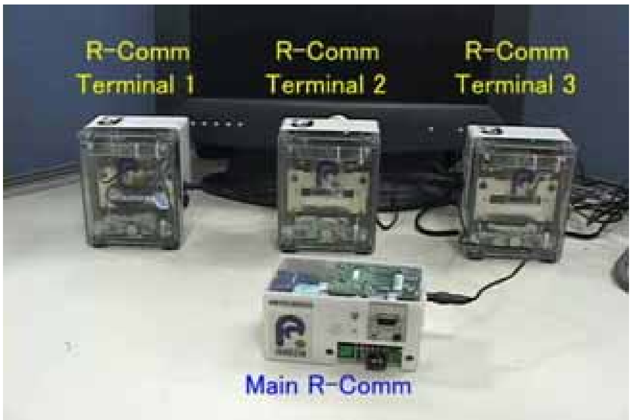


Autonomous Blimp Operation & Search
(Autonomous blimp and a rescue communicator)

Coordinated search between IDC-Rs in home network





Main IDC-R server (rescue communicator)
- Earthquake (tilt) detection
- Transmission activation signal to 3 terminals
- Transmission voice data to rescuers or blimp.

Terminal IDC-Rs
- Voice playback and recording
- transmission voice data to server

Main IDC-R server (rescue communicator)
- Power-cut detection
- Transmission activation signal to 3 terminals
- Transmission voice data to rescuers or blimp.

Terminal IDC-Rs
- Voice playback and recording
- Transmission voice data to server

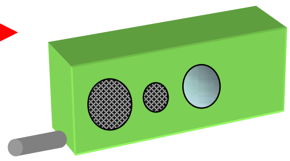
Intelligent Data Carriers for Rescue (IDC-R)

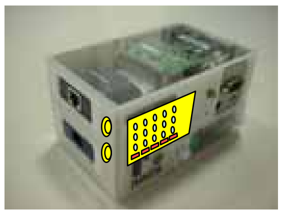
Rescue Communicator

Improvement in com. functionality

Improvement in size, power, I/F

Improvement for practical use

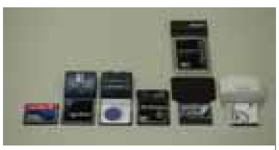




1st model (2002)
(for testing basic function)
RF communication
Voice playback
and recording
Data transmission

2nd model (2003)
(for fast & distant com.)
Extension of
Wireless comm.
(2800times speed ,
133times distance)
Anti-shock, dust-proof

3rd model (2004)
(for common platform for research)
Downsized, long buttery life
(1/3 size, 9 times longer)
Extension of communication I/O
(LAN, waveLAN, modem)
(Ad-hoc network)
Detection of earthquake,
power failure, water leak, etc.



Compact Flash, modem, LAN,waveLAN, GPS

2005 models
(under development)

- Sensor terminal
  -Small and cheap
- Handy terminal
  -Video I/O
- Robot controller

Rescue Communicator for Robot Controller

•R-COMM can be regarded as
the device sending the information acquired by robots to GIS server

Original R-COMM

- WIRED/WIRELESS LAN MODEM
- SH4+Linux
- Battery
- Voice Playback /Recording
- Serial

R-COMM for Robot Controller

- CARD BUS IF
- SH4+Linux
- IEEE1394 IF
- TITech Wire IF

CARD BUS IF: giving high expandability to add various function; USB, Wireless LAN(54Mbps)

IEEE 1394 IF: controlling image acquiring device such as camera.

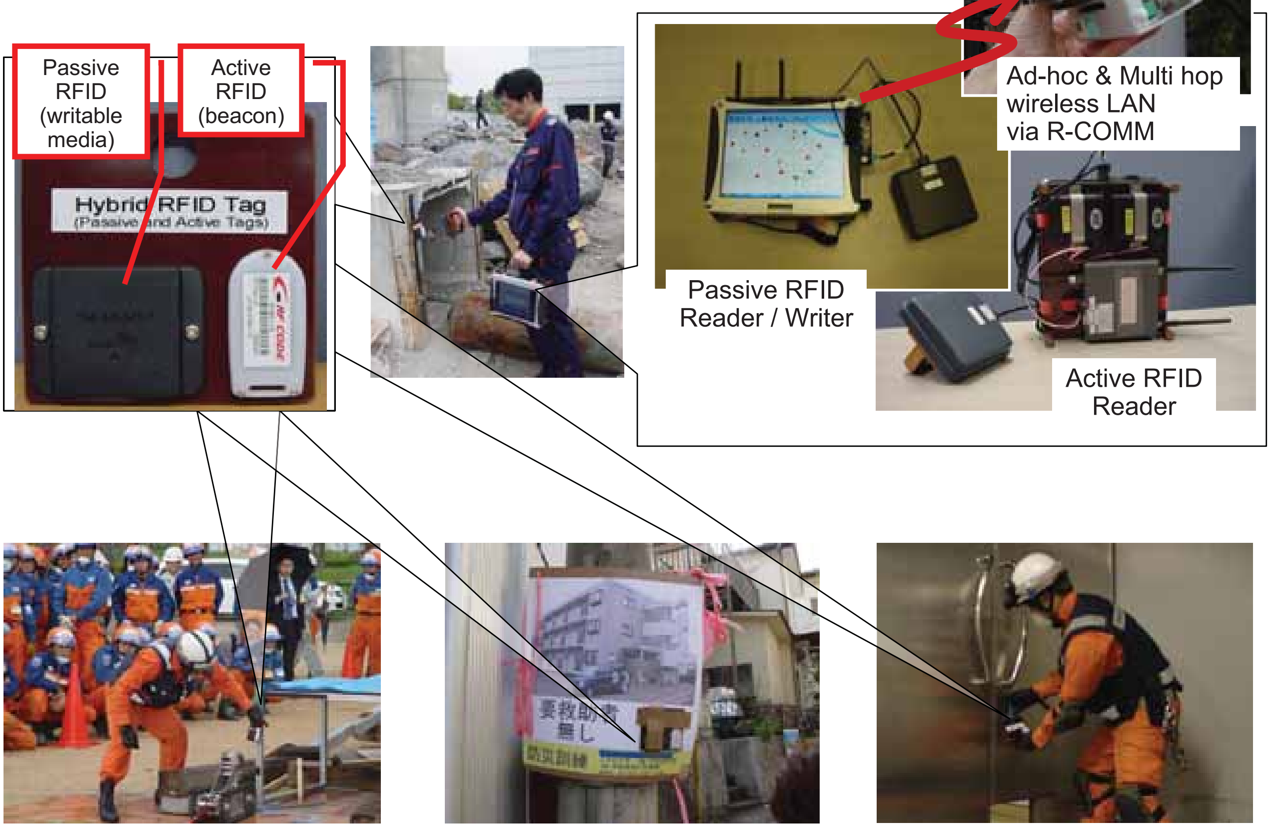
TITech Wire IF: giving high expandability to add function to control the robots; ADC, DAC, Counter, Motor Drive…

Two ways of installation

- As a controller: R-COMM controls robots and sends the acquired information to the GIS server
- As a data logger: R-COMM hooked to sensor data lines sends the acquired information with the least change of the conventional control system

NiCT

RFID system and R-COMM



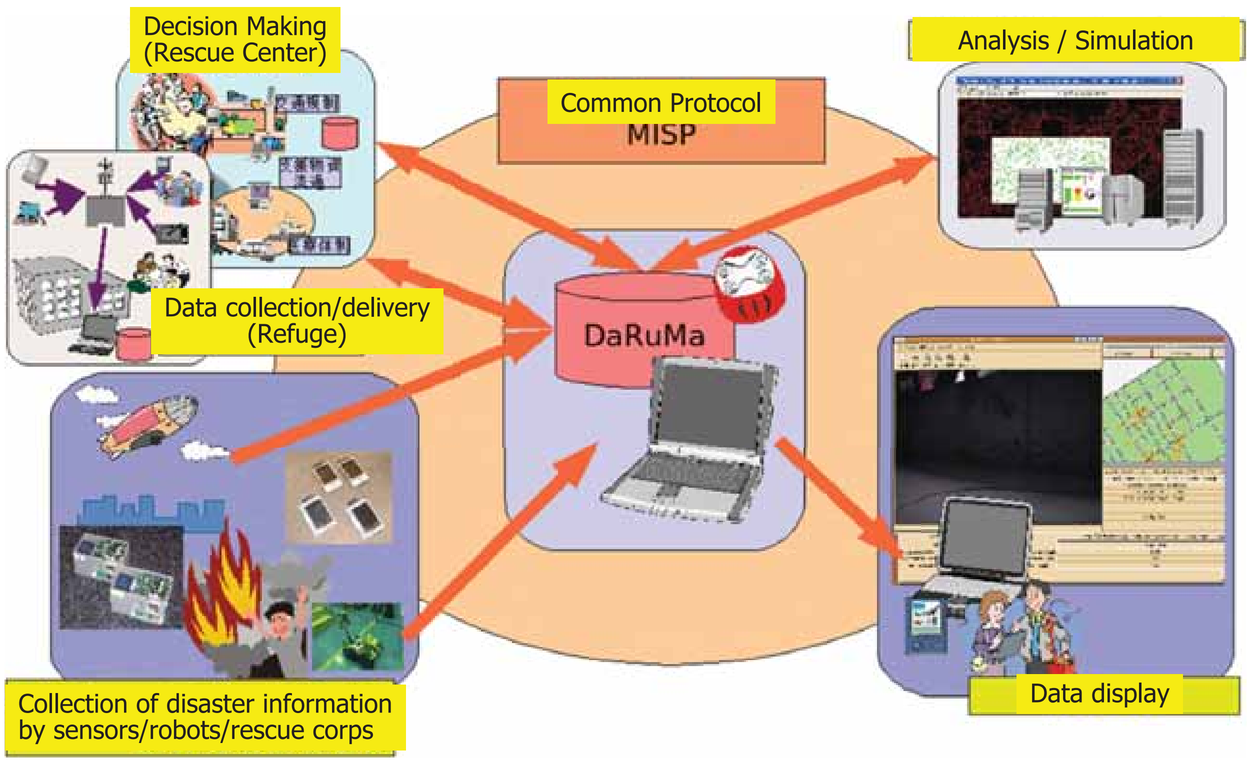
For rescue at collapsed house　For investigation in disaster area　For rescue at NBC Terrorism

(2) Design of communication protocols and development of a technology to integrate the collected information on the GIS system

- Information assistance system in disaster using ad-hoc network (AIST)
- System for integration, mapping, and storage of collected global/local information in 3D environment
  (Kyoto Univ./Univ. of Electro-Comm./Waseda Univ.)
- Integrated disaster measuring system (Asia Air Survey Co. Ltd.)

International Rescue System Institute

System Overview of DDT Project (Data Management)

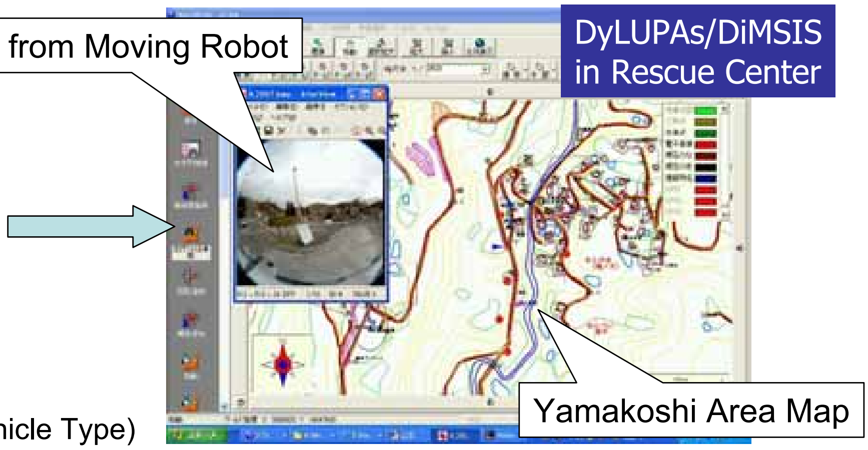


Spatial Temporal GIS Group (Michinori Hatayama, Fimitoshi Matsuno)

Main Scheme
Information Sharing based on Spatial Temporal GIS
between Rescue Robot System and Disaster Management System
-- for Integrated Decision Making under Disaster

Information Sharing Experiments
from Moving Robot for Disaster Information Collection to Spatial Temporal GIS
in Yamakoshi area (Heavy Damaged Area at Niigata Chuetsu Earthquake, 2004.10.23)

Data Collection
using Mobile Robot (Vehicle Type)



Ground and Aerial Information Collection System for Spatial Temporal GIS

PDA
(Person)

Aerial robot (UAV)
(Air)

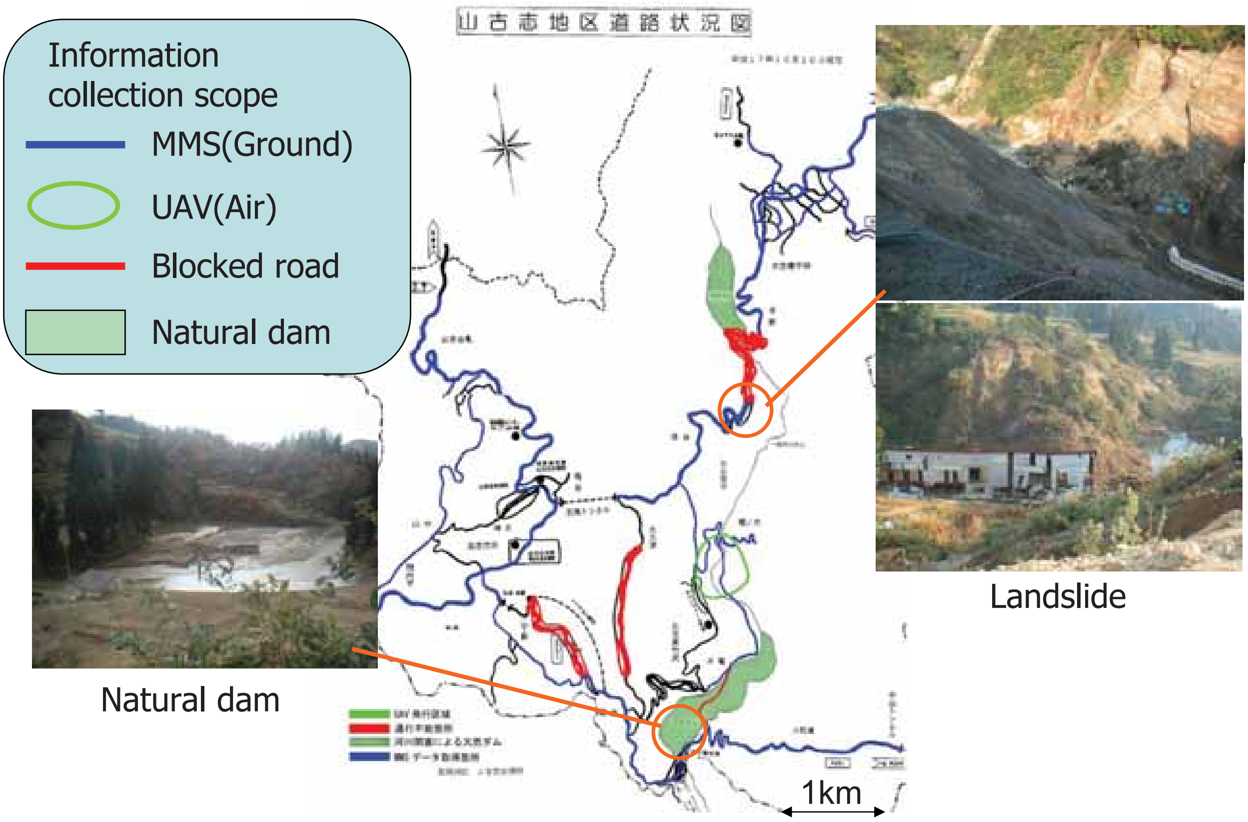
Mobile Mapping System
(Ground)

Database based on MISP
(DaRuMa)

Spatial Temporal GIS
(DiMSIS/DyLUPAs)

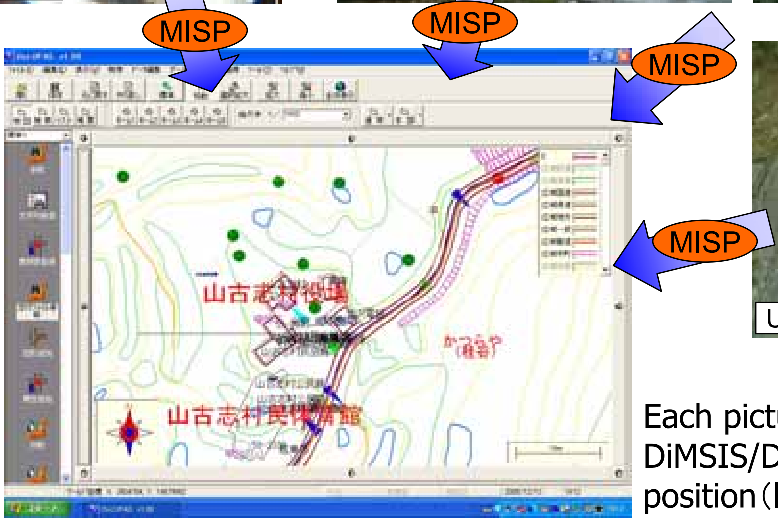
Efficient information collection of vast disaster field can be realize by the cooperation of Air / Ground automatic measurement system using PDA, MMS, and UAV.
This system was applied to disaster investigation in Yamakoshi area and vast disaster information was automatically gathered and updated in "Spatial Temporal GIS(DiMSIS)".

Disaster information gathering experiment at Yamakoshi Area



Location based images were collected at Yamakoshi area in 10th Nov., 2004.

Experiment ～Vast Disaster Field (Yamakoshi)～



Spatial Temporal GIS "DIMSIS/DyLUPAS"

Each picture is saved on DiMSIS/DyLUPAS synchronized with position（lat. lon. high）and time.

Indoor Guidance Services

- Guide visitors to the right destination
- Necessary to discriminate the persons who walk into the entrance of a building between visitors and staffs
  - » No need to guide staffs
- Use a camera deployed for surveillance
  - » It is not possible to attach any devices to persons in case of use in public space.
- Discriminate the persons based on their motion trajectories
  - » Assumption: The properties and states of persons appear in their behaviors

Hajime ASAMA
RACE *(Research into Artifacts, Center for Engineering)*
The University of Tokyo, JAPAN

Related studies and development

- Ubiquitous (Distributed) Human Monitoring System
  - » Robotic Room (Hashimoto, et al.)
  - » Intelligent Space (Sato, et al.)
  - » VSAM (Kanade, et al.), et al.

- To provide suitable services according to users and their states, it is still required to discriminate the users or their states depending on services, based on the model of users' behaviors representing the relation between users' states and users' behavior.

Hajime ASAMA
RACE *(Research into Artifacts, Center for Engineering)*
The University of Tokyo, JAPAN

Objective

- Develop a system to discriminate the users based on the human behavior.
- Develop a method to discriminate the persons walking into the entrance of a building between visitors and staffs by their motion trajectories

Hajime ASAMA
RACE *(Research into Artifacts, Center for Engineering)*
The University of Tokyo, JAPAN

Human Behavior Analysis and Discrimination based on Motion Trajectory Measurement

- Guidance service in indoor environment
- Position detection of Human by processing images taken by a camera
- Trajectory measurement and discrimination by statistical approach
  - Ubiquitous Device (μ T-Engine)
    - Artificial Retina Camera

CPU ボード	
CPU	三菱電機 M32104 （M32R, 内部クロック 216MHz）
フラッシュメモリ	4M バイト
SDRAM	16M バイト
入出力 I/F	Compact Flash （CF） カード、シリアル、eTRON チップ、 MMC カード、LED （2 個）、拡張バス I ／ F
その他の機能	RTC
電源	AC アダプタ
外形寸法	60mm × 85mm （突起物を除く）
拡張 LAN ボード	
LAN	SMSC 社製 LAN コントローラ （LAN91C111） 100BASE-TX/10BASE-T
コネクタ	SDI コネクタ （SDI デバッガを接続） LAN 用 RJ-45 コネクタ AR ボード用コネクタ パラレルインタフェース （8 ビットのポート入出力）
外形寸法	60mm × 85mm （突起物を除く）
AR ボード（※）／人工網膜カメラ	※ AR とは "Artificial Retina" の略であり、「人工網膜」の意味です。
解像度	160 × 144 × 3 （RGB）
その他	レンズ一体型パッケージ
	CDS、AGC、ガンマ補正、色調補正回路内蔵
	ゲインレベル、黒レベル調整機能内蔵
外形寸法	40mm × 35mm （突起物を除く）
電源ボード	
外形寸法	45mm × 35mm （突起物を除く）

Approach (1)

▶ Position Measurement

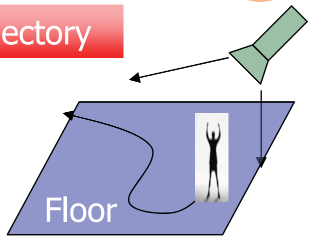
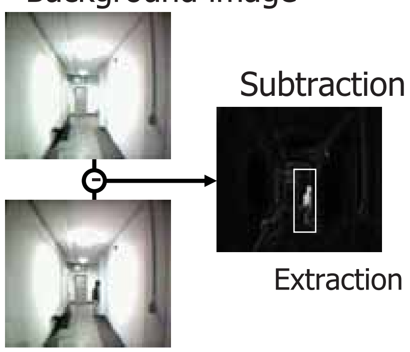
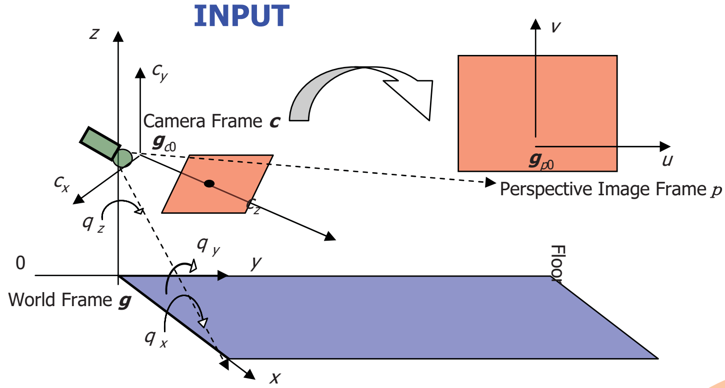


Image (u, v) ⟶ Position (x, y, z) (z = 0)

Background Subtraction

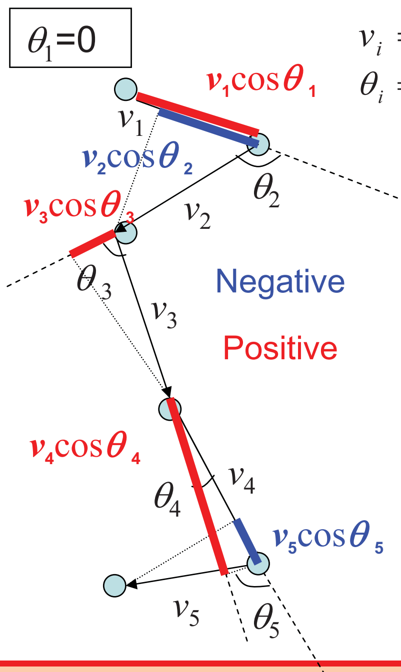


Coordinate Transformation



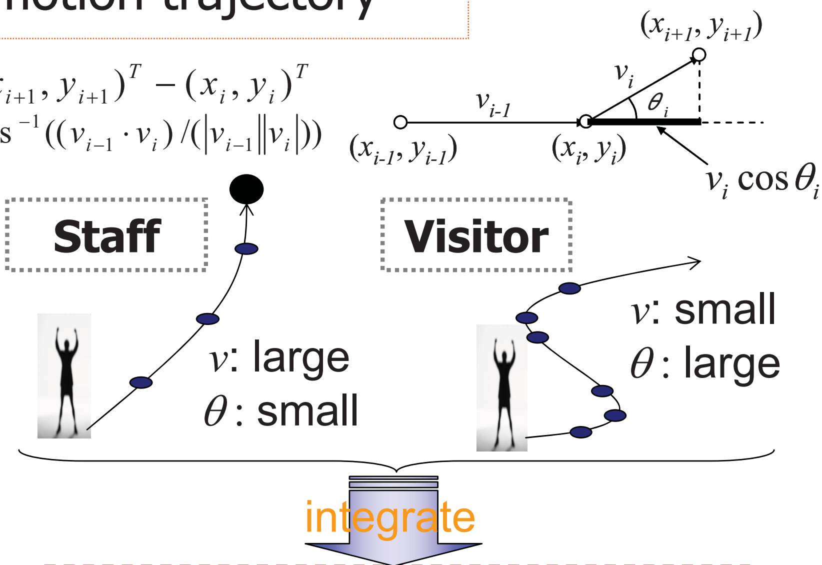
Approach (2)

▶ Analysis from motion trajectory



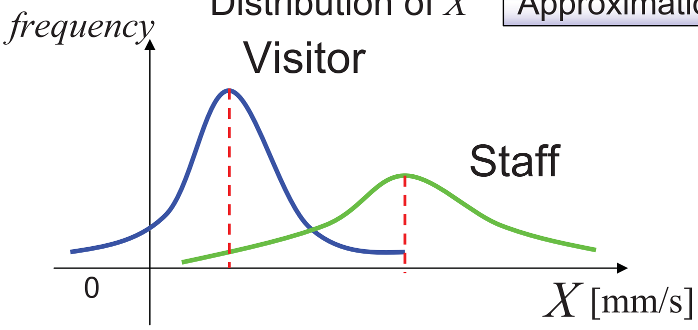
$$v_i = (x_{i+1}, y_{i+1})^T - (x_i, y_i)^T$$

$$\theta_i = \cos^{-1}((v_{i-1} \cdot v_i)/(|v_{i-1}||v_i|))$$



Motion Index: $X = \frac{1}{n}\sum_{i=1}^{n} v_i \cos\theta_i$

Probabilistic Evaluation



Approximation → Gaussian Distribution

Staff $f_s(X)$

Visitor $f_v(X)$

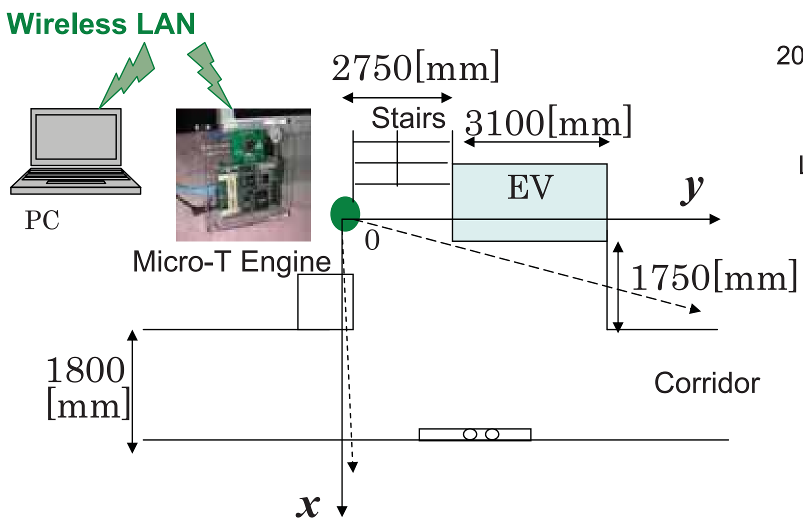
Bayes Theorem

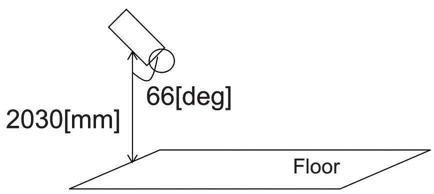
Trajectory ⇩ $X = x_i$

$$p(s|X=x_i) = \frac{p(s)\cdot f_s(X=x_i)}{p(s)\cdot f_s(X=x_i)+p(v)\cdot f_v(X=x_i)}$$

$$p(v|X=x_i) = \frac{p(v)\cdot f_v(X=x_i)}{p(s)\cdot f_s(X=x_i)+p(v)\cdot f_v(X=x_i)}$$

Preparatory Experiment

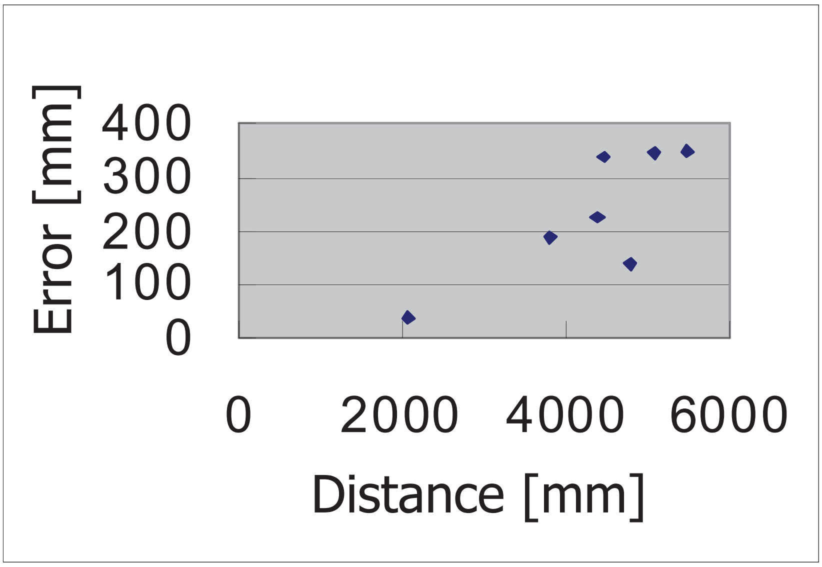




Location of Artificial Retina Camera

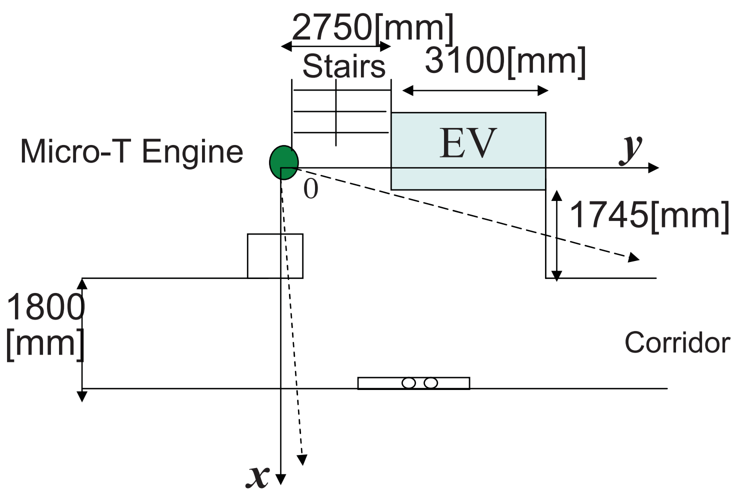
Actual Image

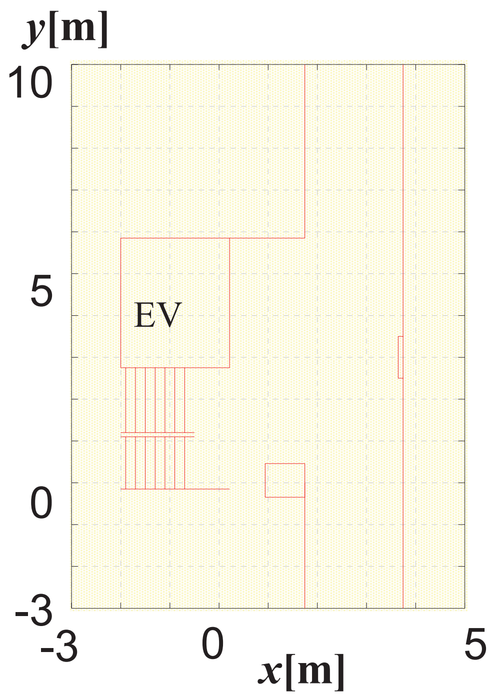
Preparatory Experiment



Accuracy of Measurement of Human Position: 400[mm]

Experiments for trajectory measurement



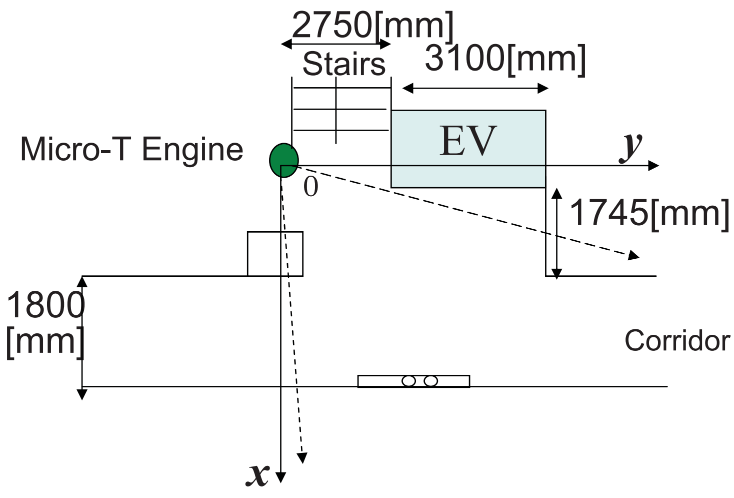


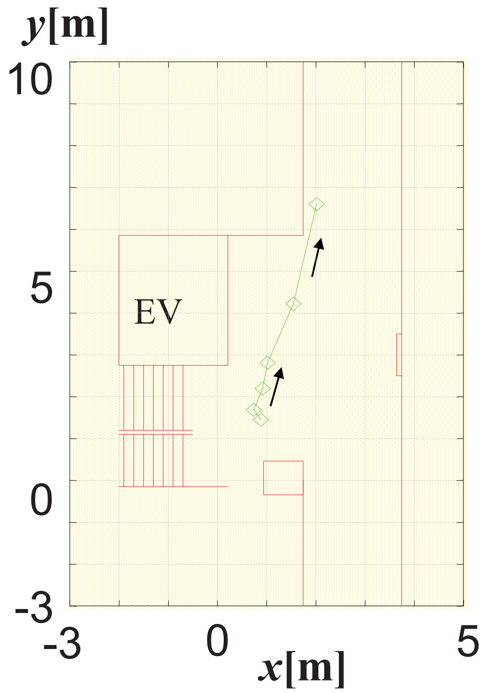
Samples: 155

—Staffs: 127

—Visitors: 28

Experiments for trajectory measurement





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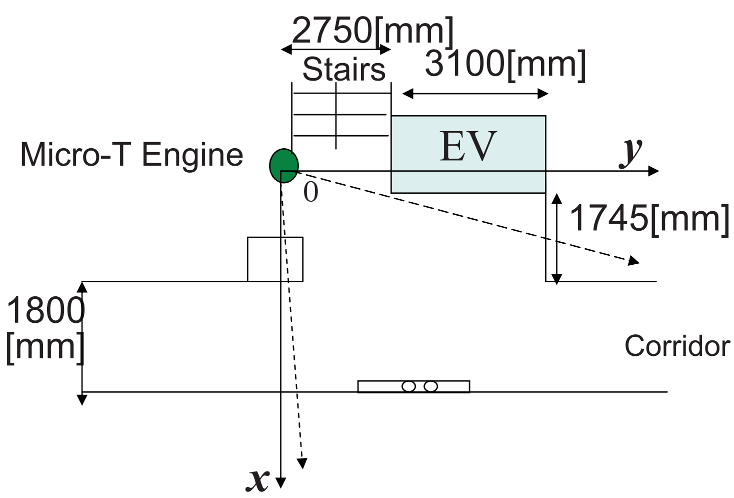
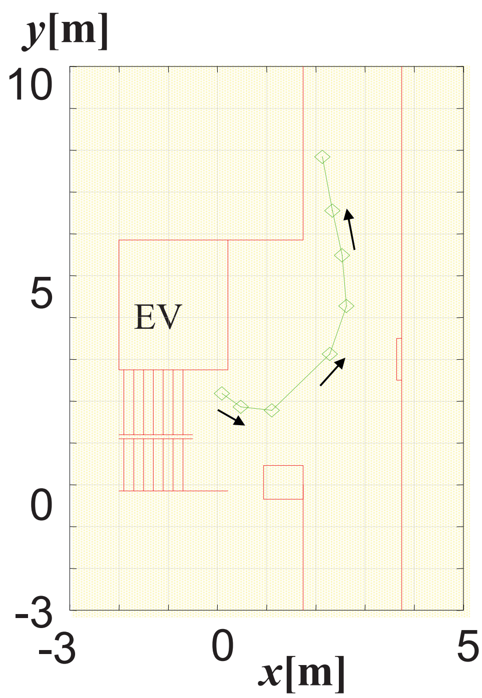
Experiments for trajectory measurement





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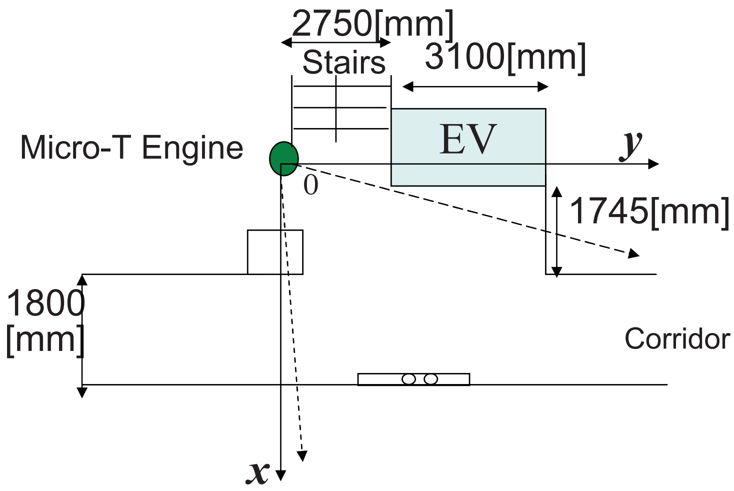
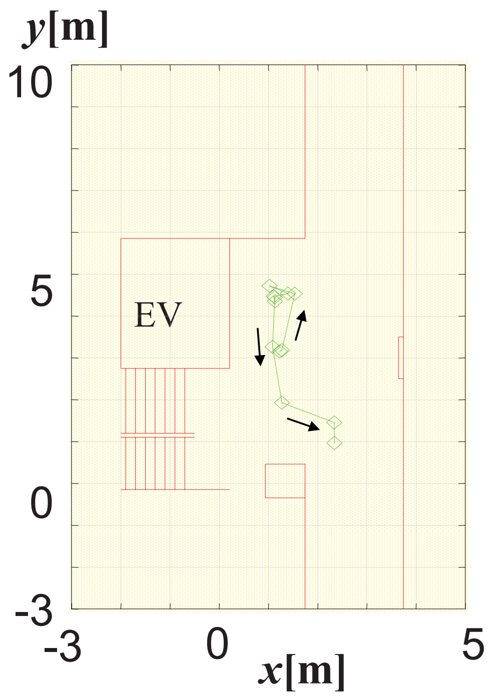
Experiments for trajectory measurement





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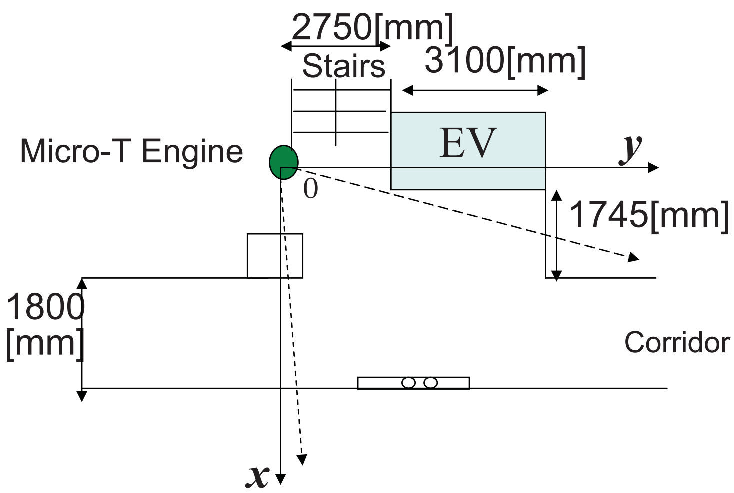
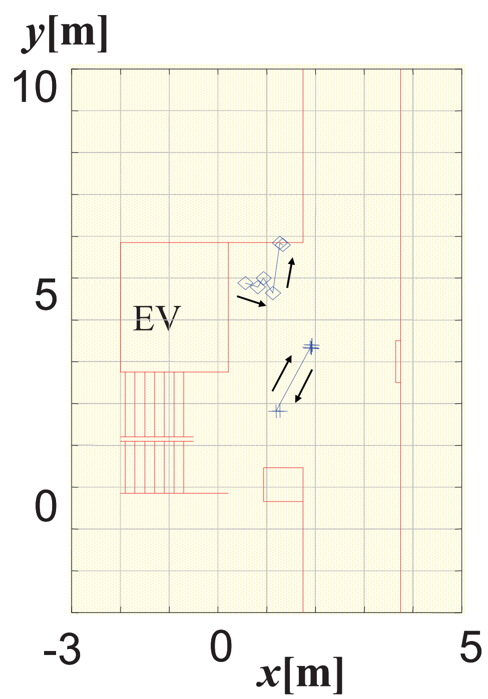
Experiments for trajectory measurement

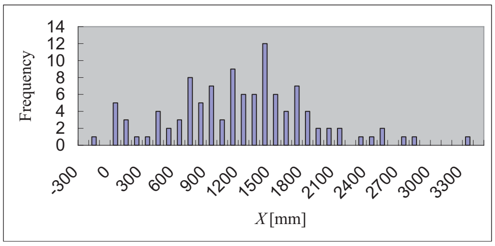




Samples: 155
- Staffs: 127
- Visitors: 28

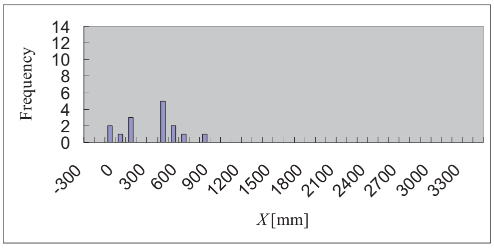
Average and Variance

Staff



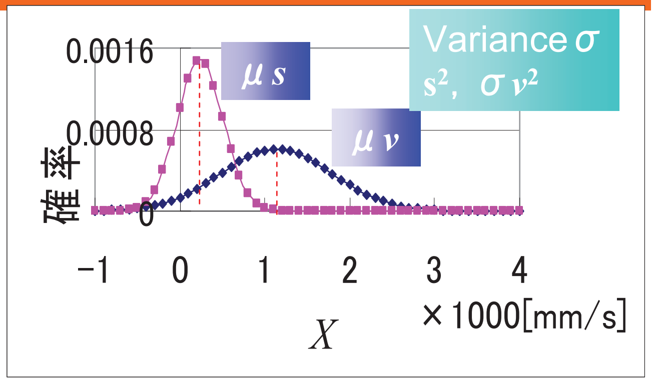
Probability Distribution of X for staffs

Visitor



Probability Distribution of X for visitors

Gaussian Distribution



Average: $\mu_s = 1135,\ \mu_v = 237$ [mm/s]

Variance: $\sigma_s{}^2 = 656^2,\ \sigma_v{}^2 = 270^2$ [mm²/s²]

Comparison

$$p(s|\,X = x_i) \ < \ p(v\,|\,X = x_i)$$

Visitor Discrimination

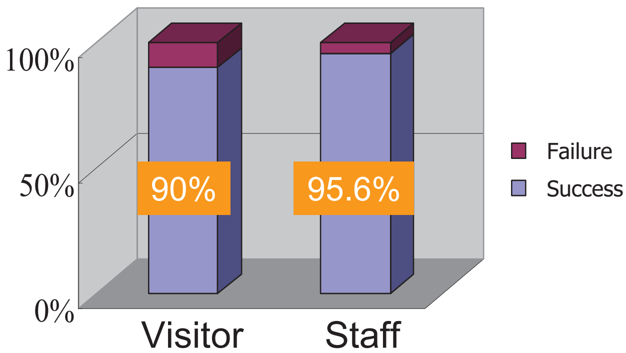
Experiments for Evaluation

Samples: 55

—Staffs: 45

—Visitors: 10

90% Reliability of Discrimination



The error ratio of the first kind = 10%
(The visitors were misrecognized as staffs)

The error of the second kind = 4.4%
(The staffs were misrecognized as visitors)

Guidance services in public space

Station

Shopping

Emergency

Problems in guidance by conventional signboard

- No notice
- Cannot guide as to intention
- Can show only static information
- Physical or design constraints

Strategies

Display information adaptive to the person

Recognition of attribute & motion of the person by camera

Display information by moving images

Dynamic information projection by pan-tilt projector

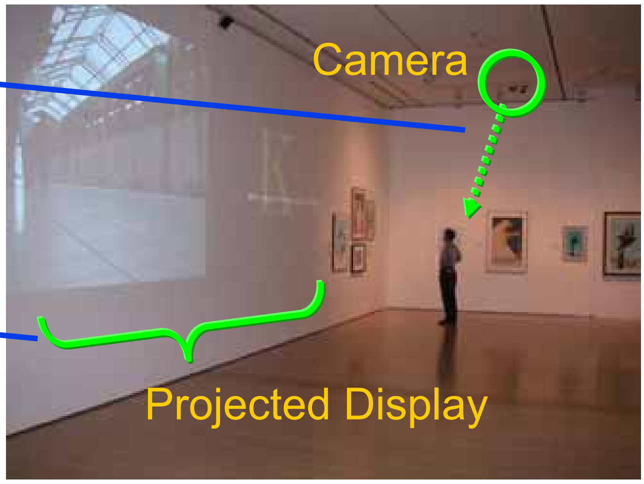
Adaptive Service System using Ubiquitous Devices

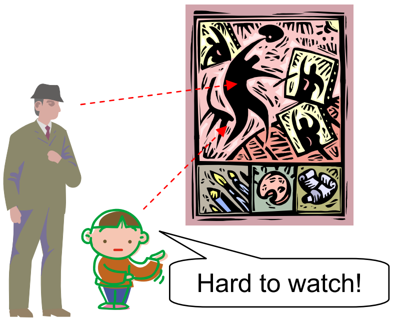
Extraction of characteristics of human behavior using cameras
and adaptive display of service contents

Perception
Height, speed, trajectory of guests

Estimation
Age

Service Provision
Display of suitable contents in suitable position in suitable way





Movable projector Display

Suntory Museum in Osaka

Guidance Method

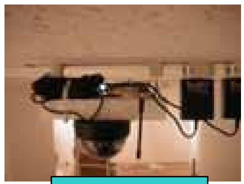
Information display adaptive to users

1. Capturing a visitor by camera
   Realtime measurement of his height
2. Realtime measurement of
   his trajectory & velocity

Dynamic display

3. Display information by pan-tilt
   projector when the visitor
   approaches to the entrance
4. Guide to the target painting

Proposed method



Camera

Pan-tilt projector

Arrow image

Classification of guidance methods

No guidance				Case1
Guidance	Sign board			Case2 (Fig. 1)
	Projector	Static		Case3 (Fig. 2)
		Dynamic	Constant speed	Case4
			Adaptive speed	Case5

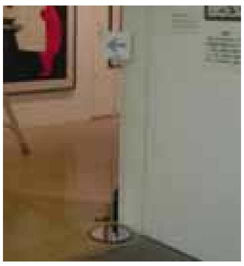


Figure 1

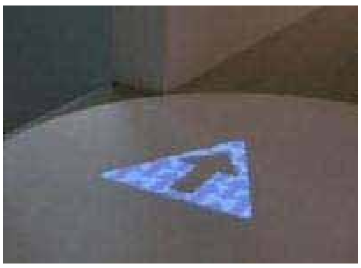
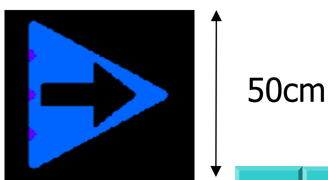
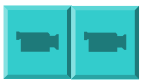


Figure 2

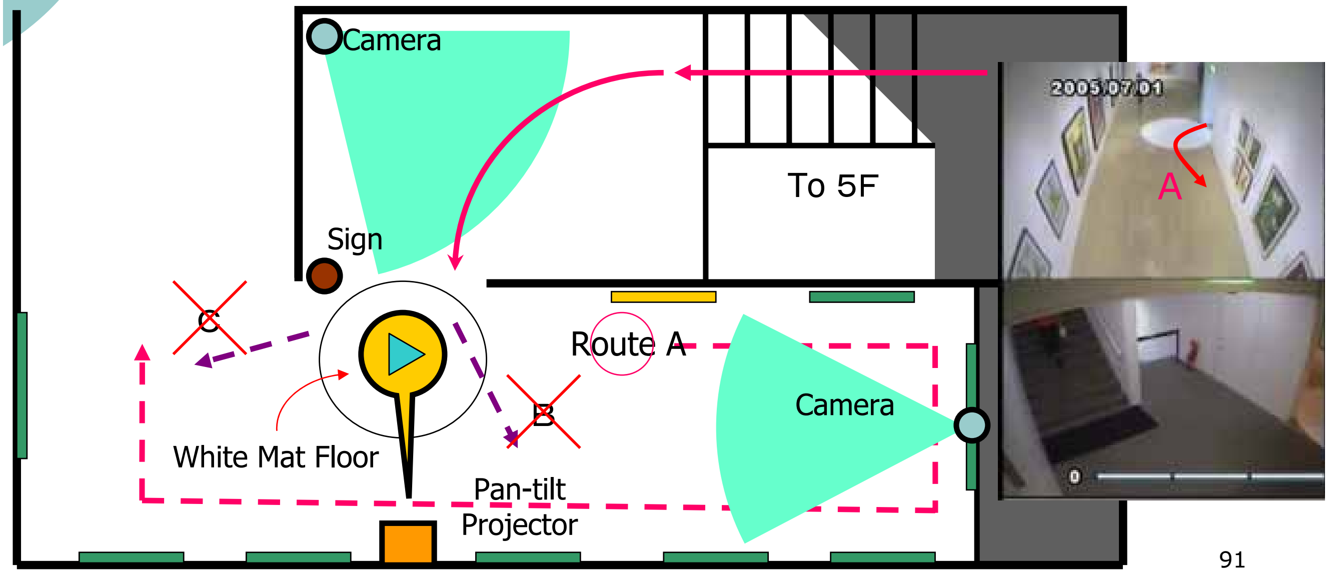




Arrow image

Experiment of Motion Guidance

Measurement: Position, Stature, Speed, Trajectory
Induction: Moving image projection,
Adaptive projection according to the measurement
Experiment: Musium



Experimental Results

				Data no	Guided rate	Improvement	Comfortability
No guidance				170	84.7%	―――	- - -
Guidance	Sign board			203	90.6%	38.8%	- - -
	Projector	Static		216	82.9%	-12.0%	- - -
		Dynamic	Constant speed	215	**96.2%**	**74.9%**	2.67
			Adaptive speed	292	**96.4%**	**76.3%**	**3.48**

Summary

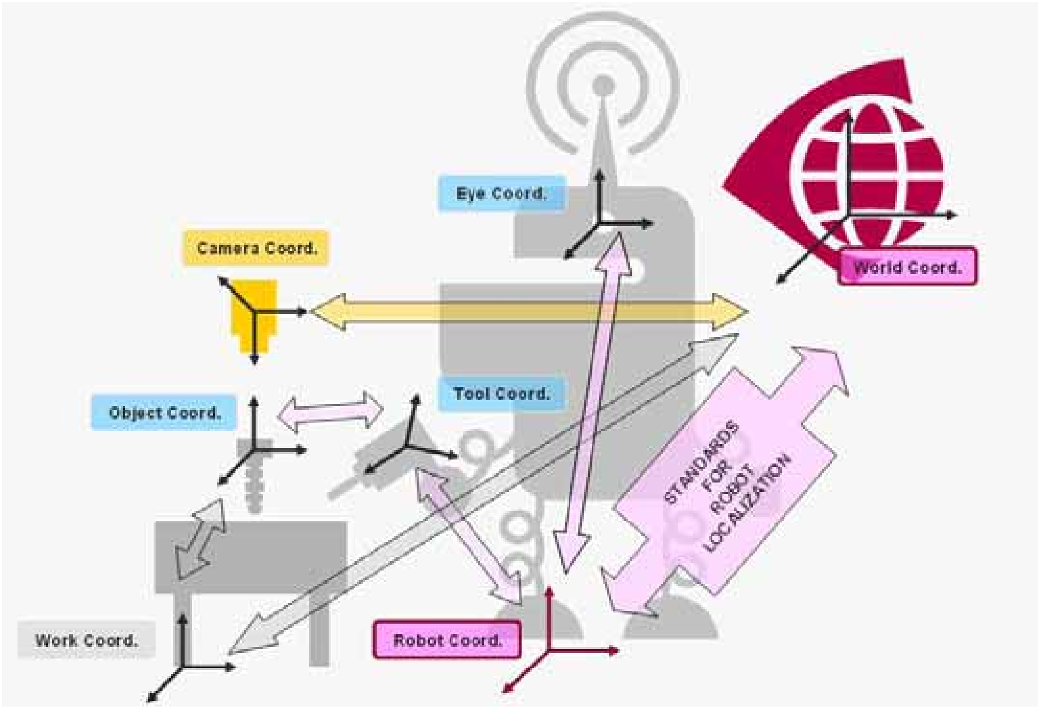
- Introduction of service engineering and concept of service media
- Service media implemented by applying RT and ubiquitous computing technology
- Effective to construct intelligent environment
- Introduction of various adaptive service systems providing services through intelligent environment

Location Service RFP
1st Review

Problem Statement

- One of the main difference between robotic systems and traditional information system is the fact of dealing with physical objects, real or virtual (in case of simulation) including :
  - The robot itself
  - The objects it manipulates
  - The environment in which it evolves
  - The people with who it interacts
- One of the most important information inherent to physical objects is their shape and location in space. This information is fundamental for :
  - The robot to be able to go from a point A to a point B (self-location, robot ⇔ obstacle relative location)
  - The robot to manipulate object (gripper ⇔ object relative location)
  - The robot to locate physical events and understand its environment (sensor location)
  - The robot to interact with the user (robot ⇔ user relative location)
- The location of an object is usually referred as the combination of it position and orientation both with regard to a coordinate system, a reference frame and a unit of measurement.

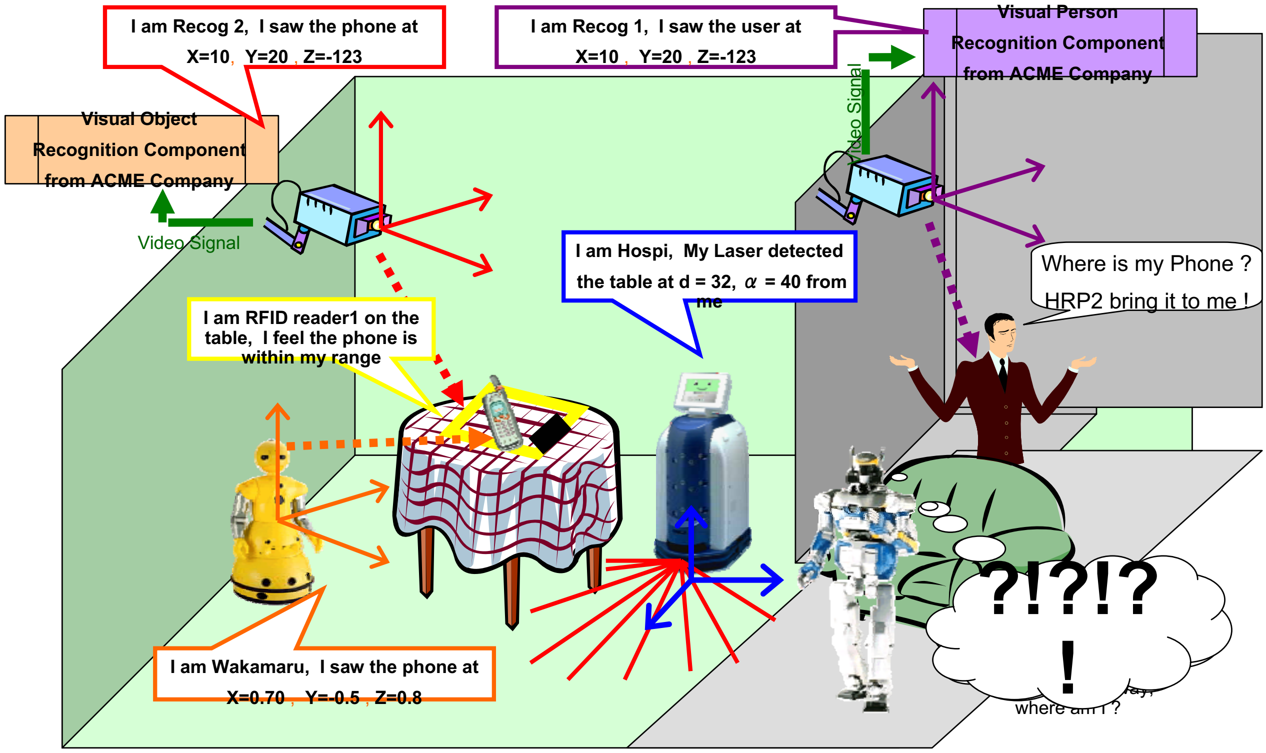
Internal Data Representation (Coordinate Systems)

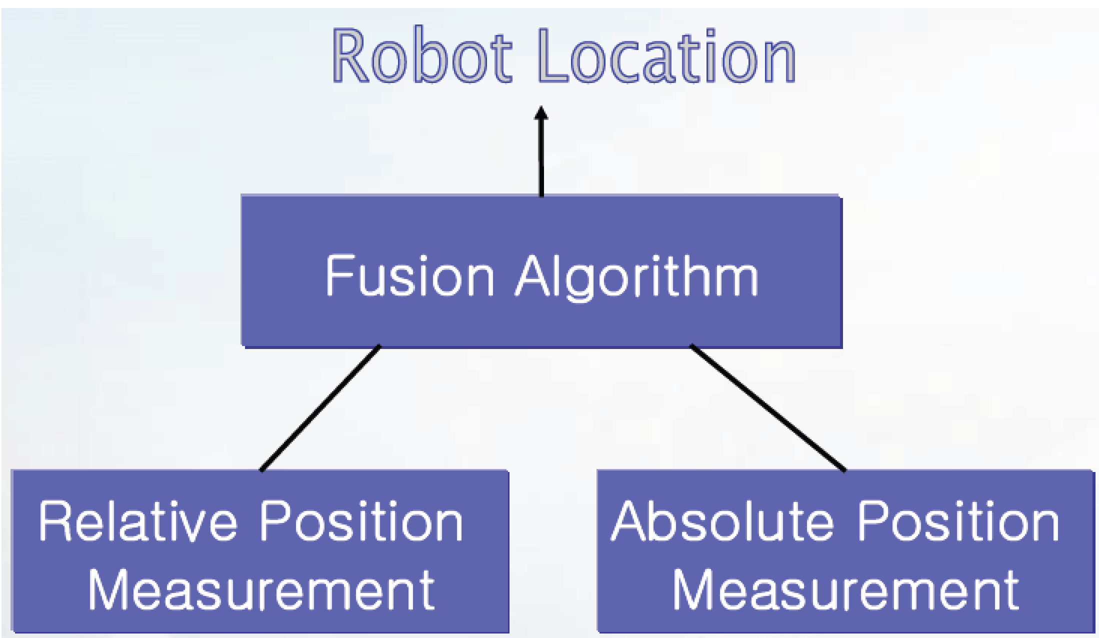


Problem Statement

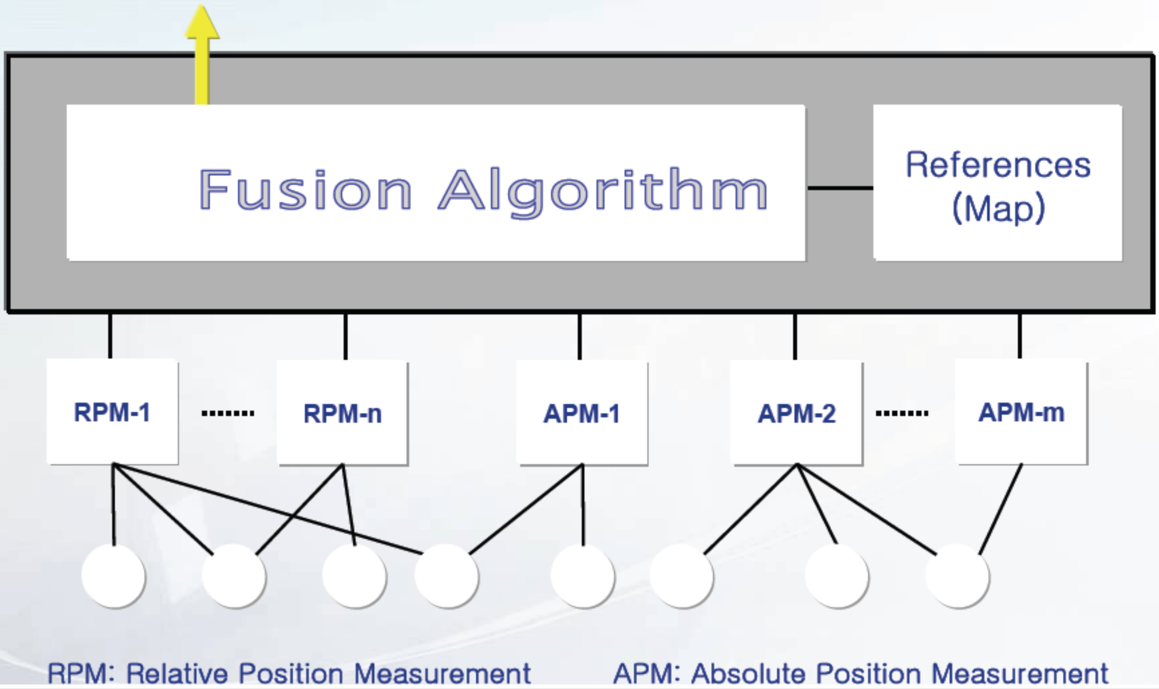
- In Mobile Robotic Systems, Localization refers to the technique through which a robot can determine or update its location through analysis of sensor data.
- In Ubiquitous Robotic Systems, Localization refers more generally to the technique through which the system can determine or update the location of an object through analysis of sensor data.
- The fact of using sensor data makes the localization process subject to noise and uncertainty of sensor
- A wide range of localization solutions are or will become available, making use of various types of sensors and algorithms.
  - Each will provide a different level of accuracy
  - Each will return a location depending on the sensor used
  - Each component is developed independently

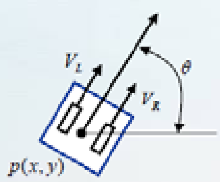
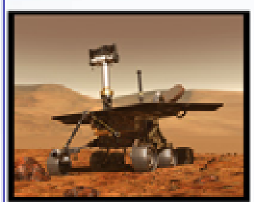
Typical Robotic Scene

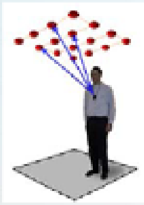
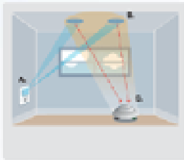




Robot Location

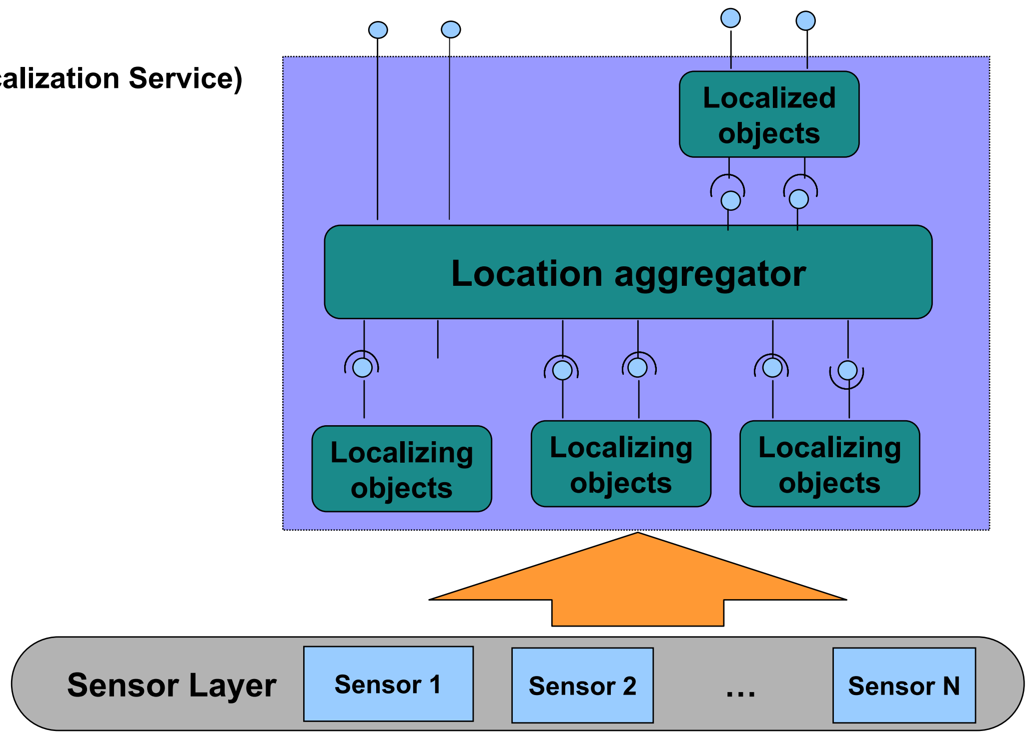


Odometry using Shaft Encoder	Inertial Navigation	Visual Odometry	Odometry using Speed Sensor
Incremental Optical Encoders  $\Delta x_{k+1} = A_k \Delta x_{k-1} + F_k \Delta v_k + \Delta w_k$	Melboy  Fuse Gyro and Encoder [1]	JPL, Mars Exploration Rover 	M113 Ground Surveillance Vehicle [Harmon, 1986] 
• Pros • Good short-term accuracy • Inexpensive • High sampling rates • Totally self-contained • Cons: • Sensitive to terrain or wheel • Error accumulates	•Pros • Good short-term accuracy • Inexpensive • High sampling rates • Totally self-contained •Cons: • Error accumulation	• Pros • Insensitive to terrain or wheel • Error does not accumulate V_L •Cons: • Expensive	•Pros • Insensitive to terrain or wheel • Error does not accumulate •Cons: • Expensive

Active Beacon		Landmark		Model Matching
❑Trilateration of active beacons – Measure the distances to beacons (ex. GPS, The Bat System)  http://www.cl.cam.ac.uk/Research/DTG/research/wiki/BatSystem	❑Triangulation of active beacons – Measure the direction of incidence of beacons (ex. used for ship navigation, civil engineering)	❑ Artificial landmark recognition  http://www.evolution.com/products/northstar/works.masn	❑ Natural landmark recognition –Using image features or range data  Samsung SHR-100	❑ Geometric – 3D data in a global coordinate system ❑ Topological – Networked nodes and arcs
•Pros •Accurate •Reliable •High sampling rates •Cons: •Expensive •Need extra installation and maintenance	•Pros •Accurate •High sampling rate •Inexpensive •Cons •Work in small area	•Pros • Accurate • Unique Position •Cons •Accurate only when marks are close • Need extra installation and maintenance	•Pros • Free from extra installation and maintenance •Cons • The environment must be known • High computational cost	•Pros • Free from extra installation and maintenance •Cons • Depends on the accuracy of the map and features •High computational cost

An Example of LS Structure

LS (Localization Service)



Mandatory Requirements

- Provide PIM and at least one specific PSM of LS
  - **Proposals shall specify general mechanism for accessing the location information of objects.**
    - Proposals shall specify a set of necessary parameters to represent the location of objects including position and associated entries.
    - Proposals shall specify the format of the structures used to present:
      - Location data, Coordinate Systems, Reference Frame
  - **Proposals shall specify generic interface for modules that perform location calculation.**
    - Each module shall provide interfaces to supply its generated location data to other modules.
    - Advertising what type of object / what object can be localized
    - Registering new objects
    - Accepting localization request
    - Publishing the localization process result
    - Advertising what kind of sensor data can be used, what sensors are used
  - **Proposals shall specify the interface of a facility that provides functionalities related to:**
    - Managing the different coordinate systems and frames defined in a robotic system, as well as their physical relationship
    - Managing the different localizing objects available in the robotic system
    - Managing the different localized objects present in the system
    - Providing a conversion of a location from one Coordinate System/ reference Frame/ Unit System tuple to another
    - Aggregate multiple location sources into one final position, using pluggable location fusion algorithms.

Optional Requirements

- None

Issues to be discussed

- A proposal shall
  - Demonstrate its feasibility by using a specific application based on the proposed model
  - Demonstrate its applicability to existing technology such as RTLS (Real-Time Location System)
  - Discuss simplicity of implementation
  - Discuss the possibility to apply the proposed model to other fields of interest such as Sensor Network
  - Discuss the possibility of providing standard mechanism to access map data.
  - Specify on-the-wire protocol communication technology independent

RoSta

Robot Standards and Reference Architectures
for Service Robots and Mobile Manipulation

Erwin Prassler

B-IT Bonn-Aachen Int. Center for Information Technology
Applied Science Institute
Grantham-Allee 20, 53757 St. Augustin, GERMANY
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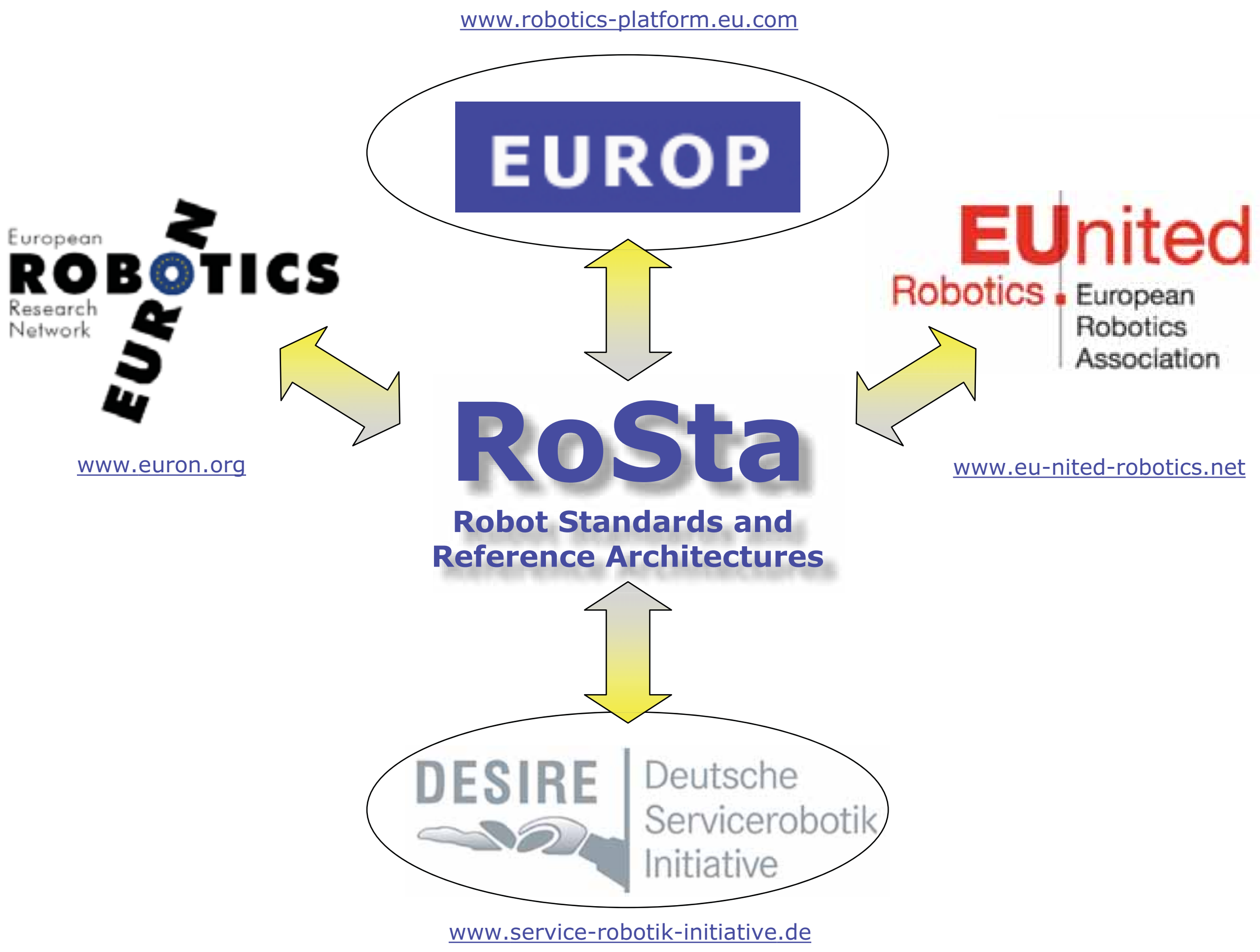


RoSta's Overall Mission

RoSta

Mission

- **Europe as key player** in the definition of formal **standards** and the establishment of **"de facto" standards** in the field of **robotics**, especially **service robotics.**
- Formulation of **action plans** for defining standards in a very few, selected **key topics** which have the highest possible impact.
- Form the **root of a whole chain of standard defining activities** going beyond the specific activities of RoSta.

Topics

- **Glossary/ontology** for mobile manipulation, service robots
- Specification of a **reference architecture**
- Specification of a **middleware**
- Formulation of **benchmarks**

Profile of RoSta

RoSta

- Relation: FP6, Priority 2: "Information Society Technologies", 6th Call, 2.6.1 Advanced Robotics; Contract IST-045304
- Duration: Jan. 1st, 2007 to Dec. 31st, 2008 (24 months)
- Budget: ~ 1 MEUR
- Project Lead: Fraunhofer IPA
- Project office: GPS Stuttgart

No.	Partners	Role
1	FhG-IPA	Coordinator, Lead WP4 "Benchmarks for Mobile Manipulation and Service Robots"
2	FHBRS	Lead WP3 "Middleware for Mobile Manipulation and Service Robots
3	LTH	Lead WP2 "Reference Architecture for Mobile Manipulation and Service Robots"
4	UVR	Lead WP1 "Glossary/Ontology for Mobile Manipulation and Service Robots"
5	Sagem DS	Cooperation RoSta and CARE (EUROP), contributions to architecture and benchmarking WPs
6	GPS	Lead WP MA "Management", set-up, maintenance of project infrastructure, controlling, etc.
7	VISUAL	Knowledge hub, contribution to ontologies and architectures/middleware WPs
8	EUnited	Multiplier to European robotics industry, coordination with standardization initiatives

Ultimate RoSta Deliverables

RoSta

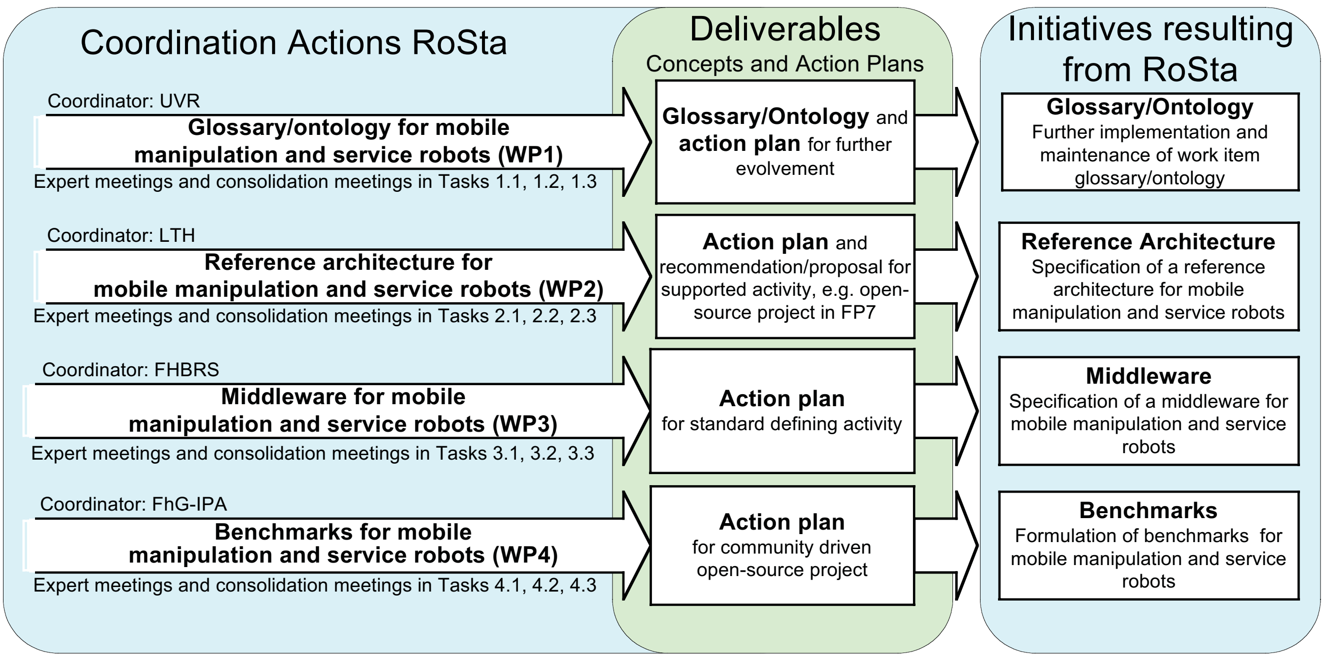
Each line of activity will result either in:

- An **action plan** for a **standard defining activity** or
- An **action plan and a recommendation/proposal** to the European Commission for a **supported activity** (e.g. a open-source project with financial support in FP7) or
- An **action plan for a community driven** open-source activity with seed-money for example to run a project office or alike

  - "Challenge 2: Cognitive Systems, Interaction, Robotics" (~€195m), future calls
  - FET

RoSta Overall Structure

RoSta



The RoSta Workplan

RoSta

WP i.1 State of the art

- T0+1 Expert meeting (6-8 experts)
- T0+3 Expert meeting dito
- T0+5 Expert meeting dito
- T0+7 Consolidation meeting with all stakeholders

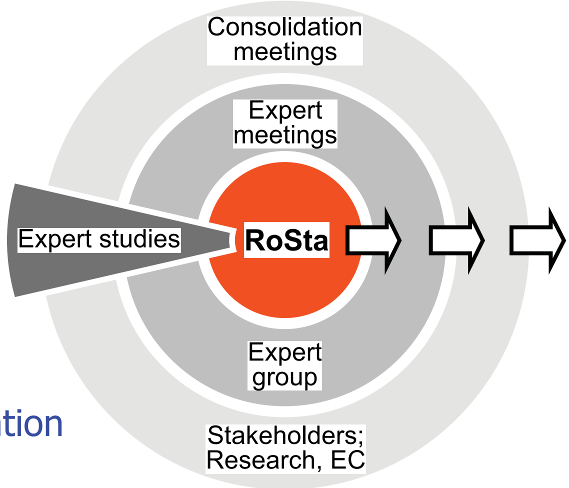
WP i.2 Requirement analysis

- T0+7 Expert meeting (6-8 experts)
- T0+9 Expert meeting dito
- T0+11 Expert meeting dito
- T0+13 Consolidation meeting with all stakeholders

WP i.3 Action plan and recommendation

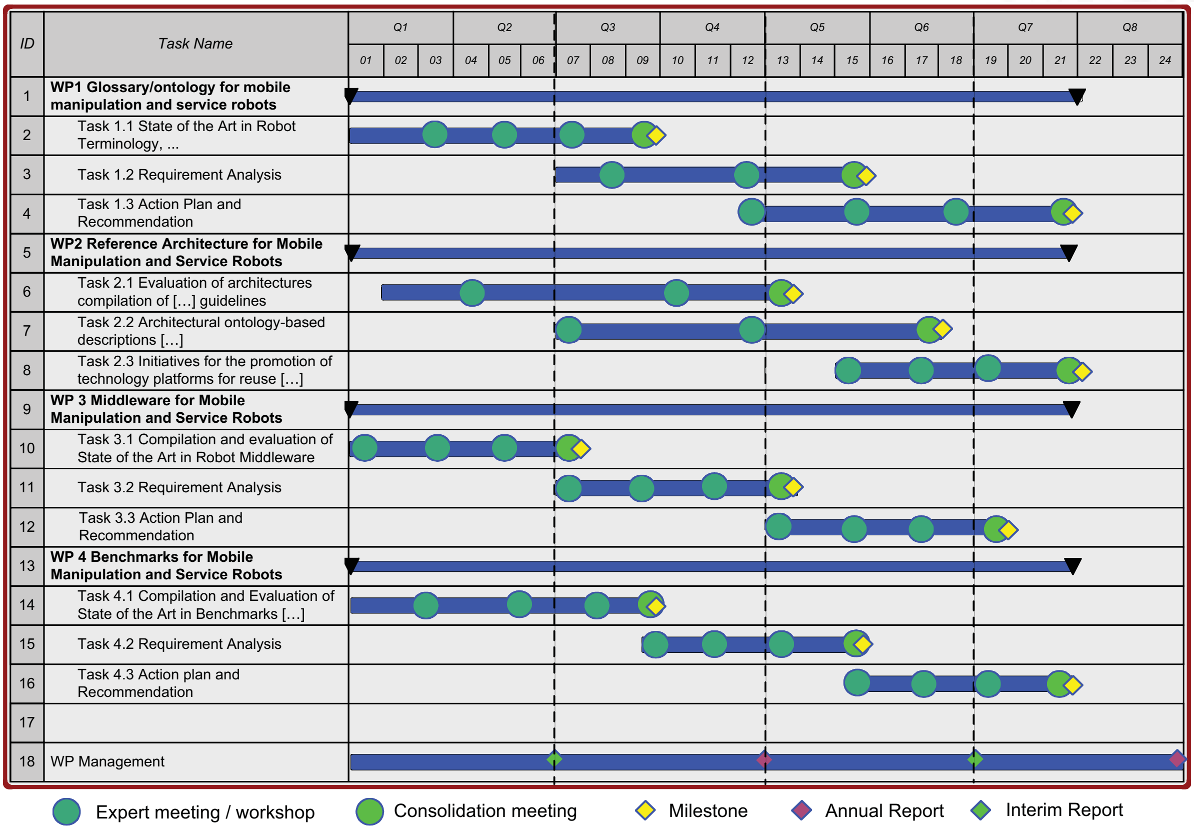
- T0+13 Expert meeting 6 - 8 experts
- T0+15 Expert meeting dito
- T0+17 Expert meeting dito
- T0+19 Consolidation meeting with all stakeholders

T0+20: compilation of reports etc.



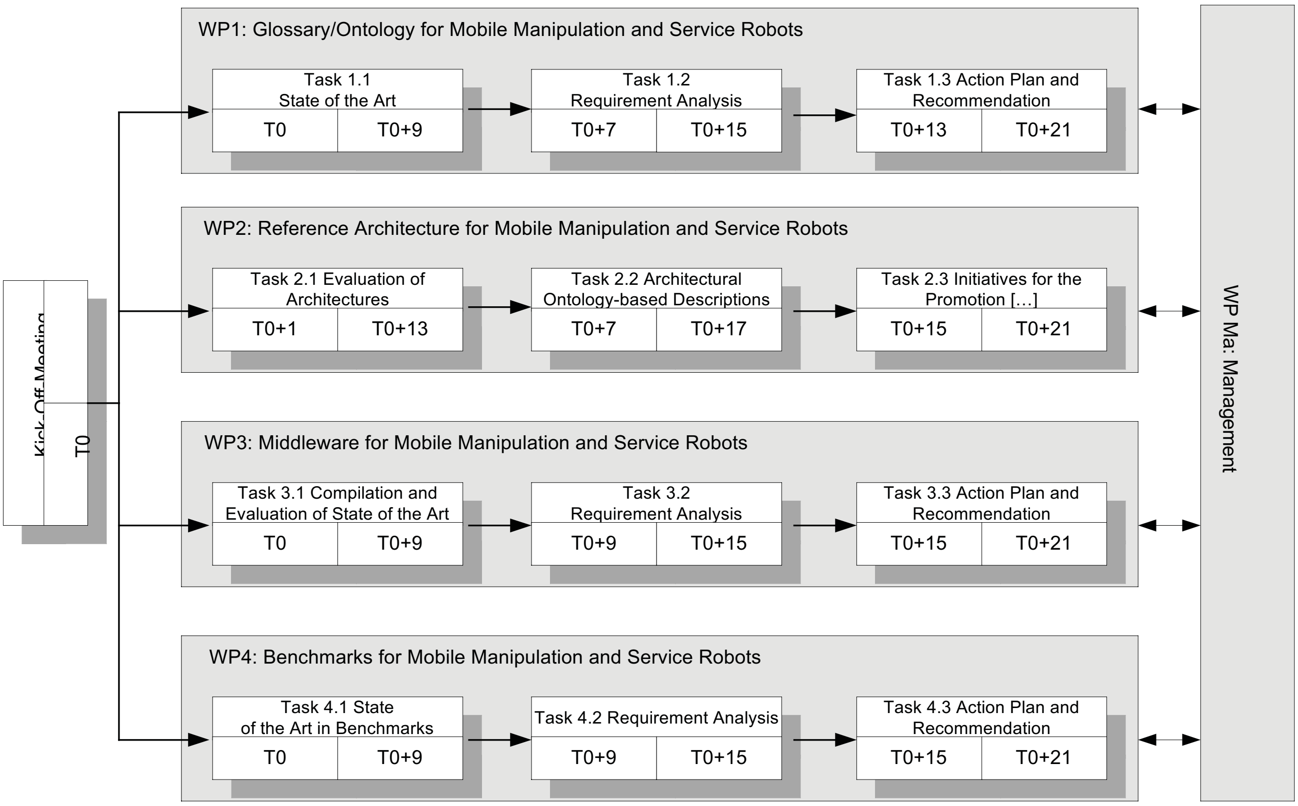
RoSta Overall Time Line

RoSta



RoSta Overall Structure

RoSta



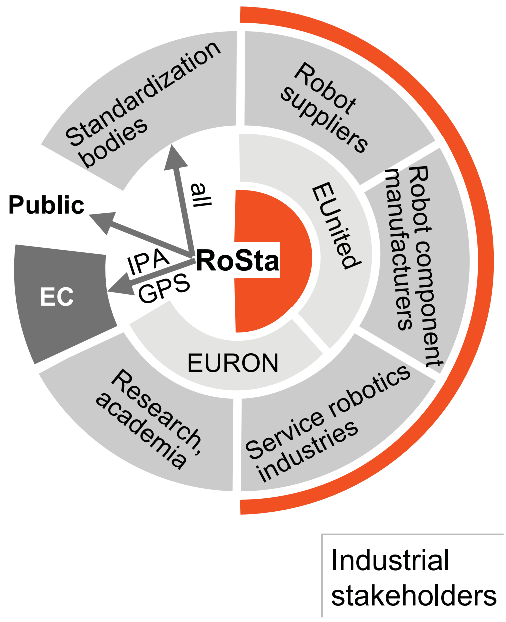
Selection of Experts

RoSta

Criteria:
- Unbiased
- Reliable
- Key-players

Two-step selection process:
- Public announcement and CFP
- Select 8-10 experts/activity

Expert participation:
- Contribution to RoSta Wiki
- Attending at expert meetings and work shops



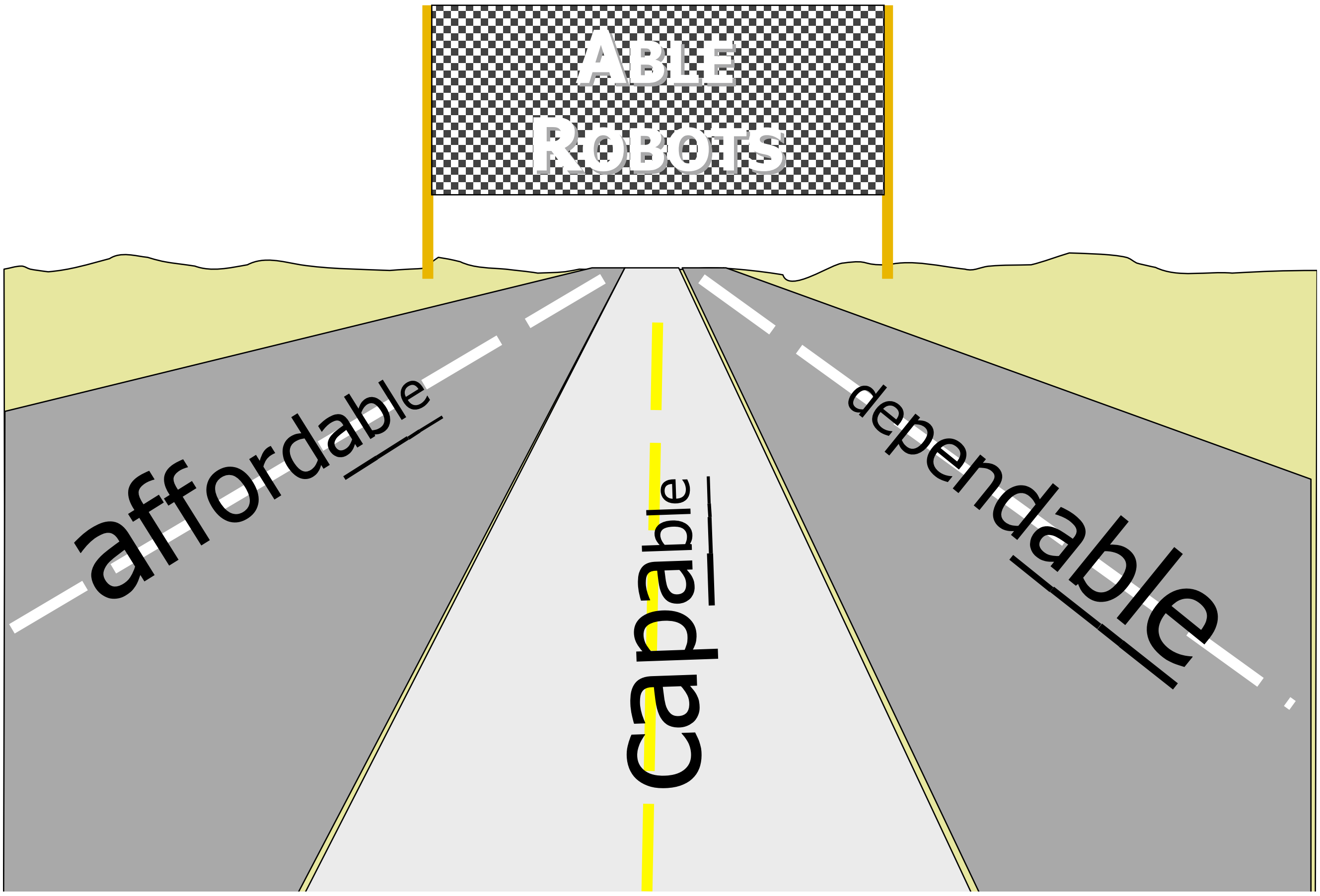
DESIRE

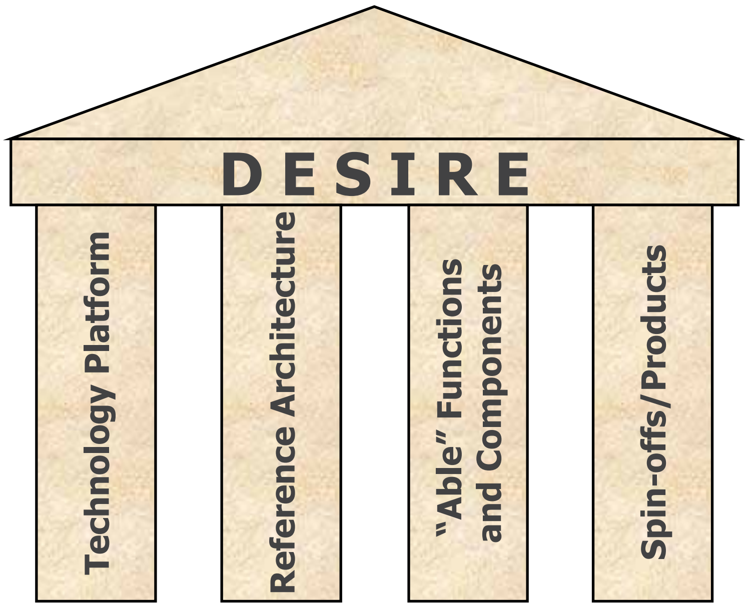
German Service Robotics Initiative

Kick-off:	Oct. 1, 2005
Consortium:	7 research labs + 6 companies
Budget:	9,5 MEUR
Duration:	4 years (3+1)
Project Lead:	Prof. Rolf Dieter Schraft Prof. Erwin Prassler

Objectives

- ⇨ **convergence of technologies** via technology platform
- ⇨ development of a **reference architecture** for service robot
- ⇨ technology leap towards **"able" key functions**
- ⇨ technology leap towards **"able" key components**
- ⇨ new spin-offs/products





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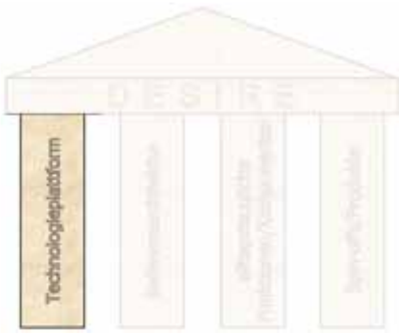
Technology Platform
„Able Service Robots in the Everyday"



Motivation and Objectives

- promote convergence of technology by integration and thereby accounting for
  - re-usability
  - scalability: from simple domestic robot to Personal Robot
  - accessibility
- scientific value of integration
- platform (highly complex system) as innovation engine
- standardization of hardware interfaces
- **<u>the</u>** test platform for benchmarking of able functions and components

Technical Challenges

- heterogeneity of components
- bandwidth in complexity of components
- openness and accessibility
- self-modeling, -monitoring, -diagnosis

Technology Platform "Able Service Robots in the Everyday"

as catalyst for the convergence of technologies in the area of dependable system architecture, perception manipulation, mobility, interaction and communication.

Design study Technology Platform

Hardware specification

- omni-directional mobile platform
- body
- two arms (=7 DOF)
- two hands (≥3 fingers)
- sensor head
- sensor (vision, 3D, color)
- interfaces to ambient intelligence

Responsibility: <u>IPA</u>/AIS/Neobotix

Indicators for everyday capability

- perception: common objects (rigid, static)
  number of objects > 100, natural light
- environment: natural, crowded (indoor-)environments
- velocities: natural, "intuitive" velocities

Functions (exemplary)

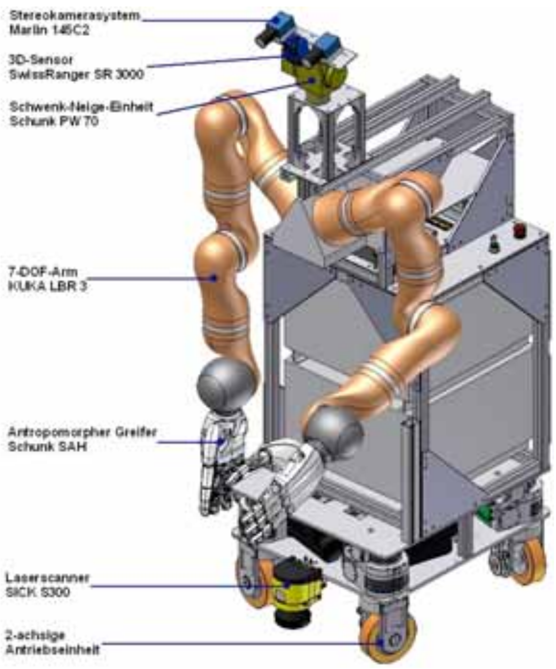
- collision-free locomotion of complex kinematic structures in dynamic environments
- fetch & carry services
- open doors and drawers
- grasping and bin picking
- cleaning out and putting away
- processing surfaces
- interaction with humans
- teaching, instructing, installing in the context of a specific application (objects, environments, tasks)

Architecture and system design

- reference architecture (Middleware/integration frameworks)
- robust autonomy, self-modeling, self-awareness
- control paradigms and architectures

Technology Platform “Able Service Robots in the Everyday”

as catalyst for the convergence of technologies in the area of dependable system architecture, perception manipulation, mobility, interaction and communication.



CAD-model of first prototype

Approach

- specification of application scenarios and benchmarks
- conceptualization of technology platform
- assembling, integration and launch of first prototype (Feb. 07)
- assembling of final platform (in year 3)
- evaluation and optimization (in year 4)

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RoboCup

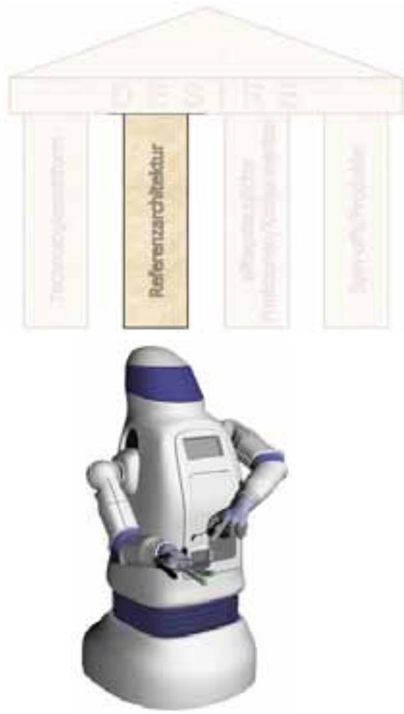
RoboCup Federation Call for Tenders: A Standard Robot Platform for Robot Soccer

RoboCup is an international joint project to promote Artificial Intelligence, Robotics and related fields. It is an attempt to foster AI and intelligent robotics research by providing a standard problem where a wide range of technologies can be integrated and examined. RoboCup chose to use the game of soccer as a central topic of research, aiming at innovations to be applied for socially significant problems and industries.

The RoboCup competition includes leagues of different kinds of robots. Teams in the four-legged robot league use a standard robotic platform. The difference between the teams is in the game-playing software that they devise. The current platform is Sony’s Aibo entertainment robot. The RoboCup Federation is seeking expressions of interest for a new platform to succeed the Aibo. The characteristics being sought are:

- A standard platform
    - No hardware development should be required of the teams. Indeed, no hardware modifications should be allowed.
    - The robot must have an operating system and software development environment allowing full control of sensors and actuators.
    - The platform should be modular, permitting upgrades and modifications from year to year.
- Many degrees of freedom
    - Quadruped robots allow for a large variety of gaits and kicks. The new platform need not be a quadruped but it should have a sufficient number of degrees of freedom that teams can create interesting new behaviours and modes of locomotion.

Reference Architecture
„Able Service Robots in the Everyday”



Motivation and Objectives

- integration of heterogeneous modules
- interchangeability of modules
- re-usability

Challenges

- coordination of a multitude of technical components and their behaviors
- robustness
- self-modeling, monitoring, diagnosis
- maintainability
- integration of hybrid control paradigms

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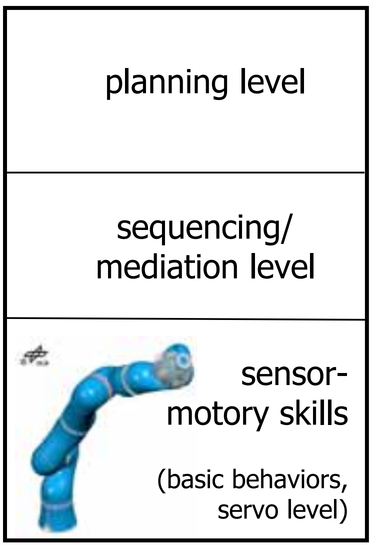
Reference Architecture
"classical" hybrid control architecture



- Panning level
  model based, operates on pre-/ post-conditions and symbolic "actions"
- Sequencer
  - contains programs, which translate actions in sequences or "network" of skills
  - integration language ~ programming language of the sequencer
  - interface description language ~ language in which the functions of the skills are invoked
- Skills, behaviors, level
  encapsulates elementary (reactive) robot functions

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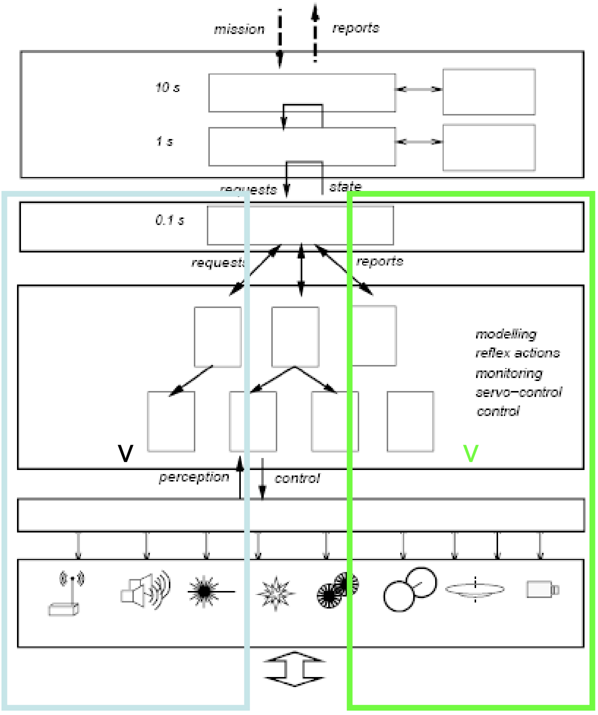
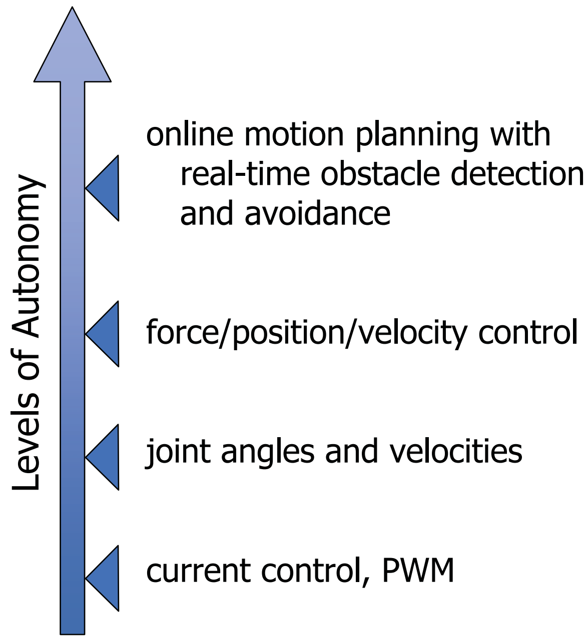
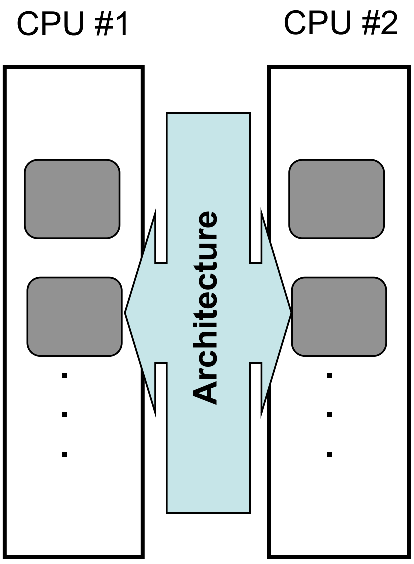
Reference Architecture
"classical" hybrid control architecture vs. "market" requirements



Reference Architecture
"classical" hybrid control architecture vs. "market" requirements



Reference Architecture
Software Component Architecture



- building components is an established software-engineering practice to reduce the system complexity
- architecture defines the cooperation of the components
- abstract interface description language
- apply distributed systems methods for performance and fault tolerance

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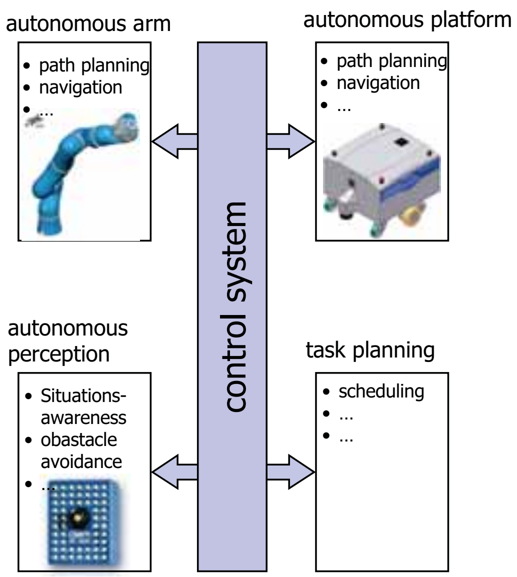
Reference Architecture
DESIRE Approach: Architecture of Autonomous Components



- subsystems react „autonomously" to sensor input
- a component may comprise several "classical" levels

  ➔ *architecture of autonomous components*
- component based „execution monitoring"
- components may return „wish lists"
- subsystems are temporarily part of a common control loop (coordinated, cooperating)
- coordination has to take place under real-time conditions

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Reference Architecture
First activities and “results”

- Architectural concept of „autonomous components‟
- B-IT Tutorial “Middleware and Integration Frameworks for Service Robots and Mobile Manipulation” with international experts in the area of Robot Middleware
- Workshop “Measuring and Comparing Robot Architectures‟ (in preparation)
- Special Issue IEEE Transactions on Robotics (in preparation)
- Set up of IEEE Robotics and Automation Society Standards Committee
- Coordinated Action RoSta (Robot Standards and Architectures) (in FP6 Advance Robotics)

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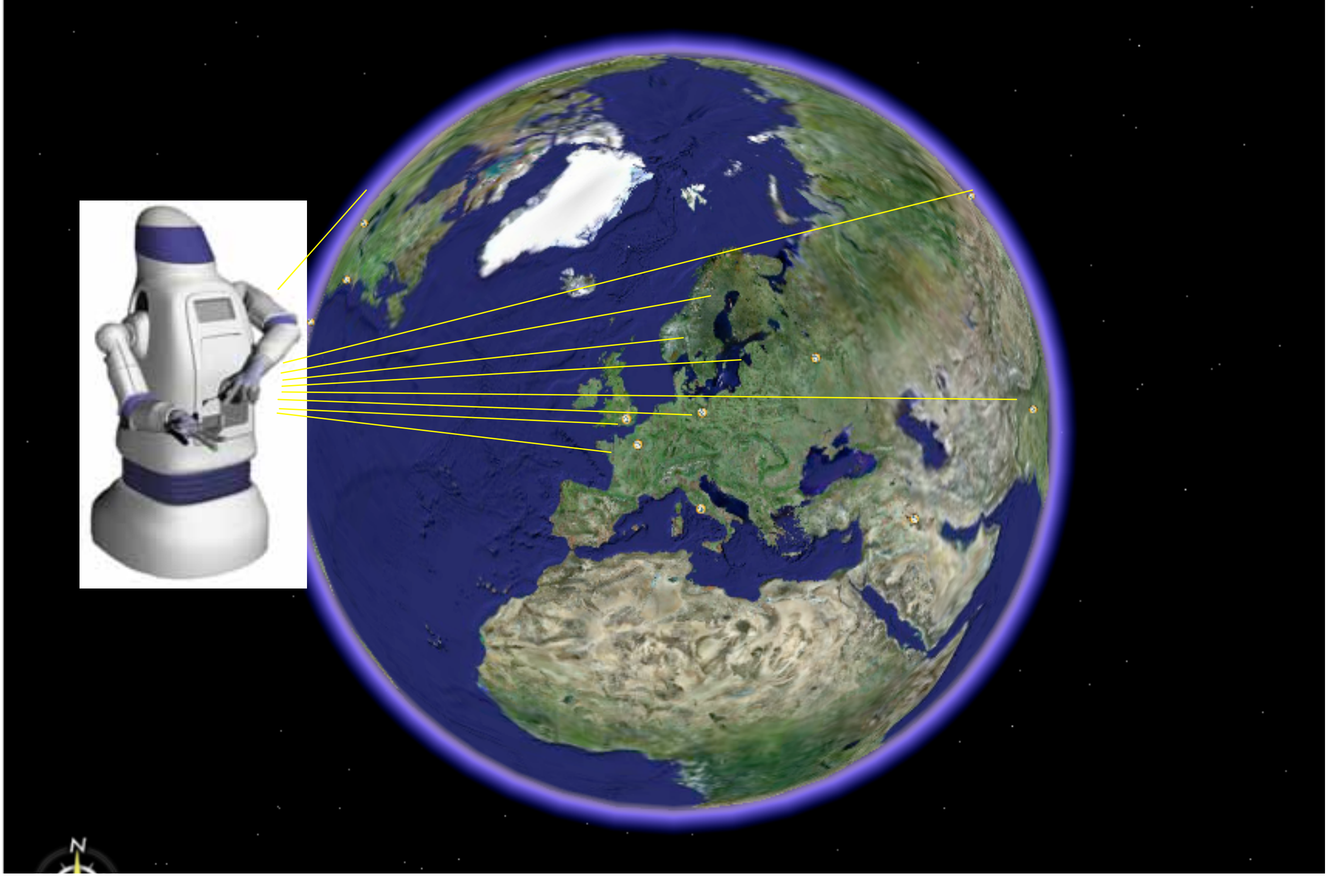
Vision: “open”DESIRE



Vision: "open"DESIRE

„open" technology platform

\+ reference architecture for service robots

"open"DESIRE

Involve robot labors from all over the world in the specification and development of reference architecture and platform

- Germany (Projects "Leitinnovation Service Robotics")
- Europe (e.g. LAAS (France), Helsinki Univ. Technology (Finland), Univ. Leuven).
- Japan, South Korea
- Developing countries like India, China, Brazil

as early as possible as „reference"

AND

as Co-designer e.g. of perception, grasp, manipulation skills or planning methods („best practice")

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The End

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robotics/2007-03-21

San Diego 2007 Mar 26-28

OMG Robotics DTF
Robotic Devices & Data Profile WG
Progress Report

Seung-Ik Lee and Bruce Boyes, co-chairs

2006 Washington Meeting Summary

1. Presentation on IEEE-1588
2. Presentation on IEEE-1451
    1. Plan to support TEDs in our specification
        1. Store our tagging data in XML form
        2. Support 1451-compliant access methods to our tag data
3. Monday we worked on a draft RFP
    1. Draft of programmer API view is mostly complete
    2. We had some discussion of whether we need a separate
        1. RFP for the hardware-view, or if it can be included.
    3. We will present this RFP draft now...

2007 San Diego Meeting Summary

1. Monday & Tuesday we worked on a draft RFP
   1. Internal review
      1. A process or guidelines are necessary for adopting of new devices
      2. Reordering mandatory requirements in a logically meaningful order
         1. Classification (categorization) comes first
         2. By using the classification method, abstract interfaces are defined
   2. We need some comparison of related standards

2007 San Diego Meeting Summary

1. Monday & Tuesday we worked on a draft RFP
   1. Who's going to be submitters?
      1. ETRI
      2. Samsung elec. (?)
      3. Systronix
      4. AIST (?)
      5. Kangwon Univ (?)

WG actions prior to Brussels meeting

1. Comparison table of other related standards
   1. By Seung-Ik Lee
   2. Concentration on relation with our RFP
   3. Presentation at the Brussels meeting
2. Draft RFP
   1. By Bruce Boyes (in working)
   2. 1st review in Brussels
3. Seek for candidate submitters
   1. Still in double who's going to submit when the RFP is ready

Robotics Devices and Data Profiles WG Road Map

Item	Washington DC Dec, 2006	San Diego Mar, 2007	Brussels Jun, 2007	Florida Sep, 2007	Burlingame Dec, 2007
Programmers API: Typical device abstract interfaces and hierarchies	Outline draft RFP	Internal Review	1st review	2nd review & issue	Response
Hardware-level Resources: define resource profiles	Outline draft RFP	Internal Review	1st review	2nd review & issue	Response

Profile WG Mail List

- Please use the WG mail list for all profile communication, by sending to:

  omg-profile@m.aist.go.jp

- First: to join, send a message from your email with the subject “subscribe {your name}” and be sure to always post to the list with that same email address.

robotics/2007-03-22

- OMG Robotics DTF-

- Robotic Functional Services Working Group -

Meeting Report

- San Diego TC Meeting -

San Diego (California, USA) – March 28, 2007

Co-chairs : Olivier Lemaire (olivier.lemaire@aist.go.jp) / Soo-Yong Chi (chisy@etri.re.kr)

Schedule

- **Monday**
- PM 13:00 - 13:15 : Welcome - Roadmap presentation
- PM 13:15 - 13:45 : *"Short Introduction to the ISO19100 Specifications"* -Olivier Lemaire (AIST)
- PM 13:45 - 14:15 : *"A brief Report for ISO 19116 Positioning Service Standard"* - Dr Han (ETRI)
- PM 14:15 - 14:40 : *"Need for position data quality indication for Agricultural robots"* - Dr Nagasaka (NARC)
- PM 14:40 - 15:10 : *"Introduction to Localization related projects at JST"* - Dr Tomizawa (AIST)
- Coffee Break
- PM 15:20 - 16:00 : *"Ultrasonic 3D tag system for robot localization"* – Dr Hori (AIST)
- PM 16:00 - 16:40 : *"Experience using ISO19100 in Robotic Systems"* - Dr Noda (AIST)
- PM 16:40 - 17:30 : Discussion

- **Tuesday**
- AM 10:00 – 11:10 : Discussion (cont'd)
- AM 11:10 – 11:30 : *"Introduction to User Identification Service"* – Dr Chi (ETRI)
- AM 11:30 – 12:00 : Roadmap review, Homework, Next meeting WG Schedule
- PM 14:00 – 17:00 : Localization Service RFP 1st Review

- **Wednesday**
- PM 16:00 – 17:00 : WG Reports and Roadmap Discussion

Discussion Topics

Localization Service for Robotics

- Our stance regarding to ISO19100
  - The mini workshop allowed for every member to better understand the scope and content of ISO19100 specifications
  - Many concepts addressed by ISO also apply to robotics but most of their application are not suitable for robotics (insufficiencies in data model, complexity, too GPS centric)
  - While getting inspiration from the ISO spec, every members of the WG agreed there is still a need to develop a standard more consistent with actual localization practices in the robotics community)
- Assert that our focus for RFP is in line with needs of businesses
  - A concern was raised that by focusing too much on large scale robotic system integration (which is still at a research level), the needs of existing businesses (still mainly focused on the development of single bodied (mobile) robots may not be covered, making the standard of limited use.
  - We tried to demonstrate the two approach where not incompatible and that a single framework could well cover the needs of both robot developers and system integrators
  - Several organizations (at least 4) expressed their interest in responding to the RFP as it presently is, including industrial stakeholders (Samsung)
- See RFP Presentation

Discussion Topics

User Identification Service for Robotics

- Dr Chi…

Roadmap

Item	Status	San Diego Mar-2007	Brussels Jun-2007	Jackson ville Sep-2007	Burlingame Dec-2007	Wash. DC Mar-2008	Ottawa Jun-2008	TBD Sept-2008
Localization Service	On-going	RFP 1st Review	RFP 2nd Review Issuance		Init. Submis. 1st Review		Revised Submis.	Adoption
User Identification Service	On-going	Topic Discussion	Discussion	RFP 1st Draft	RFP 2nd Draft	RFP 1st Review	RFP 2nd review	RFP Issuance

Schedule for next meeting (Tentative)

- **Sunday**
- PM 13:00-18:00 : Localization Service RFP pre-review meeting

- **Monday**
- AM 10:00 – 12:00 : Robotics DTF Plenary second review VOTE Required !!!
- PM 13:00 - 17:00 : Robotics Information Day (Presentation Schedule TBD)

- **Tuesday**
- AM : Localization Service RFP Presentation to C4I DTF (Joint meeting with C4I)
- PM : Localization Service RFP Second Review

- **Wednesday**
- AM 15:00 – 16:00 : WG Reports and Roadmap Discussion
- PM 17:00 -> Thursday 09:00 : Rewrite RFP

- **Thursday**
- 09:00 : 10:00 : RFP “3rd” review VOTE Required !!!
- Localization Service RFP Presentation to Architecture Board

KIRSF – Contact Report

Robotics DTF (San Diego Meeting)
Date: March 28, 2007
Reporter: Yun Koo Chung

1. KIRSF Standardization Activities

– Feb 27th, 2007: Coordination Committee (CC) Plenary meeting

. 5 Standards approved: 4 standards are for safety guide and specs. And one for service modeling language.

– March 21st, 2007: Personal Service Robot Committee Plenary meeting

. 37 standards projects discussed

. Testing and evaluation

. Safety guide of robots

. Specifications for URC such as middlewares, HRIs, ..

. Quality Certification Test Criteria for URC Robots

※ KIRSF: Korean Intelligent Robot Standardization Forum

KIRSF – Contact Report

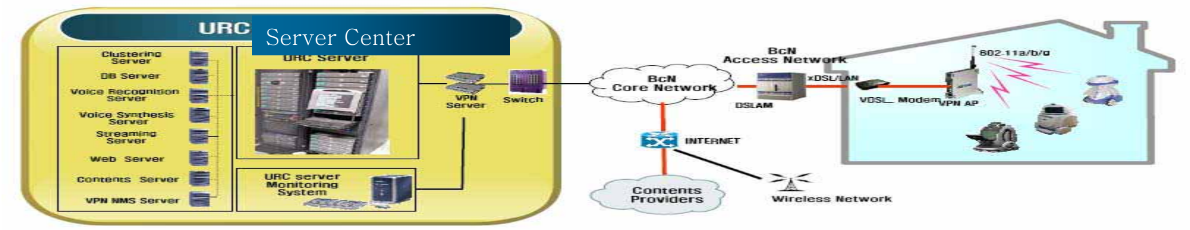
Robotics DTF (San Diego Meeting)
Date: March 28, 2007
Reporter: Yun Koo Chung

Analysis of KIRSF Standards in 2006

	Types	Details	Number of standards
1	Vacabulary	Terminology	1
2	Performance measure	Cleaning robots, location, mobility, motor, camera, battery	8
3	safety	Service robots	1
4	interface	Logical devices, motors, robot & home network	4
5	HRI	User-identification	1
6	Language	Service modeling language, voice commands,..	4
7	URC protocols	Communication protocols, message, object info., .sense representation	5

KIRSF – Contact Report

Robotics DTF (San Diego Meeting)
Date: March 28, 2007
Reporter: Yun Koo Chung



2. URC network robots in Pilot business in the first year

- URC home service robots were tested by TTA.
- 850 home service robots and 20 public service robots have been serviced by KT company from October, 2006.
- Satisfaction Survey to the URC services :
  - 70% of users for public service robots are satified.
  - Service functions for personal home service robots need to be improved more.
- Established for commercializing environments for URC robots
- Authentication test is very important for quality assurance of services

Contact Report

Contact of ISO/TC 184/SC 2
Makoto Mizukawa
Shibaura Institute of Technology

ORiN and RAPI
(Middleware for Industrial Applications)

- ORiN (Open Resource interface for the Network)
- RAPI (Robot communication framework and Application Program Interface) [subset of ORiN]
  - the presentation on RAPI was made at the ISO/TC 184 plenary meeting in Madrid 9-10 October 2006.
  - New Work Item Proposal was submitted on 31 Oct 2006.
    - Voting due: 20 Feb 2007
    - Liaison TC184 SC1/WG7,SC4/WG3/T24,SC5/WG6

RAPI voting result

- ISO/TC 184 / SC 2 Doc#N 534
  - 18 P-members
- Not approved
  - 6-Y, 3-N, 2-Abstentions, 7-No vote
  - 4-express participation to the WG <5 for qualify

the next ISO/TC 184/SC 2 meeting

- 7 and 8 June, 2007
- Washington DC
- The dates 4-6 June are reserved for PT (Project Team) 10218, the new Project team *PT Robots in personal care* and Advisory Group *AG Service robots*, but these meetings are to be confirmed
- The following week, 11-15 June 2007, the International Robots and Vision Show will take place in Chicago, including the ISR and IFR meetings.

ISO/TC184/SC2

- AG1: Advisory Group in *Service Robots*
- PT2: Project Team for *Robots in Personal Care*

- ISO TC 184/AG meeting
  - La Plaine Saint-Denis (AFNOR's building), 2007-01-19

Plenary Meeting in Madrid (2006-10-09/10), ISO TC 184

- approved the change in scope & title for ISO TC 184/SC 2 (Resolution # 430) ,
- recognised that its standards were being applied beyond the current scope of ISO TC 184 ,
- and invited its SCs to propose their requirements for a new TC title and scope to be submitted as a proposal to ISO/TMB (Resolution # 431),

Resolution 447
Title and scope of ISO TC 184

- **TC 184 approves the new title and scope of ISO TC 184 as proposed by its Advisory Group (Recommendation 2007-7):**
- *Automation systems and integration*
- *Standardization in the field of automation systems and the integration of those systems for design, sourcing, manufacturing and delivery , support, maintenance and disposal of products and their associated services. This standardization encompasses the application of multiple technologies, such as information systems, machines, equipment, robotics for fixed and mobile robots in industrial and non-industrial environments, automation & control software, multi-media capabilities, and multi-modal communications networks.*

Resolution 447 (cont'd)
Title and scope of ISO TC 184

- *Excluded are base standards in the following areas:*
  - Electrical and electronic equipment as dealt with by IEC TC 44
  - PLCs for general application as dealt with by IEC TC 65
  - multi-media capabilities as dealt with by IEC TC100
- **and requests its secretariat to submit them to the ISO/Technical Management Board for review and approval.**

Resolution 430 (Madrid 7) SC 2 title and scope

- Title: Robots and robotic devices
- Scope: Standardization in the field of automatically controlled, reprogrammable, manipulating robots and robotic devices, programmable in more than one axis and either fixed in place or mobile.
- Excluded: Toys and military applications.

ISO TC184/SC2 Contact change

- JARA named Dr. Tetsuo Kotoku as a AG member of TC184/SC2 instead of Prof. Mizukawa in the ISO TC 184/AG meeting at La Plaine saint-Denis (2007-01-19)
- OMG contact to ISO TC184/SC2
- → Dr. Chug and Dr. Kotoku

IEEE ICRA 2007 Workshops Rome, Italy, April

- 2007 IEEE International Conference on Robotics and Automation
  - 10-14 April 2007
  - http://www.icra07.org/
- [SF-5] SDIR 2007 : April 14th 2007
  - Second International Workshop on Software Development and Integration in Robotics
  - *Understanding Robot Software Architectures*
  - http://robotics.unibg.it/tcprog/sdir2007/
- [SF-2] Network robot systems: ubiquitous, cooperative, interactive robots for human-robot symbiosis
  - http://www.irc.atr.jp/icra07_nrs_workshop/

Coming conferences

- 2007 IEEE/RSJ International Conference on Intelligent Robots and Systems (**2007 IROS**) http://www.iros2007.org/
- Sheraton Hotel, San Diego, CA, USA
- Oct 29-Nov 2 2007
- Important Deadlines
  - February 28, 2007 Proposals for Invited Sessions
  - **April 9, 2007 Submission of full-length papers and videos**
  - **April 25, 2007 Proposals for Tutorials/Workshops**
  - July 11, 2007 Notification of paper and video acceptance
  - August 11, 2007 Submission of final camera-ready papers

Coming conferences cont'd

- 2007 International Conference on Control, Automation and Systems (**ICCAS 2007**) **www.iccas.org**
- the COEX in Seoul, Korea, October 17 - 20, 2007
  - Organized by ICASE(The Institute of Control, Automation, and Systems Engineers)
  - Technically Co-sponsored by IEEE IES, RAS and CSS
  - April 15, 2007: Submission of Organized Session Proposal
  - April 30, 2007: Submission of Extended Abstracts
  - June 15, 2007: Notification of Acceptance
  - July 31, 2007: Submission of Final camera-ready Papers

Open Robot Controller Research and Its Standardization in China

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Abstract **- An open robot control system pursues easy extension, flexible reconfiguration, facile portability and jointless interoperation. Therefore, the system elements from multi-disciplinary areas can be integrated and reconfigured easily in such a system. Also the system modules can be ported flexibly. In this paper, a Rt-linux based open robot controller (RTOC) is investigated. A reference model for robot controlling is proposed, in which hardware platform, operating system module and application modules are included. Then for the implementation of RTOC, two critical implementation problems— layered architecture and the intra-layer interfaces are discussed on the base of its reference model. The RTOC openness is also analyzed. Consequently, the proposed RTOC is applied to an industrial arc welding robot. Finally, the standardization work of robotics in China is illustrated.**

Index Terms **- Open systems, Real time systems, Robot programming, Robotics**

I. INTRODUCTION

A robot system should own the ability to integrate different elements from multi-disciplinary areas. Meanwhile, it should be able to provide the designers with well-defined methods for upgrading the overall structure of the application through its entire development cycle. That is to say, it pursues an open robot controller, which permits easy extension, flexible reconfiguration, facile portability and jointless interoperation of diverse robot control elements [1-8].

The elements involved in a control application can usually be divided into three parts: *application software module*, *operating system module* and *hardware platform module* [1]. The application software always runs on some specific operating system. Its openness relates to the operating system closely. How to integrate multidisciplinary elements on some operating system is an important problem to be studied. However, hardware devices are always vendor-dependent. The compatibility of hardware devices from various vendors is another important problem to be focused. So the system integration and compatibility are the two main difficulties in realizing an open control system.

In order to overcome the incompatibility of hardware devices originating from various vendors, standards for control systems in automation area have been proposed by a number of organizations. Because some hardware and software have to be abandoned in such standards, so it has not got much attention [11].

As an alternative method, researchers have focused on developing an open architecture control system. Also several successful research results such as OMAC (Open Modular Architecture Controller), OSEC (Open Systems Environment for Control) and OSACA (Open Systems Architecture for Controls), have been presented. OMAC instigated by GM, Ford, etc specifies the requirements for the manufacturing equipment used in the automotive industry [12]. OSEC has been suggested as an open architecture reference model for open architecture NCs and FA systems [13]. However, OSACA has been presented as a reference platform for FA systems [14].

On the base of OSACA, some open architecture controllers have been presented, such as NEXUS [1, 2] and PC-ORC [11]. Also other control systems with open ideas have also been presented sooner or later such as NASRAM [15-18], $G^{en}{}_{o}M$ [9], ORC [3], etc.

In order to overcome the limits in modern open control systems, an Rt-Linux based open control system (RTOC) is proposed in this paper. It is a kind of open integration system, which can integrate different function modules, upgrade or extend hardware device drivers, port existing modules to other systems and preserve jointless interoperation. It reduces the development and maintenance costs. At the same time, the system complexity is reduced and the system modularity and reusability are improved. RTOC is also used for controlling an industrial arc welding robot in our lab.

As a typical open control system, RTOC is a kind of software integration system, which encompasses the following properties: *extensibility*, *portability*, *scalability* and *interoperability*:

Extensibility: Any system element (a software module or hardware device) which meets the RTOC interface standards can be easily extended into the controller without affecting existing elements or replace the internal elements with the same functional elements.

Portability: With minor or no changes, the software of open controllers should be able to run on any system platform.

Reconfiguration: Users can reconfigure the controller and adjust its function and size according to the application requirements.

Interoperability: One system element can coordinate with other elements well. And they can cooperate with each other by the jointless manner, if it is needed.

This research is organized in several sections. Section II discusses the RTOC reference model. On the base of this reference model, two key technologies in the implementation of RTOC are discussed in section III. Section IV analyses the openness in RTOC. In section V, we show one implemented industrial arc welding example and demonstrate RTOC capabilities and benefits in robot controller. In section VI, the standardization work of robotics in China is also illustrated. Finally section VII summarizes the research results.

II. The Reference Model For RTOC

As depicted in Fig.1, a reference model for RTOC, based upon the PC-ORC [11] and OSACA model [8], is proposed. The overall architecture is similar to that of the OSACA control system. Three main parts of this reference model are *hardware platform module*, *operating system module* and *application software module* corresponding to different system levels. In the following, the role of these three parts is briefly explained.

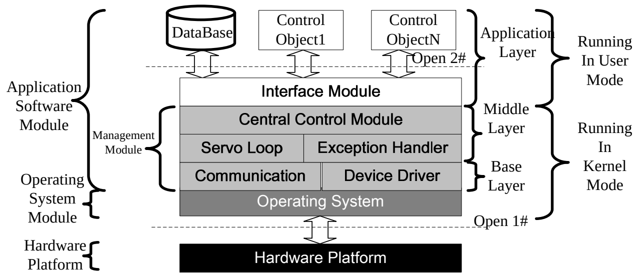

Fig. 1 The Reference Model for RTOC

A. Hardware Platform Module

Hardware platform is the base of the whole system. Usually hardware platform consists of one (or more) computer systems and peripheral devices. In order to achieve openness, the devices on the hardware platform should comply with standardized specifications. In general, it is expected that the openness of the hardware platform can be accomplished in their drivers, so the hardware devices can be upgraded easily and the uniform accessibility to hardware devices is preserved. At the same time, this can reduce the application cost and preserve easy use [11].

B. Operating System Module

Operating system module is the core of the whole system. It is in charge of managing the whole system and provides the application software module with the accessibility to the hardware platform. In order to preserve the efficiency of the system, real-time operating systems are always considered, because of its real-time management and allocation method of the system resources efficiently.

C. Application Software Module

The aim of the *application software module* is to complete system control functions and to realize openness. In an open architecture control system, universal modules of the application software ought to be allowed to be extended, reconfigured and ported. Also the communication between different modules should be supported. The four main parts—*management module, interface module, database* and *control objects* are included in the application software module. The role of them is discussed in the following.

The *management module* provides extending and reconfiguring ability in the open architecture control system. Also communications between different modules are addressed. In the management module of Fig.1, the *central control module* (CCM) manages other sub-modules to complete extending, reconfiguring or communicating functions. Among these sub-modules, the *servo loop module* (SLM) manages and reconfigures servo loops. The *exception handler* deals with system exceptions. The *communication module* exchanges data between different modules. And the device driver module extends or reconfigures device drivers for the change of devices.

In the *interface module*, two kinds of basic functions are provided to end-users. The functions include (1) system monitoring and controlling; and (2) system reconfiguration. By the use of the interface module, end-users can monitor system states and control the system in real-time mode. So the system efficiency can be preserved. Also through the interface module, the end-users can reconfigure the universal function modules in the *database* and construct new servo control loops to complete new task executions.

The *database* in the application software module stores universal application modules such as path planning modules, kinetics, PID control algorithms etc. When a new control task or a new servo control loop executes, the corresponding modules in the database are allocated orderly by the SLM.

The same as those in PC-ORC [11], the *control objects* mean the elements used in controlling the real robot devices from the aspect of software. By loading new universal software modules and new hardware device drivers, the entire control system can be constructed and modified according to the requirements in new controlling environments.

III. Implementation of RTOC

In this section, the implementation of the RTOC reference model is presented. For the importance of application software module in RTOC, the discussion focuses on its two key implementation problems. One is its layered architecture. The other is the intra-layer interfaces. For the space limit of the whole paper, the realization details can be referenced to another paper [10].

A. The Layered Architecture of Application Software Module

Application software module is the key in the implementation of the whole RTOC. In its realization, it has been divided into three function layers:

Base Layer includes communication module and device drivers, where new communication protocols and new devices can be extended.

Middle Layer includes servo loop module, exception handler and central control module, whose main function is to realize the control logic. In the servo loop module, the servo loop can be reconfigured according to the control. At the same time, new exception handlers can be extended into this layer.

Application Layer includes interface module, control objects and log information database. According to the controlling requirements, control objects can be extended on the base of the interface specification.

These three layers aim to complete different system functions and cooperate to realize open controllers. In order to cooperate with each other smoothly, the intra-layer interface is another key technology in RTOC realization.

B. Intra-Layer Interfaces

(1) The Interface Between Base Layer and Middle Layer

Base Layer and Middle Layer all run in Kernel Model of Rt-Linux. So the latter can use the hardware independent interfaces provided by Base Layer to access hardware equipments. Base Layer provides two different hardware accessing mode: periodic sampling mode and interrupt driven mode. In the former mode, Middle Layer directly uses the data sampling and rewriting application program interfaces (APIs) provided by Base Layer. In the latter, there is a data buffer in every device drivers to store the data required by Middle Layer. When interrupt occurs, the buffer is refreshed. For Middle Layer, data sampler actually gets the data from the buffer. So for the data sampler in the Middle Layer, it can get current data by means of the APIs provided by Base Layer. For Middle Layer, the data of any hardware equipment are firstly written into one variable pool. After the calculation of the control algorithm in Middle Layer, control results are written back to the variable pool. Finally, data re-writer transfers them back to Base Layer.

(2) The Interface Between Middle Layer and Application Layer

As an important part of RTOC, besides exchanging data with Base Layer, Middle Layer also needs to provide interfaces to Application Layer. For simplifying the use of the interface, APIs running in User Mode are supported. The programs in Application Layer (such as standard C programs, scripts etc al.) are suggested in User Mode, because usually no real-time requirements exist.

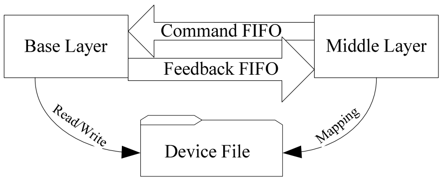

Fig.2 The Interfaces Between Middle Layer and Application Layer

Different kinds of data exchanging interfaces are supported between Middle Layer and Application Layer shown in Fig.2. On one hand, similar to the interface between Base Layer and Application Layer, the whole Middle Layer is registered as a system device and mapped to a device file. For the layer in User Mode, system parameters can be got through the operation of the corresponding device file. On the other hand, two real-time half duplex pipes are used to support a mass of exchanging data. One is a command pipe, which is used to transfer commands and data. And the other is a signal pipe, which is used to transfer denoted system states. In this method, a lot of programming methods are supported such as standard C/C++, Shell scripts, Perl scripts etc al.

(3) The Interface Between Application Layer and Base Layer

In general, data exchanging between Application Layer and Base Layer needs to be avoided. However, for system debugging and other special cases, RTOC also supports the interface between Base Layer and Application Layer. In the realization, every device in Base Layer is also mapped to one device file. Through the operation of the device file, the corresponding device can be controlled. Two benefits can be got from this kind of interface. One is that device file is supported by the kernel of Linux and stability can be preserved. The other is that the interface can be standardized as Linux standard device file.

IV. OPENNESS IN RTOC

A. Portability

From the aspect of operating system portability, the running platform of RTOC is not limited to PC platform. For the portability of Linux kernel among different platforms from embedded systems to multi-CPU systems, RTOC manifests strong portability on the base of Linux and Rt-Linux.

From the aspect of software portability, the core of RTOC is developed by means of standard C language. Most of operating system supports C language strongly. Except the Rt-Linux dependent code part in the RTOC core, most of the codes in RTOC can be compiled and ported to other operating systems. So RTOC portability is preserved.

B. Extensibility

Extensibility in RTOC manifests in its different layers.

(1) Extensibility in Base Layer

RTOC has standardized the device driver interface in Base Layer. If a new device needs to be extended into the system, the following steps can be taken:

- Decide the device type;
- Register the device;
- Complete the virtual functions referenced by the device drivers. If these are Linux device drivers, encapsulate these device drivers according to the HII interface standard.

(2) Extensibility in Middle Layer

In Middle Layer, control logic can be extended from different aspects.

Firstly, define the contents in the variable pool. In RTOC, one variable pool is used to store shared state variables. After control objects are analysed, the necessary state variables to be stored should be defined in the configure file of the variable pool. In the running of RTOC, data are shared on the base of the variable pool.

Secondly, a series of standard control processes are developed according to the control requirements. These control processes can utilize the standard control algorithm library (such as kinematics algorithm, dynamics algorithm, track planning algorithm etc al.) to generate control results. The initial data in the variable pool are input into these control processes. Then the variable pool is updated by the control results. At the same time, new control algorithms can be developed and will be loaded into the system kernel when running.

Thirdly, servo loop can also be extended. One servo loop is made up of control process list (CPL) and servo period list (SPL). One or more control algorithm modules are loaded into the RTOC kernel when running. At the same time, they are also registered in SLM. By editing the configure file in SLM, the servo loop allocation about CPL and SPL are denoted. Then in the initialization, RTOC will initialize the corresponding servo loop according to the SLM configure file.

Finally, users can also register the command processor to extend new commands and exception handlers in Middle Layer.

(3) Extensibility in Application Layer

Besides the existing controlling and monitoring interface, new application human computer interfaces (HCI) are supported to be extended. A virtual file system is provided by Middle Layer, which is used to send system state information. At the same time, Real-time fist-in-first-out file is used to receive the commands from Application Layer and to feedback the control results. By means of these exchanging methodologies, new HCI can be developed and extended into RTOC.

C. Reconfiguration

On one hand, the operating system used by RTOC also manifests flexible reconfiguring ability. For universality, different kinds of functions are supported in this operating system, such as various network protocol stack, different process communication mechanism, different bus equipments etc al. In order to save system resources, users can edit the Rt-Linux configure file to only load necessary functional modules. At the same time, the properties of the loaded function modules can also be defined, such as the size of shared memory, the size of RT-FIFO buffer, etc al.

On the other hand, Middle Layer itself also supports flexible reconfiguring ability. The important modules in Middle Layer can be reconfigured by means of editing configure file. For example, the running architecture of the variable pool, servo loop and exception handler can be defined in the configure file.

D. Interoperability

In the implementation of RTOC, the extensibility and information exchange between different modules are strongly supported and the corresponding interfaces are also standardized. According to the defined interface standard, different modules can interoperate by the jointless manner.

V. An Application Example

Up to now, RTOC has been implemented and tested on two application systems. One of these is SIASUN-GRC industrial arc welding robot system. The system includes a six-joint robot (fig.5) and a control cabinet (fig.6). Inside the cabinet, there is a PC104 main board with an AMD 486 DX 100 CPU, which supports the Rt-Linux operating system.

Fig.5 Our Arc Welding Robot

Fig.6 The Control Cabinet

The overall object of this industrial arc welding robot is to realize playback function. A small application that partially achieves this object has been completed. For this purpose, three different robot movement commands are used, which can control robot movement according to different strategies. These commands are listed in Table I.

TABLE I

THE ROBOT COMMANDS IN RTOC

Commands	Descriptions
MOVJ	Adding a teaching point in joint space.
MOVL	Adding a teaching point where to go on the straight line. (In the cartesian reference frame)
MOVC	Adding a teaching point where to go on the circular arc (In the cartesian reference frame)
START	Starting movement (Playing back the teaching points)

In order to preserve the efficiency, when Rt-Linux is installed on the hardware platform, it is reconfigured according to the application requirements. In the reconfiguration, the necessary functions in the application have been preserved, while others are unloaded. After the reconfiguration, the system is recompiled and re-installed on the hardware platform. The reconfiguration details are described in Table II.

In our application, RTOC is modified to adapt to the application. The modification mainly focuses on the interface module to fulfil the application requirements. Little time has been spent on the modification and the application costs have been reduced compared with the development of proprietary controllers because of the openness in RTOC.

TABLE III

THE CONTENTS RELATED TO THE HARDWARE DRIVERS IN THE DRIVER INFORMATION

Entry	Description
[driver]	
NAME=Siasun Robot Driver	# Driver description
VERSION=0.9	# Version of this file
TYPE=Pulse Sequence	# Driver type
VENDOR=Siasun	# Hardware vendor

```
AUTHOR=Cao Yiming                # Driver author
STARTUP_ARGS=BASE_ADDR=  # Driver startup arguments
LOAD=load.sh                     # Driver loader script
UNLOAD=unload.sh                 # Driver unloader script
MODULES=sr                       # Driver kernel modules
```

In the modified RTOC, the interface module provides one *management interface* and three kinds of operation interface: *reconfiguration interface*, *command interface* and *monitoring interface*. When the system starts in the beginning, a *management interface* is firstly shown and users can use it to enter other interfaces. In order to reconfigure different function modules, two types of reconfiguration interfaces are used. Users can reconfigure hardware driver modules by the *driver reconfiguration interface* according to the application requirements. Also the *function reconfiguration interface* can be used to select and reconfigure the corresponding universal function modules. After the reconfiguration, the corresponding modules are inserted into the kernel mode. So the efficiency can be preserved when they are used. The information about the modules to be reconfigured comes from the corresponding INF files, which are maintained by users when hardware drivers or function modules are extended into the RTOC. The contents of the information files are listed in Table III and Table IV. A control *command interface* is provided in this application to complete the playback function. In this interface, users can teach the robot and control it to re-appear the movement according to different movement strategies.

TABLE II
THE RT-LINUX RECONFIGURATION DETAILS

Modules	Preserved Options	Closed Options	Description
Loadable module support	Preserve all the functions.		Support inserting modules into kernel mode dynamically.
Processor type and features		Close all the advanced options, such as SMP, Local APIC etc.	
General Setup	Preserve the support part of System V IPC.	Close the parts of PCI, EISA，advanced power management BIOS support.	In Rt-Linux, it is recommended to close advanced power management BIOS support.
Parallel port support		Close all the options.	No parallel devices.
Plug and Play configuration		Close all the options.	No plug and play devices.
Multi-device support (RAID and LVM)		Close all the options.	No RAID devices.
Networking options	Preserve the basic TCP/IP part of support IPV4.	Close the parts of Multicast, IPX protocol etc.	
SCSI Support		Close all the options.	No SCSI devices.
Network device support	Preserve the net adaptive card “NE2000 ISA” drivers.	Close other options.	
File System Support	Preserve the file system of Ext3、Fat、Fat32、ISO9660 and /proc.	Close other options.	The file system /proc is necessary.
Console drivers		Close the option of Frame Buffer.	Prohibit high resolution to preserve system stability.
Sound		Close all the options.	
USB Support		Close all the options.	
Bluetooth support		Close all the options.	

System states can also be monitored through the *monitoring interface*. In this application, the information of the six joints of the robot is shown in the monitoring interface. In the application, all the interfaces are textual interfaces so as to accommodate it to the slow hardware platform.

TABLE IV
THE CONTENTS OF FUNCNTION MODULE INFORMATION FILE

```
Entry                     Description
[function]
NAME=Siasun Teach8G0      # Function description
VERSION=0.9               # Version of this file
TYPE=OPERATION            # Type: OPERATION or ALGORITHM
AUTHOR=Cao Yiming         # Function author
STARTUP_ARGS =NULL        # Function startup arguments
LOAD=startup.sh           # Function loading script
DRIVER=Sr                 # Dependent drivers
DEPENDENCY=NULL           # Dependent functions
```

VI. STANDARDIZATION IN CHINA

These years, the standardization work of robotics is also conducted in different application fields in China. 15 standardization documents have been issued by Standardization Administration of P. R. China (SAC).

The issued standards by SAC are listed in the following Table IV. The issued Chinese robot standards can be divided into three types. The first type of standards includes the General specifications for industrial robots (3-6, 8-15). Then the second type of standards discusses the general specifications for welding robots (2,7). The last type of standards gives the general specification for processing robots (1).

TABLE IV
THE ROBOT STANDARD IN CHINA

Sequence No.	Standard No.	Standard Title
1	GB/T 20722-2006	General specifications of laser processing robots
2	GB/T 20723-2006	General specifications of Arc welding robots
3	GB 11291-1997	Industrial robots--Safety specification
4	GB/T 12642-2001	Industrial robots--Performance criteria and related test methods
5	GB/T 12643-1997	Industrial robots--Vocabulary
6	GB/T 12644-2001	Industrial robots--Presentation of characteristics
7	GB/T 14283-1993	General specifications of spot-welding robots
8	GB/T 14468.1-2006	Industrial robot -- Mechanic interface Part 1: Plates
9	GB/T 14468.2-2006	Industrial robot -- Mechanical interface Part 2: Shafts
10	GB/T 16720.3-1996	Industrial automation systems--Manufacturing message specification(MMS)--Part 3:Companion standard for robotics
11	GB/T 16977-2005	Industrial robots Coordinate systems and motion nomenclatures
12	GB/T 17887-1999	Industrial robots--Automatic end effector exchange systems--Vocabulary and presentation of characteristics
13	GB/Z 19397-2003	Industrial robots--EMC test methods and performance evaluation criteria--Guidelines
14	GB/T 19399-2003	Industrial robots--Graphical user interfaces for programming and operation of robots(GUI-R)
15	GB/T 19400-2003	Industrial robots--Object handling grasp-type grippers--Vocabulary and presentation of characteristics

VII. CONCLUSIONS AND FUTURE WORKS

In this paper we have described an Rt-Linux based open robot controller: RTOC, a software extension of the real-time operating system "Rt-Linux" that allows us to integrate the system elements of a robot system in a flexible and efficient way. Its main feature is extensibility, portability, reconfiguration and interoperability. To achieve this, RTOC inherits some important features of Linux and integrate different kinds of application software modules. The system openness has been improved. At the same time, the standardization about robots in China has also been discussed.

We have experimented and tested RTOC in a real application, in which our industrial robot serves as the experimental platform. The process of adapting RTOC to the robot is incredibly short. And the openness of RTOC has been demonstrated. When system exceptions occur, they can be captured and processed duly. Also system real-time performance is satisfactory.

In the near future, it is expected that RTOC can be used in a real industrial manufacturing environment. Other new extensions are expected to be completed.

- Encapsulate the RTOC's functional modules in an Object-Oriented fashion. This is quite challenging but tempting.
- Enriching the robot command set in RTOC.
- Providing powerful visual tools for the RTOC operations on distant computers.
- Extending the universal modules in the database such as artificial intelligence, plan execution, etc.

ACKNOWLEDGMENT

This work is jointly supported by the National Nature Science Foundation (Grant No: 60405011, 60575057), the China Postdoctoral Foundation for China Postdoctoral Science Fund (Grant No: 20040350078) and the National 863 Project of China (Grant No: 863-512-9804-35 and 2001AA423120).

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Robotics-DTF/SDO-DSIG

Joint Meeting
Closing Session

March 28, 2007
San Diego, CA, USA
Hyatt Regency La Jolla at Aventine

Document Number

- robotics/2007-03-01 Final Agenda (Tetsuo Kotoku)
- robotics/2007-03-02 Washington Meeting Minutes [approved] (Yun Koo Chung and Bruce Boyes)
- robotics/2007-03-03 Steering Committee Presentation (Tetsuo Kotoku)
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- robotics/2007-03-12 Experience using ISO19100 for developing Robotic Systems (Itsuki Noda)
- robotics/2007-03-13 Robotics-DTF Flyer (trifoldblue) - DRAFT –
- robotics/2007-03-14 Robotics-DTF Flyer (trifoldgray) - DRAFT –

AIST

Document Number

- robotics/2007-03-15 Introduction to User Identification Service (Su-Young Chi)
- robotics/2007-03-16 Adaptive Service Media as Intelligent Environment (Hajime Asama)
- robotics/2007-03-17 Location Service RFP 1st Review (Kyuseo Han)
- robotics/2007-03-18 RoSta: Robot Standards and Reference Architecutures (Erwin Prassler)
- robotics/2007-03-19 DESIRE: German Service Robotics Initiative (Erwin Prassler)
- robotics/2007-03-20 EUROP: (Erwin Prassler)
- robotics/2007-03-21 Robotic Profiles and Data Profiles WG Activity Report (Seung-Ik Lee)
- robotics/2007-03-22 Robotic Functional Services WG Progress Report (Olivier Lemaire)
- robotics/2007-03-23 KIRSF - Contact Report (Yun Koo Chung)
- robotics/2007-03-24 ISO/TC184/SC 2 - Contact Report (Makoto Mizukawa)
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- robotics/2007-03-28 DTC Report Presentation (Tetsuo Kotoku)
- robotics/2007-03-29 San Diego Meeting Minutes - DRAFT (Tomizawa and Su-Young Chi)

AIST

Publicity Activities

- Robotics Wiki is available
  http://portals.omg.org/robotics
- Robotics-DTF fly sheet
  issue ver.1.0 by mail polling before Brussels
- Robotics Information Day
  (Brussels Meeting)
  Set-up Program Committee

NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST)

Potential WG Speaker

Services WG:

Infrastructure WG:

Profiles WG:

Potential Plenary Speaker

Technical Topics:

- Bruce Boyes (Systronix), Microsoft Robotics Studio?
- CanOpen?

Standardization Activities:

- Hyun Kim (ETRI) " Introduction of URC Network Robot System in ongoing pilot business with its standardization "

Robotics Domain Task Force Preliminary Agenda -DRAFT- ver0.0.4

OMG Technical Meeting - Brussels, Belguim -- June 25-29, 2007

http://robotics.omg.org/

		TF/SIG Host	Joint (Invited)	Agenda Item	Purpose	Room
Sunday (June 24)						
13:00	18:00			Localization Service for RoboticsRFP pre-review meeting		
Monday (June 25) Robotics Plenary and Robotics Information Day						
9:00	10:00	Robotics	(SDO)	Robotics Steering Committee		
10:00	10:15	Robotics		Joint Plenary Opening	Robotics/SDO joint plenary kick-off	
10:15	12:00	Robotics		Localization Service for Robotics RFP Review	2nd review **vote-to-vote**, **voting**	
12:00	13:00	**LUNCH**				
13:00	18:00			Architecture Board Plenary		
13:00	18:00	Robotics		**Robotics Information Day**	Demonstration and Informative	
Tuesday (June 26) WG activities						
9:00	12:00	Robotics		**Profile WG(3h):** - Seung-Ik Lee, Bruce Boyes	discussion	
				Robotic Services WG(3h): - Olivier Lemaire and Su-Young Chi	discussion	
				RTC-FTF meeting(3h): - Rick Warren	discussion	
10:30	11:00	C4I	Robotics	Joint Session: Localization Service for Robotics RFP	Information Exchange	
12:00	13:00	**LUNCH**				
13:00	17:00	Robotics		**Profile WG(4h):** Discussion on profile standardization - Seung-Ik Lee, Bruce Boyes	discussion	
				Robotic Services WG(4h): - Olivier Lemaire and Su-Young Chi	discussion	
				RTC-FTF meeting(4h): - Rick Warren	discussion	
Wednesday (June 27) Robotics Plenary						
9:00	10:30	Robotics	(SDO)	WG Reports and Roadmap Discussion (Infrastructure, Robotic Service, Profile)	reporting and discussion	
10:30	11:15	Robotics	(SDO)	**Special Talk: - TBA**	presentation and discussion	
11:15	12:00	Robotics	(SDO)	**Special Talk: Anybot stduio - Samsung Network Robot SW Platform - SoonHyuk Hong (Senior Engineer, Telecommunication R&D center,**	presentation and discussion	
12:00	14:00	**LUNCH and OMG Plenary**				
14:00	15:00	Robotics	(SDO)	**Demonstration of Microsoft Robotic Studio - Bruce Boyes (Systronix)**	demonstration and discussion	
				Break (30min)		
15:30	16:15	Robotics	(SDO)	**Special Talk: Europian Standardization Activities -TBA**	presentation and discussion	
16:15	17:15	Robotics	SDO	Contact Reports: - Makoto Mizukawa(Shibaura-IT), and Yun-Koo Chung(ETRI)	Information Exchange	
17:15	17:30	Robotics	(SDO)	Publicity SC Report, Next meeting Agenda Discussion	Robotics/SDO joint plenary closing	
17:30				Adjourn joint plenary meeting		
17:30	18:00	Robotics		Robotics WG Co-chairs Planning Session (Agenda for Jacksonville, Draft report for Friday	planning for next meeting	
18:00	20:00	**OMG Reception**				
Thursday (June 28) Robotics Plenary and WG Activity						
9:15	10:00	ManTIS	Robotics	Joint Session: Localization Service for Robotics RFP	Information Exchange	
10:00	12:00	Robotics		Localization Service for Robotics RFP Review	2nd review **voting**	
12:00	13:00	**LUNCH**				
13:00	18:00			Architecture Board Plenary		
13:00	17:00	Robotics		**Robotic Services WG(4h)**: - Su-Young Chi and Olivier Lemaire	discussion	
Friday						
8:30	12:00			AB, DTC, PTC		
12:00	13:00	**LUNCH**				

Other Meetings of Interest

Monday						
8:00	8:45	OMG		New Attendee Orientation		
18:00	19:00	OMG		New Attendee Reception (by invitation only)		

Please get the up-to-date version from http://staff.aist.go.jp/t.kotoku/omg/RoboticsAgenda.pdf

Robotics-DTF

Date: Friday, 30th March, 2007
Chair: Tetsuo Kotoku, YunKoo Chung, Hung Pham
Group URL: http://robotics.omg.org/
Group email: robotics@omg.org

➢Highlights from this Meeting:

Robotics/SDO Joint Plenary: (18 participants)

- 2 WG Reports [robotics/2007-03-21, -22]
- 2 Interesting Talks
  - Adaptive Service Media as Intelligent Environment (Hajime Asama, Univ. of Tokyo) [robotics/2007-03-16]
  - RoSta: Robot Standards and Reference Architectures (Erwin Prassler, B-IT Bonn-Aachen Int. Center for Information Technology, Applied Science Institute) [robotics/2007-03-18,-19,-20]

Robotic Functional Services WG

- 6 Interesting Talks [robotics/2007-03-07,-08,-09,-10,-11,-12]

Robotics-DTF

Date: Friday, 30th March, 2007
Chair: Tetsuo Kotoku, YunKoo Chung, Hung Pham
Group URL: http://robotics.omg.org/
Group email: robotics@omg.org

➢Deliverables from this Meeting:

- Localization Service for Robotics RFP 1st Review [robotics/2007-03-17]

➢Future deliverables (In-Process):

- Localization Service for Robotics RFP

➢Next Meeting (Brussels, Belgium):

- Robotics Information Day (Monday, Afternoon)
- Localization Service for Robotics RFP
- Guest presentations
- Roadmap discussion
- Contact reports
- Information Exchange with ManTIS and C4I

Minutes of the Robotics-DTF / SDO-DSIG Joint Meeting – DRAFT
March 27-28, 2007, San Diego, USA
robotics/2007-03-29

Minutes Highlights

- Localization Service for Robotics RFP 1st Review [robotics/2007-03-17]
- Two invited presentation :
  - Adaptive Service Media as Intelligent Environment (Hajime Asama, Univ. of Tokyo)
  - RoSta: Robot Standards and Reference Architectures (Erwin Prassler, B-IT Bonn-Aachen Int. Center for Information Technology, Applied Science Institute)
- Two WG Reports (Services WG and Profiles WG)
- Robotics-DTF fly sheet is not approved to issue in San Diego. After several modifications, we would like to make a poll by mail.
- Half-day Robotics Information Day in Brussels was discussed. We give program committee a free hand in deciding.

.

List of Generated documents

robotics/2007-03-01 Final Agenda (Tetsuo Kotoku)
robotics/2007-03-02 Washington Meeting Minutes [approved] (Yun Koo Chung and Bruce Boyes)
robotics/2007-03-03 Steering Committee Presentation (Tetsuo Kotoku)
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robotics/2007-03-29 San Diego Meeting Minutes - DRAFT (Tomizawa and Su-Young Chi)

MINUTES

Mar. 27th, 2007, Tuesday, Mykonos room

13:00-13:15 plenary opening
. Washington DC minutes were reviewed and approved.
(Motion: Mizukawa (Shibaura I.T.), Second: Rick Warren (RTI))
. Minute takers for the San Diego meeting: Tetsuo Tomizawa, Su-young Chi

Special talk:
13:15-14:15 Adaptive Service Media as Intelligent Environment by Hajime Asama (Univ. of Tokyo)
. Concept of the service media is that the system monitors user at all times, and desired contents will be provided by service media or ubiquitous devices.
. Examples of cooperative motion by multiple systems are shown; (1)Object pushing with team organization (2)Step climbing by mutual handling (3)robocup soccer.
. The Intelligent Data Carrier (so-called IDC), which is a portable electric device as an agent for local information management was developed. It consist of CPU, memory, RF, Battery and I/O. The concept of IDC is any data (alert warning, handling method) can be left for other agent.
. Some movies of applications are shown; (1)self-localization using RF communication (2)information sharing system in unknown environment (3)optical guidance using information assistant (4)environment-driven outdoor cart.
. Guidance services in public space are evaluated. Adaptive service system using a pan-tilt projector (information display).
. When the earthquake broke out, ordinary infrastructures are not available, then adhoc network will be needed. So global victims search system using intelligent data carrier and blimp are developed. ICD-R is "intelligent data carrier for rescue." In normal situation, it works as network module, and emergency period it was used a victims searching device. DDT project (data management): DaRuMa system which is a database for multi robot system for disaster mitigation developed by Noda
. Human behavior analysis using motion trajectory are done. The system can make the difference between staff or guest.

1st Review
14:15-15:15 Robotics Localization Function Service RFP by Han and Lemaire
. Han and Lemaire set out the 1st review of RFP.

"Self localization vs Ubiquitous localization"
[Lee] In Ubiquitous environment, the robot doesn't need to measure own position, is it correct? And when robot detects a object, is it self or ubiquitous?
[Tsubouchi] when a robot detect unknown object, the information should be shard via ubiquitous system. The difference of definition between "mobile robot self localization" and "ubiquitous localization" is not clear.

[Kim] Is Beacon system self or ubiquitous?
-> “Ubiquitous” is not general expression. use “external” .

“relative vs absolute”
[Noda] All coordinate are thought as relative.
[Lee] is it needed to categorize relative and absolute.
-> in this discussion, incremental typed sensor categorize “relative.”

“Classification of sensors and profile”
[Lemaire]because on characteristics of between Odometry and LRF are different, categorize is important.

“an example of localization service”
[Noda]The connections between Location aggregator and Localizing object should be modified.
[Nagasaka]The number of localizing object and sensors are different. ::
[Han] one-to-many relationship
[Tsubouchi] What is minimum set? It means (x,y,theta)? :: [Han] change to “specify a set”
[Chung]outputted connection to upper application is redundancy.

. Motion which is this discussion is continued for next meeting.
(Motion: Lemaire (AIST), Second: Lee (ETRI) White ballot: Kotoku (AIST))
The second review of the RFP will be held on the Monday of the Brussels meeting. Draft should be provided 3 weeks before next meeting. It will be necessary to present this RFP to other DTF that may have related activities like C4I or Mantis before we can expect to go in front of the architecture board..

Mar. 28th, 2007, Wednesday, Athenia A room

Special talk:

14:00-15:00 Introduction to RoSta activities by Erwin Prassler (GPS Gesllschaft fur Produktionssysteme GmbH)

RoSta(Robot Standards and Reference Architectures) for Service Robots and Mobile Manipulation was introduced with special talk.

.RoSta is consortium of EUROP, EUnited Robotics, DESIRE and EURON Robotics.

.RoSta's mission is a play a role as key player in Europe standards.

.Topics are as follows

- Glossary/ontology for service robots and mobile manipulation
- Specification of a reference architecture
- Specification of a middleware
- Formulation of benchmarks

.Ultimate RoSta Deliverables are

- An action plan for a standard defining activity
- An action plan and a recommendation/proposal to the European Commission for a supported activity
- An action plan for a community driven open-source activity

Robotics Profile WG-report

.Meetings: Mon 10:00-12:00,Tue:10:00-12:00

.Internal review

- A process or guidelines are necessary for adopting of new devices
- Reordering mandatory requirements in a logically meaningful order
- Discussion of Mandatory requirements
- We need some comparison of related standards

.Worked on a draft RFP

- Who's going to be submitters?
  - ETRI, Samsung Elec(?), Systronix(?), AIST(?), Kwngwon Univ(?)

. WG actions prior to Brussels meeting

- Comparison table of other related standards
  - By Seung-Ik Lee
  - Concentration on relation with our RFP
  - Presentation at the Brussels meeting
- Draft RFP
  - By Bruce Boyes(in working)
  - 1st review in Brussels
- Seek for candidate submitters

.WG Roadmap

Robotics functional Service WG-report

.Meetings: Mon:13:00-17:30 Tue:10:00-17:00 Wed:16:00-17:30

.Presentations

- *"Short Introduction to the ISO19100 Specifications"* -Olivier Lemaire (AIST)
- *"A brief Report for ISO 19116 Positioning Service Standard"* - Dr Han (ETRI)
- *"Need for position data quality indication for Agricultural robots"* - Dr Nagasaka (NARC)
- *"Introduction to Localization related projects at JST"* - Dr Tomizawa (AIST)
- *"Ultrasonic 3D tag system for robot localization"* – Dr Hori (AIST)
- *"Experience using ISO19100 in Robotic Systems"* - Dr Noda (AIST)

- *"Introduction to User Identification Service"* – Dr Chi (ETRI)

.Localization Service RFP 1st Review

.Discussion Topics

- Our stance regarding to ISO 19100
  - Keep going RFP process
- Assert that our focus for RFP is in line with needs of businesses
  - Making the standard of limited use
  - Demonstrate the two approach
  - Several organizations(at least 4) expressed

.See RFP Presentation details

- Modify Problem statement
- Modify Internal data representation(Coordinate systems)
- Typical Robotic Scene

.New basic example of LS structure

.Mandatory requirements

- Provide PIM and at least one specific PSM of LS

.Optional requirements

-None

. Issues to be discussed

- A proposal shall
  - Demonstrate its feasibility
  - Its applicability
  - Discuss simplicity of implementation

.Keep going on 2st review(Brussels)

.RFP title is Localization service for robotics RFP

.Discussion to next meeting issues for User Identification Service for robotics

.Discussion of Roadmap

Contact Reports by Makoto Mizukawa(Shibaura-IT) and Yun-Koo Chung(ETRI)
16:45-17:15

.KIRSF Contract report by Yun Koo Chung, ETRI

- KIRSF standardization Activities reports
  - Feb 27th, 2007: Coordination Committee(CC) Plenary meeting
  - Analysis of KIRSF Standards in 2006
  - Report of URC network robots in Pilot business in the first year
    - URC home service robots were tested by TTA
    - 850 home service robots and 20 public service robots have been serviced by KT company from October.2006.

.ISO Contract report by Makoto Mizukawa(Shibaura-IT)

- ORiN and RAPI
- RAPI voting result
  - Not approved
- The next ISO/TC 184/SC 2 meeting
  - 7 and 8 June, 2007, Washington DC
- ISO TC184/SC2 Contact change
  - JARA named Dr. Tetsuo Kotoku as a AG member instead of Prof. Mizukawa
- OMG contact to ISO TC184/SC2
  - Dr. Chung and Dr. Kotoku

. IEEE ICRA 2007 Workshops Rome, Italy, 10-14 April

- SDIR 2007: April 14th, 2007

.Introduction to coming conference

- 2007 IROS(Oct 29-Nov 2, San Diego,USA)
- ICCAS 2007(Oct 17-20, Seoul, Korea)

.Robotics-DTF/SDO-DSIG Joint Meeting Closing Session

- Publicity Activities
  - Robotics WiKi is available
    - http://portals.omg.org/robotics
  - Robotics-DTF fly sheet
    - consult with OMG Marketing Stuff
    - not approved to issue in SanDiego.
    - After several modifications, we would like to make a poll by mail.
  - Robotics Information Day (Brussels Meeting)
    - Set-up Program Committee
    - Discussion of Potential Special Speaker
    - We give program committee a free hand in deciding.

Adjourned joint plenary meeting at 18:00

Attendees:19

- Erwin Prassler (FHBRS)
- Hajime Asama (Univ. of Tokyo)
- Itsuki Noda (AIST)
- Kyuseo Han (ETRI)
- Makoto Mizukawa(S.I.T.)
- Noriaki Ando (AIST)
- Olivier Lemaire (JARA)
- Rick Warren (RTI)
- Seung-Ik Lee (ETRI)
- SuYoung Chi (ETRI)
- Takashi Tsubouchi (Tsukuba Univ.)
- Takeshi Sakamoto (Technologic Arts)
- Tetsuo Kotoku (AIST)
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