Robotics Domain Task Force Final Agenda ver1.0.3

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	Robotics		Localization Service for Robotics RFP pre-review meeting - Kyunseo Han and Shuichi Nishio		Innovation, 1st FL
Monday (June 25) Robotics Plenary and Robotics Information Day						
8:00	9:00	Robotics		Localization Service for Robotics RFP pre-review meeting		Evasion, 1st FL
9:00	10:00	Robotics	(SDO)	Robotics Steering Committee		
10:00	10:15	Robotics		Joint Plenary Opening	Robotics/SDO joint plenary kick-off	Klimt, Ground FL
10:15	12:00	Robotics		Localization Service for Robotics RFP Review	2nd review voting	
12:00	13:00			**LUNCH**		Le Nouveau Taste, Ground FL
13:00	18:00			Architecture Board Plenary	16:40-: Robotic Localization Service RFP review	Harmony, 1st FL
13:00	18:00	Robotics		**Robotics-DTF Seminar**	Demonstration and Informative	Klimt, Ground FL
Tuesday (June 26) WG activities						
9:00	12:00	Robotics		**Profile WG(3h):** - Seung-Ik Lee	discussion	Mosaic, Ground FL
				Robotic Services WG(3h): - Su-Young Chi	discussion	Harmony, 1st FL
				RTC-FTF meeting(3h): - Rick Warren	discussion	Internal Mtg. Rm., 1st FL
10:30	11:00	C4I	Robotics	Joint Session: Localization Service for Robotics RFP	Information Exchange	Creativity, 1st FL
12:00	13:00			**LUNCH**		Le Nouveau Taste, Ground FL
13:00	17:00	Robotics		**Profile WG(4h):** Discussion on profile standardization - Seung-Ik Lee	discussion	Mosaic, Ground FL
				Robotic Services WG(4h): - Su-Young Chi	discussion	Harmony, 1st FL
				RTC-FTF meeting(4h): - Rick Warren	discussion	Internal Mtg. Rm., 1st FL
Wednesday (June 27) Robotics Plenary						
9:00	10:00	Robotics	(SDO)	WG Reports and Roadmap Discussion (Service WG and Profile WG)	reporting and discussion	Serenity, 2nd FL
10:00	11:00	Robotics	(SDO)	**Special Talk: CANopen Introduction** **- Holger Zeltwanger (CiA)**	presentation and discussion	
11:00	12:00	Robotics	(SDO)	**Special Talk: Anybot stduio - Samsung Network Robot SW Platform** **- Hyun-Sik Shim (Samsung)**	presentation and discussion	
12:00	14:00			**LUNCH and OMG Plenary**		Palace Ballroom I, Ground FL
15:30	**16:30**	Robotics	(SDO)	Contact Reports: - Makoto Mizukawa(Shibaura-IT), and Yun-Koo Chung(ETRI)	presentation and discussion	Serenity, 2nd FL
16:30	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	Serenity, 2nd FL
18:00	20:00			**OMG Reception**		Palace Ballroom, Ground FL
Thursday (June 28) Robotics Plenary and WG Activity						
9:00	**10:15**	ManTIS	Robotics	Joint Session: Localization Service for Robotics RFP	Information Exchange	Creativity, 1st FL
10:15	12:00	Robotics		Robotic Localization Service RFP Review	2nd review voting	Innovation, 1st FL
12:00	13:00			**LUNCH**		Le Nouveau Taste, Ground FL
13:00	18:00			Architecture Board Plenary		Harmony, 1st FL
Friday						
8:30	12:00			AB, DTC, PTC		Vision, 8th FL
12:00	13:00			**LUNCH**		Le Nouveau Taste, Ground FL

Other Meetings of Interest

Monday						
8:00	8:45	OMG		New Attendee Orientation		Infinity, 2nd FL
18:00	19:00	OMG		New Attendee Reception (by invitation only)		Balanced Senses Lobby & Atrium, 1st FL
Tuesday						
17:00	18:00	OMG		RTF/FTF Chair's Workshop		Internal Mtg. Rm., 1st FL
Thusday						
9:00	17:00	OMG		CORBA/e & MILS Seminar		Klimt, 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 / SDO-DSIG Joint Meeting
March 27-28, 2007, San Diego, USA
robotics/2007-06-03

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.

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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)
robotics/2007-03-04 Roadmap for Robotics Activities (Tetsuo Kotoku)
robotics/2007-03-05 Robotic Profiles and Data Structures WG Opening (Seung-Ik Lee)
robotics/2007-03-06 Robotic Functional Services WG Opening (Su-Young Chi)
robotics/2007-03-07 Introduction to the ISO19100 Specifications (Olivier Lemaire)
robotics/2007-03-08 A brief Report for ISO 19116 Positioning Service Standard (Kyuseo Han)
robotics/2007-03-09 Need for position data quality indication for Agricultural robots (Yoshisada Nagasaka)
robotics/2007-03-10 Introduction to Localization related projects at AIST (Tetsuo Tomizawa)
robotics/2007-03-11 Ultrasonic 3D tag system for robot localization (Toshio Hori)
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 -
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 Architectures (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 Progress 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)

robotics/2007-03-25 Open Robot Controller Research and Its Standardization in China (Hua Xu)
robotics/2007-03-26 Closing Presentation (Tetsuo Kotoku)
robotics/2007-03-27 Next Meeting Preliminary Agenda - DRAFT (Tetsuo Kotoku)
robotics/2007-03-28 DTC Report Presentation (Tetsuo Kotoku)
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: Makoto Mizukawa (Shibaura I.T.), Second: Rick Warren (RTI))
. Minute takers for the San Diego meeting: Tetsuo Tomizawa, and 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: Olivier Lemaire (JARA), Second: Seung-IK Lee (ETRI), WB: Tetsuo 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)
- Tetsuo Tomizawa (AIST)
- Toshio Hori (AIST)
- Vitaly Li (Kangwon National Univ.)
- Yeonho Kim (SAIT)
- Yoshisada Nagasaka(NARC)
- Yun Koo Chung (ETRI)

Prepared and submitted by Tetsuo Tomizawa(AIST) and Su-young Chi(ETRI)

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Request For Proposal

Localization Service

OMG Document: <robotics/2007-06-041

Letters of Intent due: September 15, 2007
Submissions due: November 19, 2007

Objective of this RFP

This RFP solicits proposals for a Platform Independent Model (PIM) and at least one CORBA Platform Specific Model (PSM) or C++ PSM of Localization Service that specify

- common interfaces for Localization Service to transfer data and commands
- a set of common information to represent location

For further details see Chapter 6 of this document.

6.0 Specific Requirements on Proposals

6.1 Problem Statement

A robotic system is commonly defined as an apparatus equipped with a function of interacting with physical entities in a given environment. Navigation, manipulation and human-robot interaction are typical features including physical interaction of a robot, which make a robotic system distinguished from an information appliance.

A robot requires geometric association between physical entities of interest and the robot itself for implementing a task scenario given to the robot.

There are two important attributes for describing a physical entity in space: shape and location. Of the two attributes, location information plays a far more fundamental role in carrying out various tasks involving a robot.

The following are a few of robotic tasks which employ location information.

- Navigation: a robot moves from its current to goal location. The robot should know the two locations and at the same time, it should know relative locations of obstacles it may meet along a moving path.
- Manipulation: a robotic gripper grabs an object -in a sequence of a task, identifying relative position of the object with respect to a task in a reference coordinate system.
- Human robot interaction: a robot should be aware of the location of human(s) and itself when a given task involves interaction with a human.
- Communication with environments: a robot should recognize physical events in an environment and react to them by incorporating location information of each individual event.

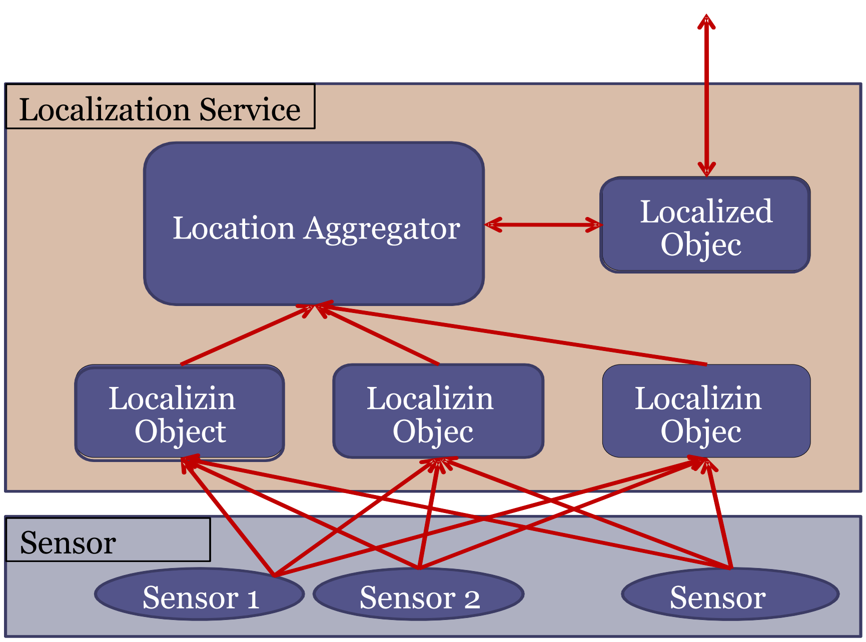
Besides these examples, the number of location-based robotic tasks is continuously increasing as personal or service robot fields are gradually expanded. Since types of location-based applications are varied along with localization methods, it is necessary to build a unified way of localization to support a wide range of location-based robotic tasks.

Localization technology may be classified into two categories: relative and absolute localization. Odometry and inertial navigation are typical examples utilizing relative localization, where the current location of a mobile robot is measured with respect to the initial location of the robot. Typical sensors used in relative localization are encoder, gyroscope, accelerometer, and so on, which are usually installed within the body of a robot.

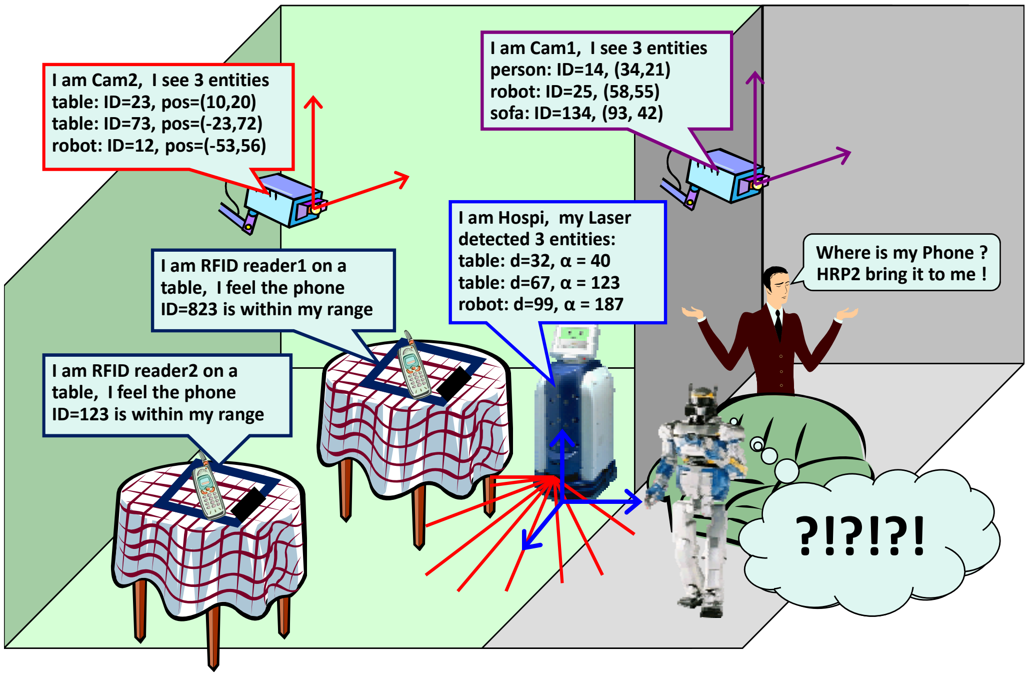
Absolute localization utilizes beacons or landmarks whose locations are known with respect to a predefined reference frame. Localization of a mobile robot is initiated by recognizing beacons or landmarks. Map matching method also belongs to this category, utilizing range scan data of an environment as a natural landmark. GPS (Global Positioning System) may be the most successful commercial solution for absolute localization in outdoor environment. Recent applications utilizing sensors installed in the environment such as networked cameras, RF tag readers, and floor sensors may also fall into this category.

Localization solutions differ from one another in accordance with employed sensors, working environment and strategic use for a specific application. Since a specific sensor usually measures a physical quantity of a single kind, it is a common practice that developers of a localization solution combine different sensors for compensating one another, which means that an unlimited number of localization solutions can be brought about. A variety of existing software and hardware platforms further increases the complexity and difficulty to develop a localization solution.

Therefore, localization can be referred to as a systematic approach to determine the current location of ~~robots or~~ physical entities including robots in question by utilizing uncertain data from sensors -in the robot or in the environment.



~~Figure 1. An Example of Localization Service Structure~~



With an ever-increasing need for a location solution applicable to a wide range of robotic tasks, it is necessary to create a much more flexible way to provide location information irrespective of characteristics of employed sensors, algorithms, and so on. Once such a capability is provided to a localization solution, it can be easily adopted to the vast majority of robotic tasks including localization of robots and related entities.

To achieve flexibility and robustness of localization in robotic systems, it is important to standardize functionalities and associated interfaces for localizing robots and entities as a service. We call such a service as "Localization Service (LS)".

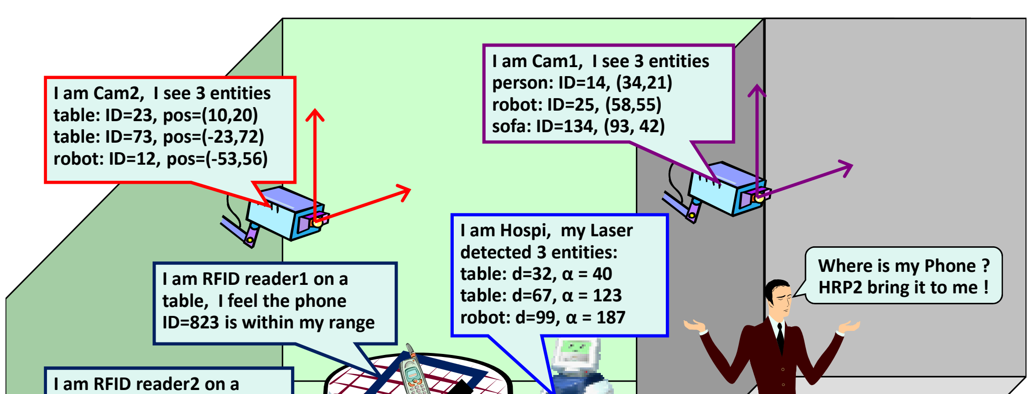


Figure 1 Example of a typical robotic service situation requiring localization of an entity

The LS is a framework of software modules which supports the functionalities for localizing ~~robots or~~ entities in the physical world including robots, regardless of specific sensors and algorithms. Figure 1 illustrates a typical situation in a robot service where localization of an entity is required. Here, a robot in service needs to obtain the location of a cellular phone, utilizing information from various robotic entities in the environment. These robotic entities have the ability to estimate the location of the entities within their sensing range. Thus, the problem here is to combine the location estimations from the robotic entities, and to localize the cellular phone in target. Here, three major issues arise.

- The location information provided by the robotic entities may only be partial, incomplete information. For example, Cam2 in figure 1 provides only 2D information for the entities within its sensing range. These location information shall be combined with responses from other robotic entities, in order to make a 3D location information required for the robotic service.

- The location information provided by the robotic entities may be based on the local coordinate system of each robotic entity. In order to combine these responses, the provided location information needs to be translated into some common coordinate system. This common coordinate system may be a global coordinate system, or the local coordinate system of the robot in service.

The ID information in the location information provided by the robotic entities may be based on the local ID system of each robotic entity. In order to combine these responses, the provided ID information needs to be translated into some common ID system. This common ID system may be the global ID system, or the local ID system of the robot in service.

- ~~Figure 1 illustrates a basic structure of LS to realize the descriptions above. The LS has following characteristics:~~

The LS shall hold the functionality to provide a solution to these issues. Figure 2 illustrates an example structure of LS. In this implementation, the LS is composed by the following three functionalities:

- ~~The LS has interfaces for accepting requests and for publishing localization results. For example, applications can send requests to the LS for the current location of a robot and then the LS responds to them via a predetermined interface protocol. Also, the LS can publish its localization result to applications even if there were no requests from them. "Localized Object" in Figure 1 shows a component providing an entry point of LS dealing with various forms of requests from applications.~~

- ~~The LS supports actual localization components which determine locations of robots and objects. "Localizing Object" in Figure 1 is one instance of a localization component which converts raw data from more than one localization sensor into specific location information. Each individual "Localizing Object" embodies a specific localization algorithm as well as input and output interfaces to take sensor data and provide a localization result.~~

- ~~The LS provides a means to aggregate various location data from "Localizing Objects" to produce an integrated response to a requester. "Location Aggregator" in Figure 1 realizes the process of combining multiple location data from each "Localizing Object" into a single location in a synergistic manner.~~ An interface for accepting requests and for publishing localization results. For example, applications can send requests to the LS for the current location of a robot and then the LS responds to them via a predetermined interface protocol. Also, the LS can publish its localization result to applications even if there were no requests from them.

- A *Localizing Object* which is an actual localization components which determine locations of physical entities by converting raw data from more than one localization sensor into specific location information.

Each individual Localizing Object embodies a specific localization algorithm as well as input and output interfaces to take sensor data and provide a localization result.

- A *Location Aggregator* is a means to aggregate various location data from Localizing Objects to produce an integrated response to applications. Location Aggregator in Figure 2 realizes the process of combining multiple location data from each Localizing Object into a single location in a synergistic manner.

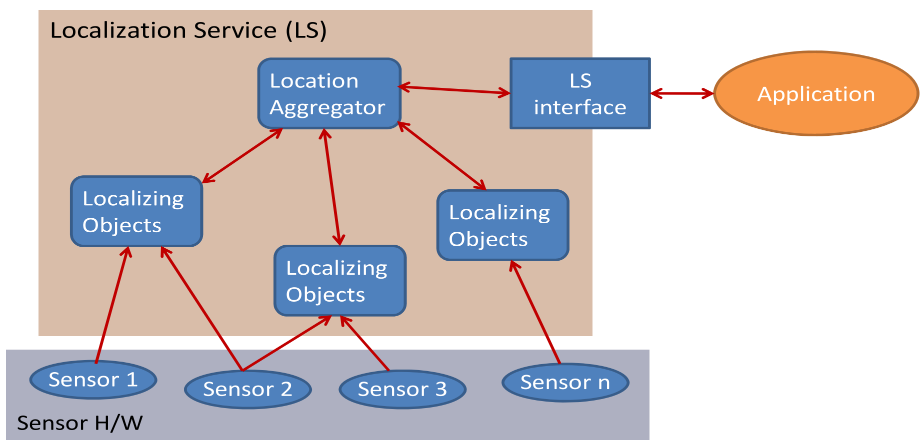


Figure 2 An Example of Localization Service Implementation Structure

6.2 Scope of Proposals Sought

This RFP seeks proposals that specify a localization service, on top of which various robotic applications are developed.

It is necessary to consider the ~~followings~~ followings in the specification of a localization service.

(1) The LS specification should provide a framework for supporting flexible configuration of its own functionalities.

(2) The LS specification must be general enough to incorporate various localization sensors and algorithms.

(3) The LS specification should provide the data representation for its external application interface as well as its internal functionalities

- The data representation may ~~includes~~ include elements for specifying location such as location format, coordinate system, measurement unit, etc.

- The location format may include auxiliary information, such as identification, time stamp, error estimate, etc.

(4) The LS specification should satisfy interoperability and reusability. An LS implemented by one vendor should be able to be replaced with LSs provided by other vendors with little efforts.

(5) The LS specification should provide a minimum set of functionalities to satisfy the following:

- Providing an interface in order to accept requests and to publish localization results.

- Providing a mean for initialization or adjustment of the localization service.

- Providing a mean for specifying the data format, such as the coordinate system for the location data, the identification system for the identification data, or the format for the error data.

- Providing an interface in order to accept translation requests and publish the results.

(6) Real-time operations are especially important for the localization service. The LS specification should be able to demonstrate its real-time support.

6.3 Relationship to Existing OMG Specifications

Submitters should examine the following OMG specifications for possible benefit:

- Platform Independent Model (PIM) and Platform Specific Model (PSM) for super Distributed Objects (SDO) Specification version 1.0 [formal/2004-11-01]
- Unified Modeling Language: Infrastructure version 2.0 [ptc/2004-10-14]
- Unified Modeling Language: Superstructure version 2.0 [formal/ 2005-07-04]
- Lightweight CORBA Component Model [ptc/2004-06-10]
- Robotic Technology Component specification version 1.0 [ptc/2005-09-01]

6.4 Related Activities, Documents and Standards

Proposals may include existing systems, documents, URLS, and standards that are relevant to the problems discussed in this RFP. They can be used as background information for the proposal.

Example:

- IEEE Robotics and Automation Society, Technical Committee on Network Robot
- IEEE Robotics and Automation Society, Technical Committee on Programming Environment in Robotics and Automation
- SAE AS-4 Unmanned Systems Committee or JAUS: Joint Architecture for Unmanned Systems

- URC(Ubiquitous Robotic Companion) Project
- URS(Ubiquitous Robotic Space) Project
- OGC (Open Geospatial Consortium): OpenGIS Location Service (OpenLS) Implementation Specification: Core service [IS/05-016]
- ISO/ TC 211 Geographic Information/Geomatics : ISO 19116:2004 Geographic Information – Positioning Service
- ISO/ TC 211 Geographic Information/Geomatics : ISO 19111:2004 Geographic information – Spatial referencing by coordinates

6.5 Mandatory Requirements

Proposals shall provide a Platform Independent Model (PIM) and at least one CORBA-specific model of Localization Service (LS) or C++ -specific model of LS. The models shall meet the following requirements.

1. Proposals shall specify a general mechanism for accessing location information of ~~objects~~ physical entities to be localized.
   - ~~Proposals shall specify a set of necessary parameters to represent the location of objects~~
   - ~~Proposals shall specify the format of the structures used to present the following data like but limited to location data, coordinate systems, and reference frame.~~
   - Proposals shall specify a set of necessary data and/or their structures to represent location information of entities.
   - Proposals shall specify a set of methods and/or their parameters to access location information of entities.
2. Proposals shall specify generic interface for modules that perform location calculation.
   - Proposals shall specify each module that shall provide interfaces to supply its generated location data to other modules.
   - ~~Proposals shall specify the interface being able to advertising what type of object and/or what object can be localized.~~
   - ~~Proposals shall specify the interface being able to register new objects.~~

- Proposals shall specify the interface being able to accept localization request.
- Proposals shall specify the interface being able to publish the localization process result.
- ~~Proposals shall specify the interface being able to advertise what kind of sensor data can be used and/or what sensors are used.~~

3. 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 the 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, and/or unit system tuple to another.~~
- Providing a conversion of a location from one coordinate system to another.
- ~~Aggregating multiple location sources into one final position, using pluggable location fusion algorithm.~~
- Providing a functionality for aggregating multiple Localizing Object outputs into one final location.

~~6.6~~ Optional Requirements

6.6 ~~None~~

- Proposals shall specify the interface being able to advertising what type of entity and/or what entity can be localized.
- Proposals shall specify the interface being able to register new- entities.
- Proposals shall specify the interface being able to advertise what kind of sensor data can be used and/or what sensors are used.
- Managing the different coordinate systems and frames defined in a robotic system, as well as the physical relationship.

- Managing the different *Localizing Objects* in the robotic system.
- Managing the different instances of *Localization Service* present in the system.
- Aggregating multiple location sources into one final location, using pluggable location fusion algorithm.

6.7 Issues to be discussed

These issues will be considered during submission evaluation. They should not be part of the proposed normative specification. (Place them in Part I of the submission.)

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

6.8 Evaluation Criteria

Proposals will be evaluated in terms of consistency in their specifications, feasibility and versatility across a wide range of different robot applications.

6.9 Other information unique to this RFP

None

6.10 RFP Timetable

The timetable for this RFP is given below. Note that the TF or its parent TC may, in certain circumstances, extend deadlines while the RFP is running, or may elect to have more than one Revised Submission step. The latest timetable can always be found at the

OMG *Work In Progress* page at http://www.omg.org/schedules/ under the item identified by the name of this RFP. Note that “<month>” and “<approximate month>” is the name of the month spelled out; e.g., January.

Event or Activity	Actual Date
Preparation of RFP by TF	*June 1, 2007*
RFP placed on OMG document server	*June 4, 2007*
Approval of RFP by Architecture Board *Review by TC*	*June 28, 2007*
TC votes to issue RFP	*June 29, 2007*
LOI to submit to RFP due	*September 15, 2007*
Initial Submissions due and placed on OMG document server (“Three week rule”)	*November 1~~9~~2, 2007*
Voter registration closes	*December 3, 2007*
Initial Submission presentations	*December 10, 2007*
Preliminary evaluation by TF	
Revised Submissions due and placed on OMG document server (“Three week rule”)	*February1~~8~~1,2008*
Revised Submission presentations	*~~March~~ May ~~10~~26, 2008*
Final evaluation and selection by TF *Recommendation to AB and TC*	
Approval by Architecture Board *Review by TC*	
TC votes to recommend specification	*~~March~~ June ~~13~~27, 2008*
BoD votes to adopt specification	*~~June~~September, 2008*

Appendix A References and Glossary Specific to this RFP

A.1 References Specific to this RFP

None

A.2 Glossary Specific to this RFP

None

Appendix B General Reference and Glossary

B.1 General References

The following documents are referenced in this document:

[ATC] Air Traffic Control Specification, *http://www.omg.org/technology/documents/formal/air_traffic_control.htm*

[BCQ] OMG Board of Directors Business Committee Questionnaire, *http://www.omg.org/cgi-bin/doc?bc/02-02-01*

[CCM] CORBA Core Components Specification, *http://www.omg.org/technology/documents/formal/components.htm*

[CORBA] Common Object Request Broker Architecture (CORBA/IIOP), *http://www.omg.org/technology/documents/formal/corba_iiop.htm*

[CSIV2] [CORBA] Chapter 26

[CWM] Common Warehouse Metamodel Specification, *http://www.omg.org/technology/documents/formal/cwm.htm*

[DAIS] Data Acquisition from Industrial Systems, *http://www.omg.org/technology/documents/formal/dais.htm*

[EDOC] UML Profile for EDOC Specification, *http://www.omg.org/techprocess/meetings/schedule/UML_Profile_for_EDOC_FTF.html*

[EJB] "Enterprise JavaBeans™", *http://java.sun.com/products/ejb/docs.html*

[FORMS] "ISO PAS Compatible Submission Template". *http://www.omg.org/cgi-bin/doc?pas/2003-08-02*

[GE] Gene Expression, *http://www.omg.org/technology/documents/formal/gene_expression.htm*

[GLS] General Ledger Specification , *http://www.omg.org/technology/documents/formal/gen_ledger.htm*

[Guide] The OMG Hitchhiker's Guide,, *http://www.omg.org/cgi-bin/doc?hh*

[IDL] ISO/IEC 14750 also see [CORBA] Chapter 3.

[IDLC++] IDL to C++ Language Mapping, *http://www.omg.org/technology/documents/formal/c++.htm*

[MDAa] OMG Architecture Board, "Model Driven Architecture - A Technical Perspective*", http://www.omg.org/mda/papers.htm*

[MDAb] "Developing in OMG's Model Driven Architecture (MDA)," *http://www.omg.org/docs/omg/01-12-01.pdf*

[MDAc] "MDA Guide" (*http://www.omg.org/docs/omg/03-06-01.pdf*)

[MDAd] "MDA "The Architecture of Choice for a Changing World™"", *http://www.omg.org/mda*

[MOF] Meta Object Facility Specification, *http://www.omg.org/technology/documents/formal/mof.htm*

[MQS] "MQSeries Primer", *http://www.redbooks.ibm.com/redpapers/pdfs/redp0021.pdf*

[NS] Naming Service, *http://www.omg.org/technology/documents/formal/naming_service.htm*

[OMA] "Object Management Architecture™", *http://www.omg.org/oma/*

[OTS] Transaction Service, *http://www.omg.org/technology/documents/formal/transaction_service.htm*

[P&P] Policies and Procedures of the OMG Technical Process*, http://www.omg.org/cgi-bin/doc?pp*

[PIDS] Personal Identification Service, *http://www.omg.org/technology/documents/formal/person_identification_service.htm*

[RAD] Resource Access Decision Facility, *http://www.omg.org/technology/documents/formal/resource_access_decision.htm*

[RFC2119] IETF Best Practices: Key words for use in RFCs to Indicate Requirement Levels, (*http://www.ietf.org/rfc/rfc2119.txt*).

[RM-ODP] ISO/IEC 10746

[SEC] CORBA Security Service, *http://www.omg.org/technology/documents/formal/security_service.htm*

[TOS] Trading Object Service, *http://www.omg.org/technology/documents/formal/trading_object_service.htm*

[UML] Unified Modeling Language Specification, *http://www.omg.org/technology/documents/formal/uml.htm*

[UMLC] UML Profile for CORBA, *http://www.omg.org/technology/documents/formal/profile_corba.htm*

[XMI] XML Metadata Interchange Specification, *http://www.omg.org/technology/documents/formal/xmi.htm*

[XML/Value] XML Value Type Specification, *http://www.omg.org/technology/documents/formal/xmlvalue.htm*

B.2 General Glossary

Architecture Board (AB) - The OMG plenary that is responsible for ensuring the technical merit and MDA-compliance of RFPs and their submissions.

Board of Directors (BoD) - The OMG body that is responsible for adopting technology.

Common Object Request Broker Architecture (CORBA) - An OMG distributed computing platform specification that is independent of implementation languages.

Common Warehouse Metamodel (CWM) - An OMG specification for data repository integration.

CORBA Component Model (CCM) - An OMG specification for an implementation language independent distributed component model.

Interface Definition Language (IDL) - An OMG and ISO standard language for specifying interfaces and associated data structures.

Letter of Intent (LOI) - A letter submitted to the OMG BoD's Business Committee signed by an officer of an organization signifying its intent to respond to the RFP and confirming the organization's willingness to comply with OMG's terms and conditions, and commercial availability requirements.

Mapping - Specification of a mechanism for transforming the elements of a model conforming to a particular metamodel into elements of another model that conforms to another (possibly the same) metamodel.

Metadata - Data that represents models. For example, a UML model; a CORBA object model expressed in IDL; and a relational database schema expressed using CWM.

Metamodel - A model of models.

Meta Object Facility (MOF) - An OMG standard, closely related to UML, that enables metadata management and language definition.

Model - A formal specification of the function, structure and/or behavior of an application or system.

Model Driven Architecture (MDA) - An approach to IT system specification that separates the specification of functionality from the specification of the implementation of that functionality on a specific technology platform.

Normative – Provisions that one must conform to in order to claim compliance with the standard. (as opposed to non-normative or informative which is explanatory material that is included in order to assist in understanding the standard and does not contain any provisions that must be conformed to in order to claim compliance).

Normative Reference – References that contain provisions that one must conform to in order to claim compliance with the standard that contains said normative reference.

Platform - A set of subsystems/technologies that provide a coherent set of functionality through interfaces and specified usage patterns that any subsystem that depends on the platform can use without concern for the details of how the functionality provided by the platform is implemented.

Platform Independent Model (PIM) - A model of a subsystem that contains no information specific to the platform, or the technology that is used to realize it.

Platform Specific Model (PSM) - A model of a subsystem that includes information about the specific technology that is used in the realization of it on a specific platform, and hence possibly contains elements that are specific to the platform.

Request for Information (RFI) - A general request to industry, academia, and any other interested parties to submit information about a particular technology area to one of the OMG's Technology Committee subgroups.

Request for Proposal (RFP) - A document requesting OMG members to submit proposals to the OMG's Technology Committee. Such proposals must be received by a certain deadline and are evaluated by the issuing task force.

Task Force (TF) - The OMG Technology Committee subgroup responsible for issuing a RFP and evaluating submission(s).

Technology Committee (TC) - The body responsible for recommending technologies for adoption to the BoD. There are two TCs in OMG – *Platform TC* (PTC), that focuses on IT and modeling infrastructure related standards; and *Domain TC* (DTC), that focus on domain specific standards.

Unified Modeling Language (UML) - An OMG standard language for specifying the structure and behavior of systems. The standard defines an abstract syntax and a graphical concrete syntax.

UML Profile - A standardized set of extensions and constraints that tailors UML to particular use.

XML Metadata Interchange (XMI) - An OMG standard that facilitates interchange of models via XML documents.

Robotics Domain Task Force Steering Committee Meeting

June 25, 2007

Brussels, Belgium

Crowne Plaza Brussels City Centre

San Diego Meeting Summary

- Localization Service for Robotics RFP 1st Review
- Two invited presentation :
  - (Hajime Asama, Univ. of Tokyo)
  - (Erwin Prassler, Rosta)
- Two WG Reports (Services WG and Profiles WG)
- Robotics-DTF fly sheet is not approved
- Planning a Half-day Robotics Information Day in Brussels

Agenda

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

Agenda Review

Mon(June 25):

Steering Committee, RFP voting

Robotics Seminar

Tue(June 26):

Profiles WG, Services WG

Joint session with C4I

Wed(June 27):

Task Force Plenary

Thu(June 28):

RFP voting, 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
  - Fumio Ozaki
  - Yun-Koo Chung

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

Our fly sheet will be authorized

Robotics Functional Services WG

Volunteers (present)

- ~~Olivier Lemaire (AIST)~~ → quit (job change)
- Su-Young Chi (ETRI)

New Volunteer

- Shuichi Nishio (ATR)

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), 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), Shuichi Nishio (ATR, 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

Sep. 24-28 (Jacksonville, FL, USA)

Monday-Tuesday:

Steering Committee (morning)
WG activity [Parallel WG Session]

Wednesday :

Robotics-DTF Plenary Meeting
•Guest and Member Presentation
•Contact reports

Roadmap for Robotics Activities

robotics/2007-06-06

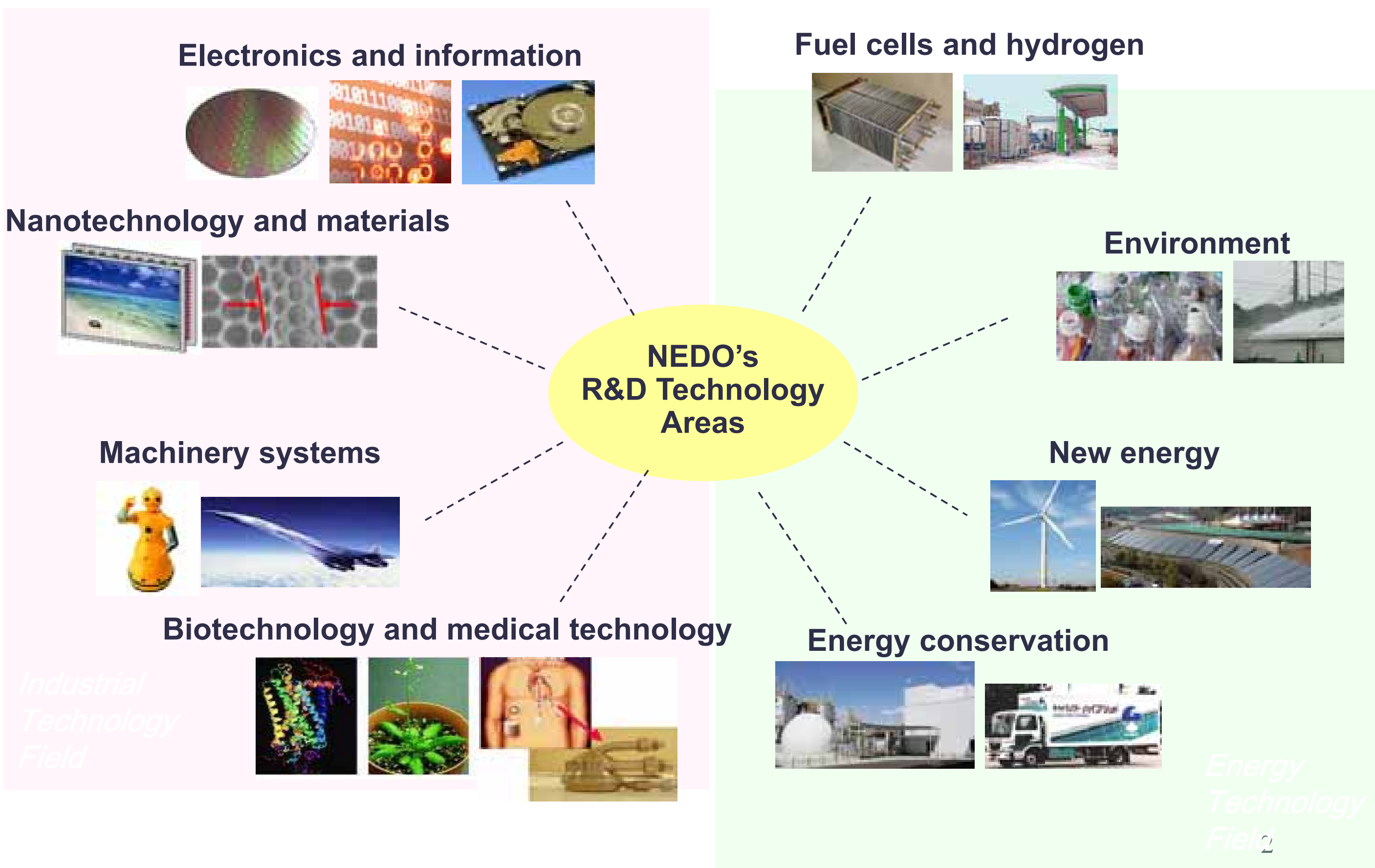
Item	Status	San Diego Mar-2007	Brussels Jun-2007	Jacksonville Sep-2007	Burlingame Dec-2007	Washington DC Mar-2008	Ottawa Jun-2008	Orlando Sep-2008	Santa Clara Dec-2008	POC / Comment
RTC Finalization Task Force	In Process		Comment Due 7/2	Report	Report Deadline 10/5					Rick(RTI)
SDO Revision Task Force	In Process		Report							Sameshima(Hitachi)
Flyer of Robotics-DTF [Publicity Sub-Committee]	In Process			issue ver.1.0						Abheek(ADA Software)
Robotic Localization Service RFP [Robotic Functional Services WG]	In Process	1st review RFP	issue RFP		Initial Submittion	Pre-review	Revised Submittion			
User Identification RFP [Robotic Functional Services WG]	In Process	discussion	discussion	1st Draft	2nd Draft	1st review RFP	RFP			
Programmers API: Typical device abstract interfaces and hierarchies RFP [Profile WG]	In Process		discussion	1st review RFP	RFP		Initial Submittion	Pre-review		
Hardware-level Resources: define resource profiles RFP [Profile WG]	In Process				1st review RFP	RFP		Initial Submittion	Pre-review	
etc…	Future									to be discussed
Robotics Information Day [Technology Showcase]	Planned	Planning	Seminar							Yokomachi(NEDO), Kotoku(AIST)
Robot Technology Components RFP (SDO model for robotics domain)	done Sep-2006									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)

Why Do We Need Standardization of Robot Technology?

OMG Robotics-DTF Seminar
June 25, 2007

Masayoshi Yokomachi
Project Coordinator
Machinery System Development Department
New Energy and Industrial Technology Development Organization (NEDO)
JAPAN

-R&D PROJECT AT NEDO-

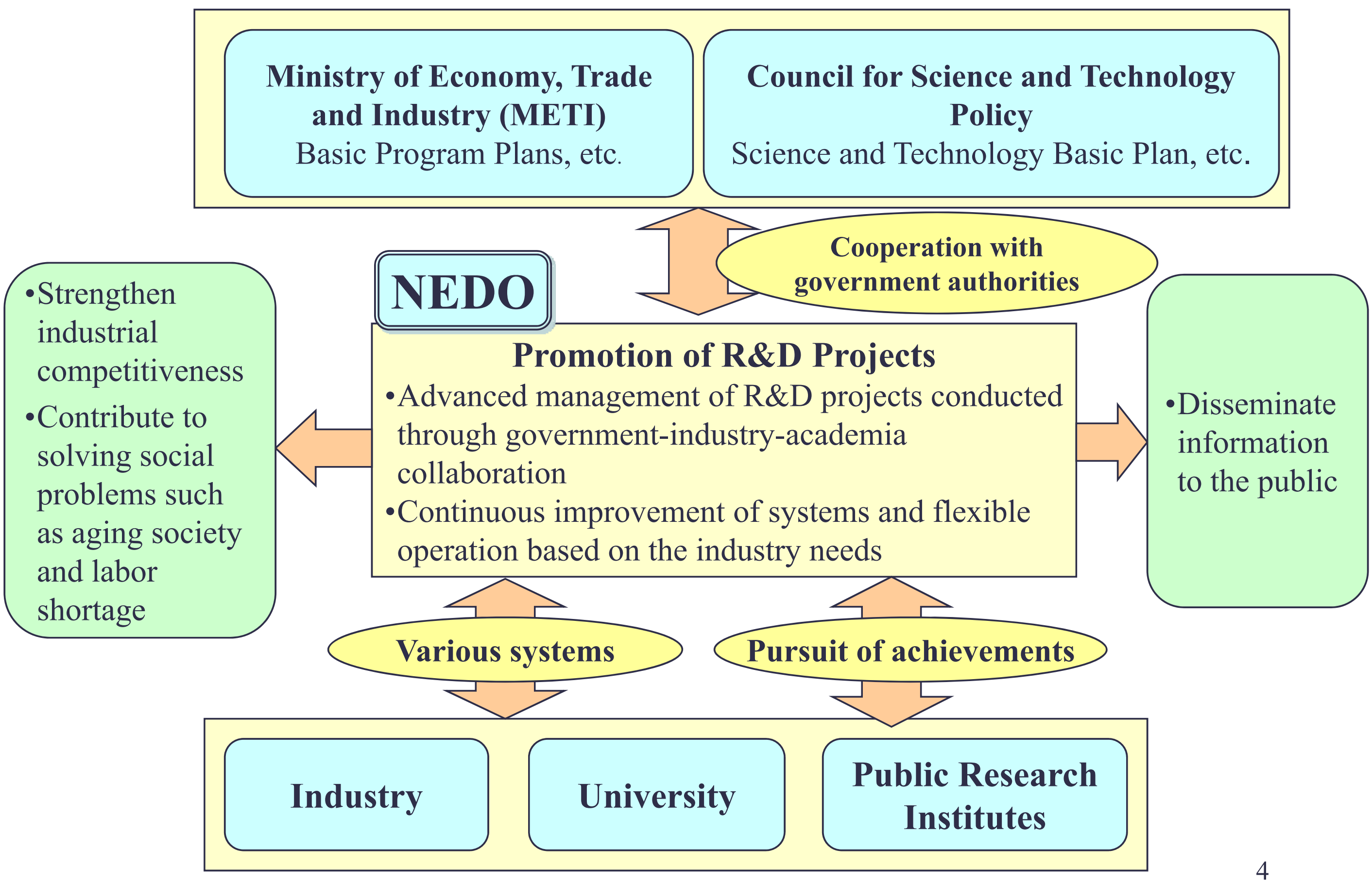


(Billion Yen)

Budget of NEDO

Budget of NEDO	FY2006	FY2007
R&D Projects	**130.6**	**149.3**
• Exploration of Industrial Seeds	6.7	5.9
• Mid-to Long-term / High Risk Research	105.7	125.3
• Support for Practical Application	16.4	16.8
• Others	1.8	1.3
Introduction of New Energy and Energy Conservation	**85.0**	**78.2**
• Field Tests / Overseas Demonstrations	38.5	32.1
• Introduction and Dissemination	41.6	41.4
• Coal Resources Development Projects	4.9	4.6
Acquisition of Emission Reduction Credits through the Kyoto Mechanisms	**5.4**	**12.9**
Administrative	**8.0**	**7.9**
TOTAL	**229.0**	**216.5**

1. Japan's Scheme for Robot R&D

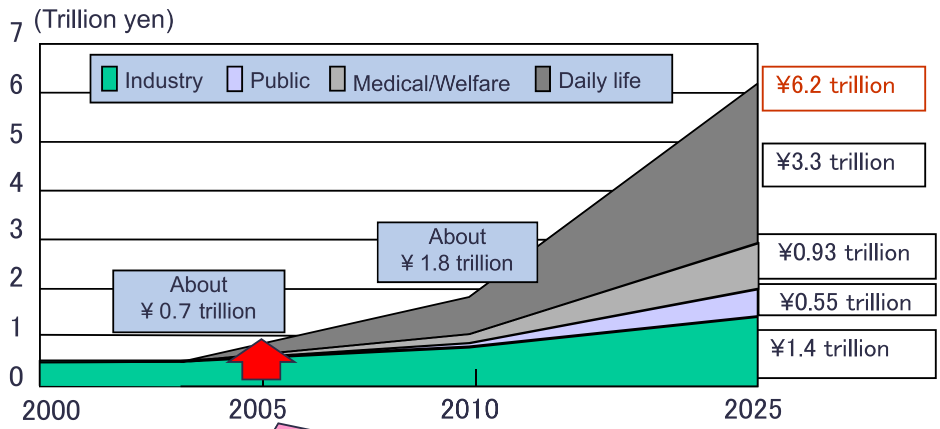


2. Back Ground

(1) General Situation

- In Japan, the robotics industry has developed and expanded through the dissemination of industrial robots (for automobiles and electric appliances).
- On the other hand, expectations regarding the development and commercialization of assistive robots for hospital, welfare, home or other uses have been increasing in Japan.
- Various technological issues such as reliability, safety, operability and ergonomics need to be considered during the development of new type of robot.
- However, as the components and software for robots are developed on an individual basis, it is difficult for developers to share and exchange their research achievements. This has resulted in considerable inefficiency in robot development.

(2) Forecast of Robot Market



Source: New Industry Promotion Strategy, METI

Challenge:
Considerable potential need in hospitals, nursing centers, home, disaster sites, etc.
↓
Specific applications unclear

Target:
① Expand the robot market by developing new applications
- Development of practical application technology
- Building an environment that promotes new market entrants

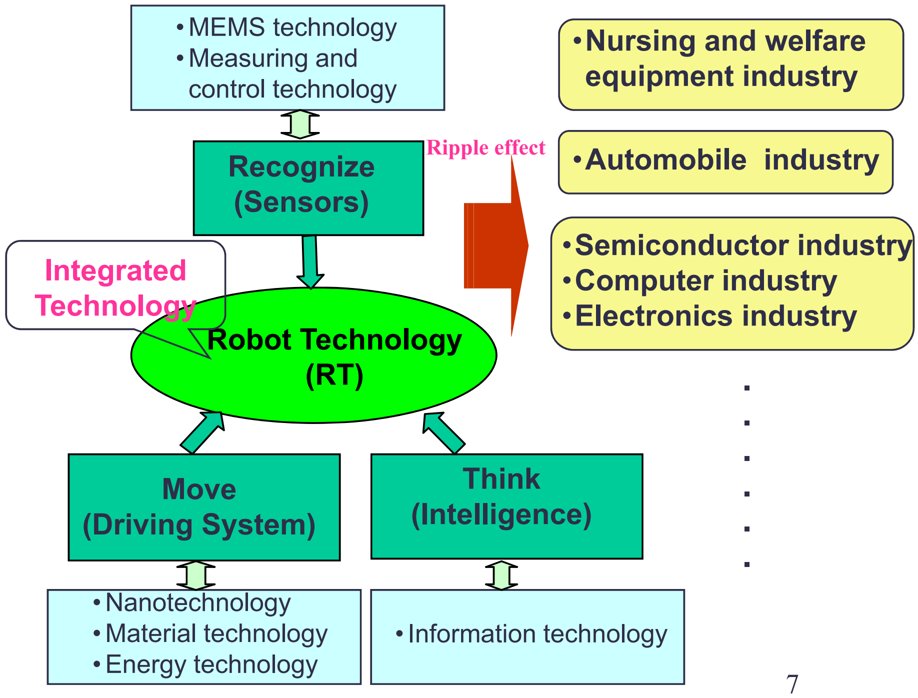
② Spread and expand robot technology to various industrial fields (IT, energy, etc.)

(3) Robot Benefit

•Contribution RT to society

•Advancement in RT contributes to improve technology levels in related fields

- **Creation of new industry and employment**
- **Strengthening of Japan's competitiveness in manufacturing technology**
- **Technological ripple effect to other industries**
- **Realization of a safe society**
- **Support for an aging society and women's participation in society**



(4) Strategic Robot R&D

•Utility Space

Industrial Area → Public Facilities → Living Space

•Robot Task

Limited Task (Production Support)

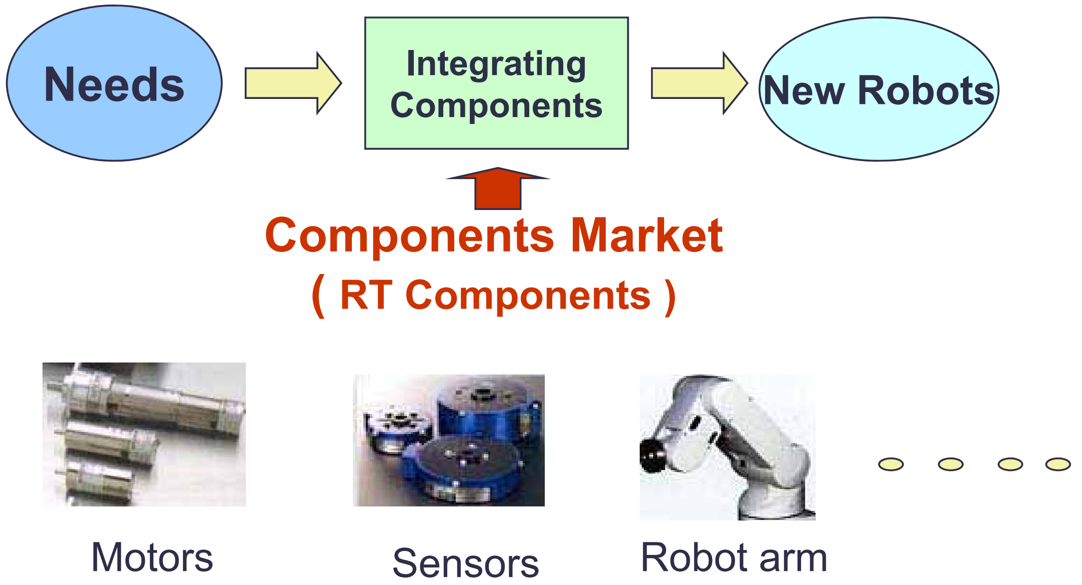
→ Public Works (Guide, Welfare, etc.)

→ General Broad Task (Family Support, etc.)

- Facilitating Practical Service Robot Development responding short-term potential needs such as security, cleaning, reception, childcare, nursing and welfare robots
- Facilitating development of elemental technologies for next-generation robots available in various fields from long-middle term viewpoint
- Establishment of R&D on Common Basis and Standardization of robot technology from the viewpoint of easy joining new player with new technology

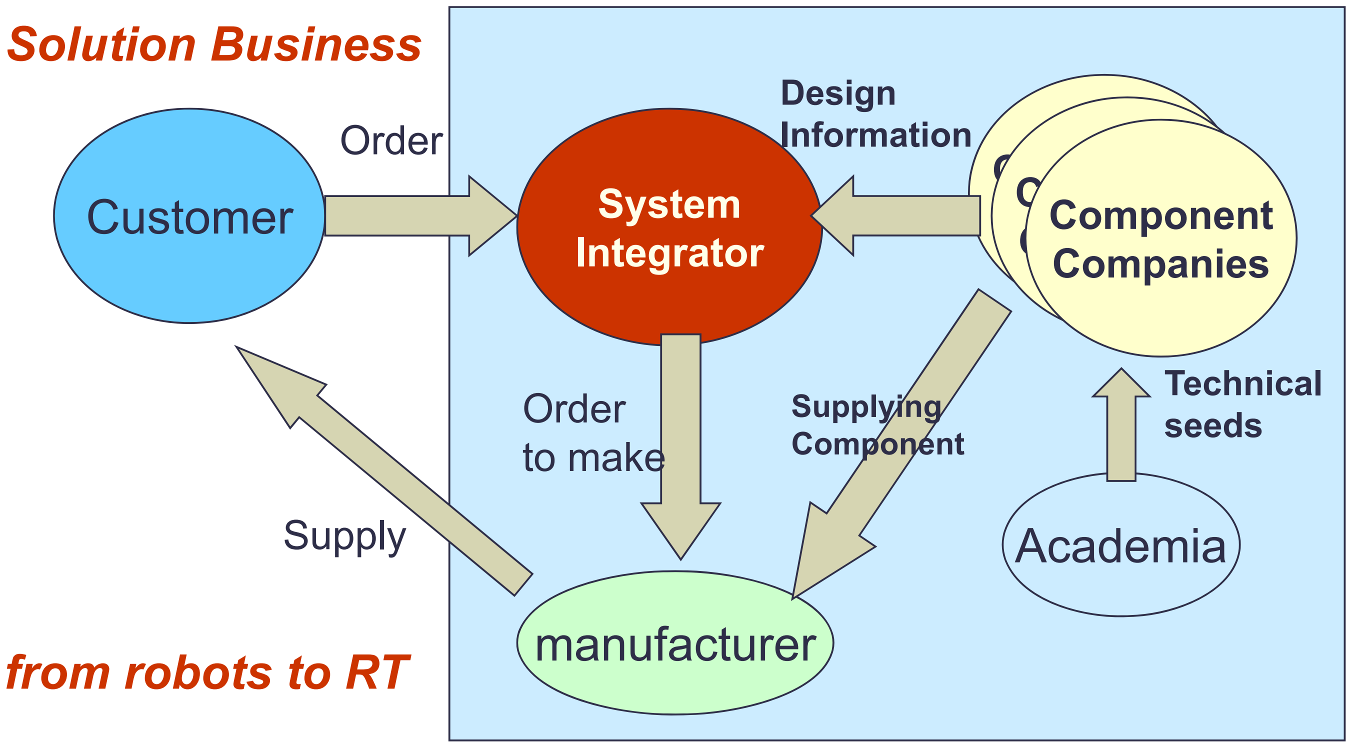
3. Technology Strategy

(1) How new robotic products will be produced?



Made-to-Order Business

(2) How new robotic business will be produced?



21st Century Business Model

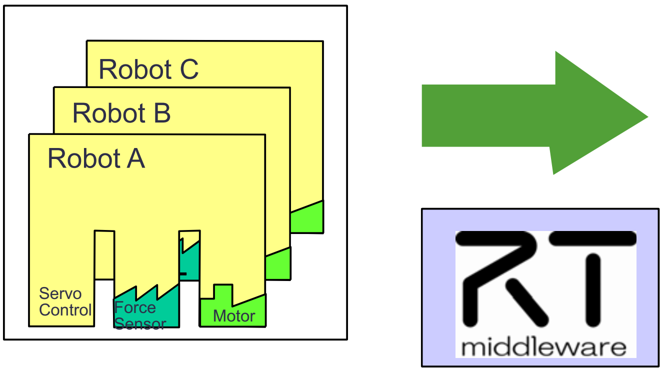
Made-to-Order Business

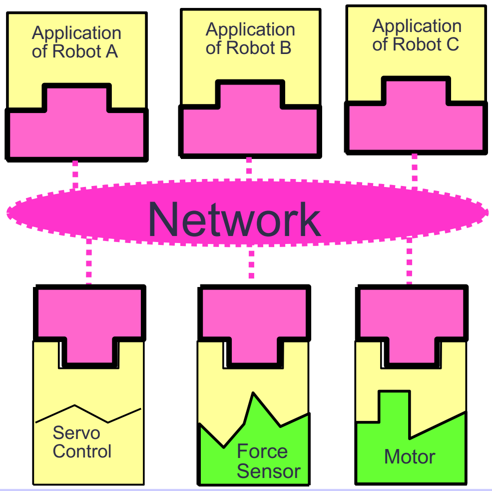
4. RT Middleware Project

(1) Comparison of robot system integration

Conventional Robot Systems

Component Based Robot Systems





- Robot Maker makes Everything of each robot.
- Interfaces of modules in each robot are not defined well. So, it is difficult to re-use them in other robot systems.
- Cost of development is high.
- It is difficult to create a variety of robots

- It will be easy to create new robot by re-using existing modules.
- Cost of development of new robot will be low.
- Module suppliers, software module suppliers and system integrators can join the new robot business.
- It will be easy to develop a variety of robots.

(2) Important Issues

- **Preparing for Technological Infrastructure for the System Integration Industry**
- **Robotic components with open architecture controller should be supplied to the market.**
- **Middleware, a kind of software which standardizes robotic component connection should be considered.**
- **A specially designed processor for open controller of robotic system should be developed.**

(3) Project History

- JARA proposed a new policy and a new development method in its "Summary Report on a Technology Strategy for Creating a "Robot Society" in the 21st Century" published in 2001.

- NEDO carried out the Development of a Software Infrastructure for Robot Systems project (hereinafter the "RT Middleware Project") for three years from FY2002.

(4) Research and Development

- The RT Middleware Project aimed to realize robot systems that can meet the wide-ranging needs of users through the modularization of software.

- Through the project, RT middleware that modularizes functional elements of a robot system was developed.

- This middleware will be utilized as fundamental technology for software that allows easy development of novel robot systems.

(5) Research and Development Outcome

- An RT middleware prototype, OpenRTM-aist-0.2.0, was developed and distributed to evaluation collaborators at no cost by AIST.
- This encouraged the dissemination of project achievements while helping to accumulate technical feedback.
- In order to verify the concept of RT middleware, two prototype systems were developed during the project.
  1)Robot arm control system
  2)Assistive robot system (RT space)

(7) Example of R&D Outcome

"RT space"
Image of a Robot System with Installed Software Modules for a Residential Housing Environment

5. International Standardization in OMG

(1) Object Management Group

- Worldwide software consortium
  - Distributed Object Middleware (CORBA)
  - Object Model Language (UML)
  - Model Driven Architecture (MDA)

- Platform Field Standardization
  OMG's middleware standards and profiles are based on the Common Object Request Broker Architecture (CORBA®) and support a wide variety of industries. All of our specifications may be downloaded without charge from our website.

- Application Fields Specific Standardization
  (Business Enterprise Integration, C4I, Finance,
  Healthcare, Life Science Research, Manufacture,
  Software-based Communication, Space, Robotics)

(2) The Research project on International Standardization of RT Middleware

- To realize a concept for RT middleware that can change robot industry business models, the dissemination of technology through standardization is indispensable.

- Prior to the completion of the RT Middleware Project in 2005, the Research project on International Standardization of Robot Technology (RT) middleware (led by Professor Mizukawa and Dr.Kotoku) for realizing an open and modularized robot system has been started by sending specialists to OMG technical meetings.

- A project has been undertaken and assisted by NEDO to promote international standardization.

(3) Adoption as a Standard Specification

- Following the strictly defined OMG standardization process, the project team released a "Request for Proposal" on the standard specification at the technical meeting held during September 2005 in Atlanta.

- In response to this proposal request, AIST and the US software vendor Real-Time Innovations, Inc. submitted primary proposals for the standard specification.

- Following discussion to build a consensus between the two proposing parties, a unified proposal was submitted at the Boston technical meeting in June 2006.

- This proposal was then modified after a technical review and adopted as a standard specification at the technical meeting in Anaheim during September 2006.

(4) The Scene at Architecture Board

Adoption of Proposed Specification at OMG's Technical Meeting in Anaheim, California (September 29, 2006).

5. Future Plan

(1) Enhancement Plan of RT Middleware

- Although the project has been completed, the RT middleware developed by AIST continues to be improved. OpenRTM-aist-0.4.0, an enhanced RT middleware complying with the adopted standard specification, has been developed.
- Development of software complying with the adopted specification will help to establish a uniform framework for interface specifications and to promote interoperability among robot modules.
- It is expected to become possible in the future to build a robot system combining modules from different vendors.
- Moreover, it is expected that concrete discussions regarding such standard specifications will take place within the OMG's Robotics Domain Task Force.

(2) Utilization of RT Middleware

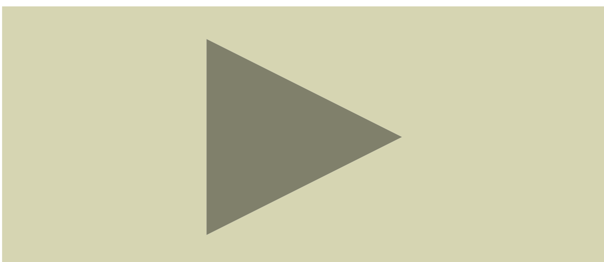
- The RT middleware technology developed by a NEDO project will be utilized in many projects including the Robot Simulator for Distributed Components.
- In these utilizations, the project result will be provided as an RT component for RT middleware. Consequently, the range of usable RT components will be enhanced.
- In addition to the companies participating in these projects, the number of enterprises joining the international standardization activities is expected to increase in the future.

6. Conclusion and Future Plan

- Expectations are high that the cost and efficiency issues to integrate robot systems can be solved by using the standardized RT components.
- Standardization will help the Robot Business expand and create new market.
- R&D for Next-Generation Robots not only contributes to social but also gives ripple effects to many related fields.
- In the future, NEDO plans to make challenges to the following main R&D targets.

7. Example of Human Support Robot

•Collaborative Work with Human Being
•See the Video



Thank you for your attention！

If you have questions, please e-mail to
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Fachhochschule
Bonn-Rhein-Sieg

RoSta

A comparative evaluation of robotic software systems: A case study

Authors: MSc. Azamat Shakhimardanov
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Content

RoSta Overall Vision and Mission

Vision

- Proactively **take the initiative** on the definition of formal **standards** and the establishment of **"de facto" standards** in the field of **robotics**, especially service robotics.
- Formulation of standards (**action plans**) in a few, selected **key topics** which have the highest possible impact.
- Form the **root of a whole chain of standard defining activities** going far beyond the specific activities of RoSta.

4 Topics ("Action Lines")

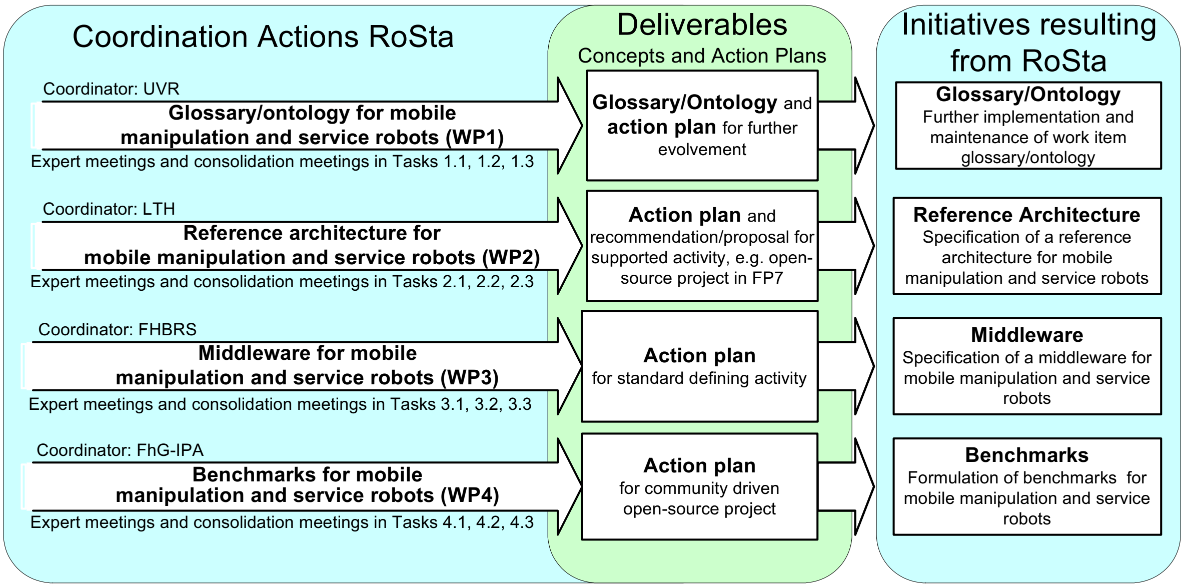
- **Glossary/ontology** for mobile manipulation, service robots
- Specification of a **reference architecture**
- Specification of a **middleware**
- Formulation of **benchmarks**

Profile of 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 mo)
- 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

RoSta Overall Structure



Ultimate RoSta Deliverables

Each line of activity will result either in:

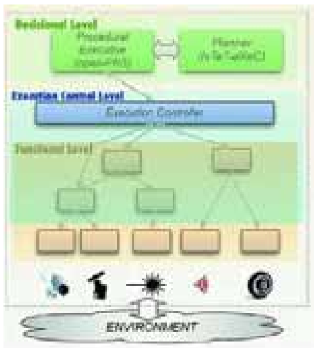
- An **action plan** for a **standard defining activity** or
- An **action plan and a recommendation/proposal** to the European Commission for a **supported activity** (e.g. a open-source project with financial support in FP7) or
- An **action plan for** a **community driven** open-source activity with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

RoSta on the Web

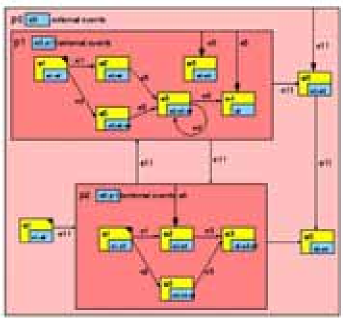
- **Public web page:**
  - http://www.robot-standards.eu/
- **Public wiki**:
  - http://wiki.robot-standards.org/index.php/Main_Page
- **Mailing lists:**
  - middleware@robot-standards.org
  - architecture@robot-standards.org
  - benchmark@robot-standards.org

Integration process – One coherent system

Hardware



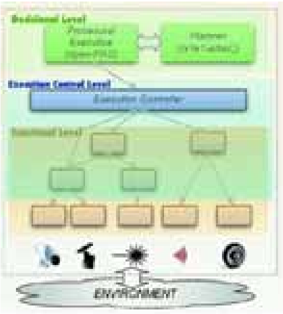
Software architecture



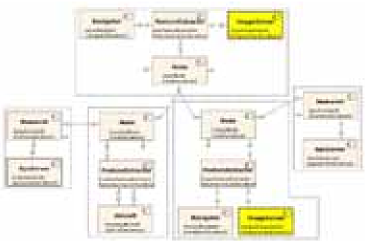
Algorithms

State of the art in robotic SIS

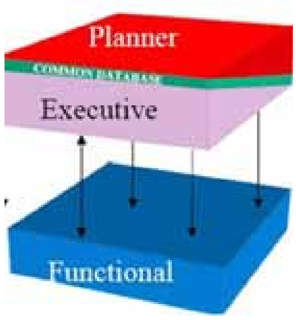
LAAS | ORCA2 | CLARAty | MIRO



* Three layered AM
* Client – server
* TCP sockets and shared memory



*Component based
* Client – server (publisher-subscriber)
* TCP sockets, messages

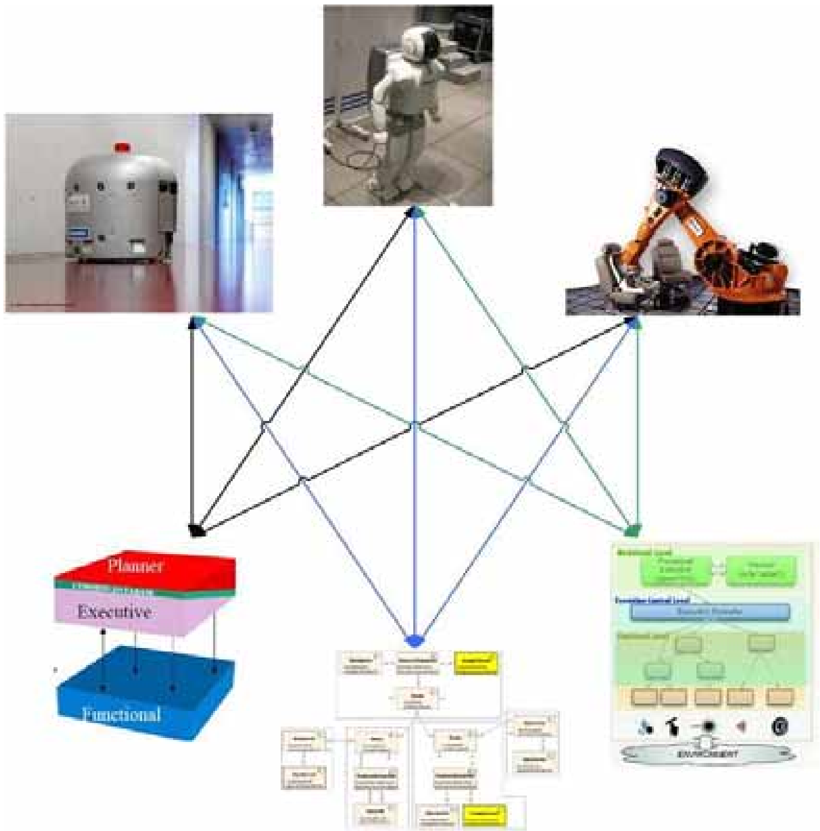


* Two layered AM
* Client – server (publisher-subscriber)
* TCP sockets, messages

* Four layered AM
* Client – server (publisher-subscriber)
* TCP sockets, messages

They are many – I am only one.

- Many projects – the same goal, different approach:
  - **Control Architectures:** LAAS, 3T, TCA, CLARAty, etc
  - **Frameworks/Middleware:** MIRO, ORCA2, Player, Pyro, Marie, MS Robotics, GO etc.
- Which system is the best?
- Which system is suitable for which robotic application?
  - Vacuum cleaner robots, Anthropomorphic robots, industrial robots
- A developer should make a wise choice but HOW?

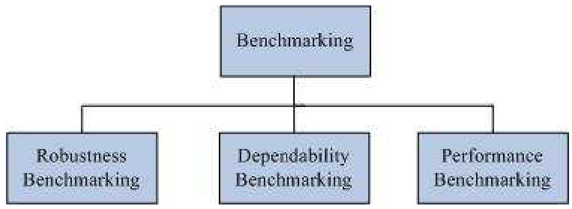


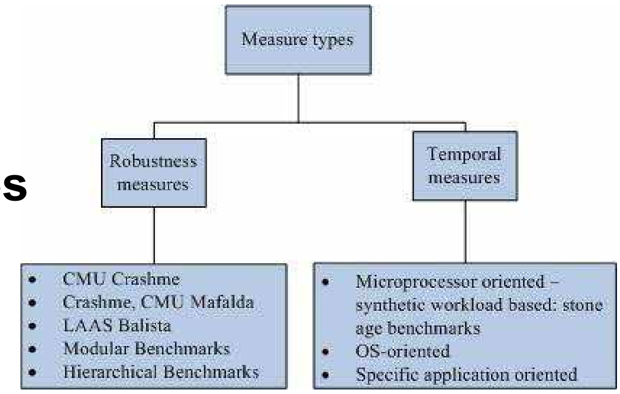
Possible solutions

- Establishing standards in robotics
- Establishing benchmarking procedures and values in robotics
- Establishing evaluation methodology in robotics
- **Our approach** is to combine concepts from *benchmarking* and *software architecture evaluation* domains

Benchmarking, a gross view

- **Benchmark types**
  - Robustness benchmarks
  - Dependability benchmarks
  - Performance benchmarks
- **Benchmark measures**
  - Robustness measures
  - Temporal measures
- **Measurement techniques**
  - Model-based techniques
  - Measurement-based techniques

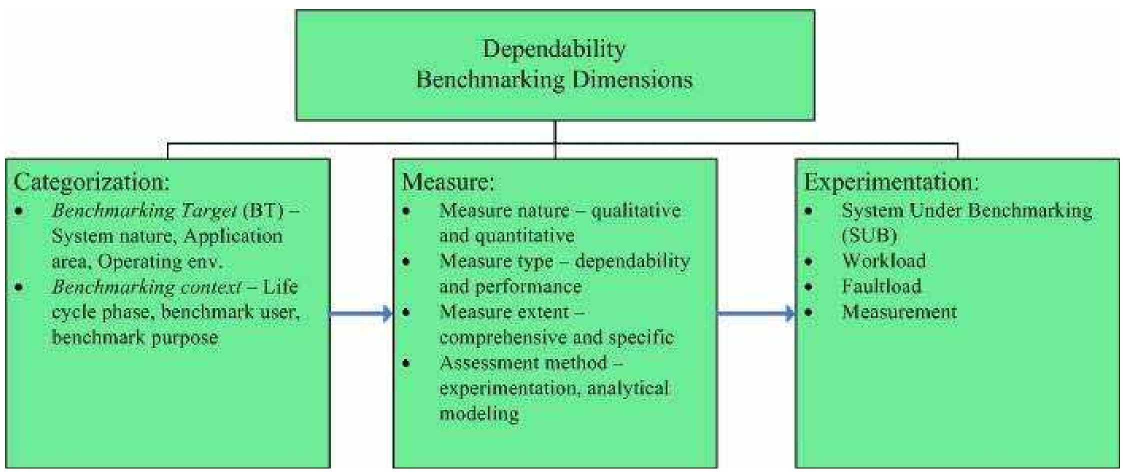




State of the Art (1)

Benchmarking, a gross view

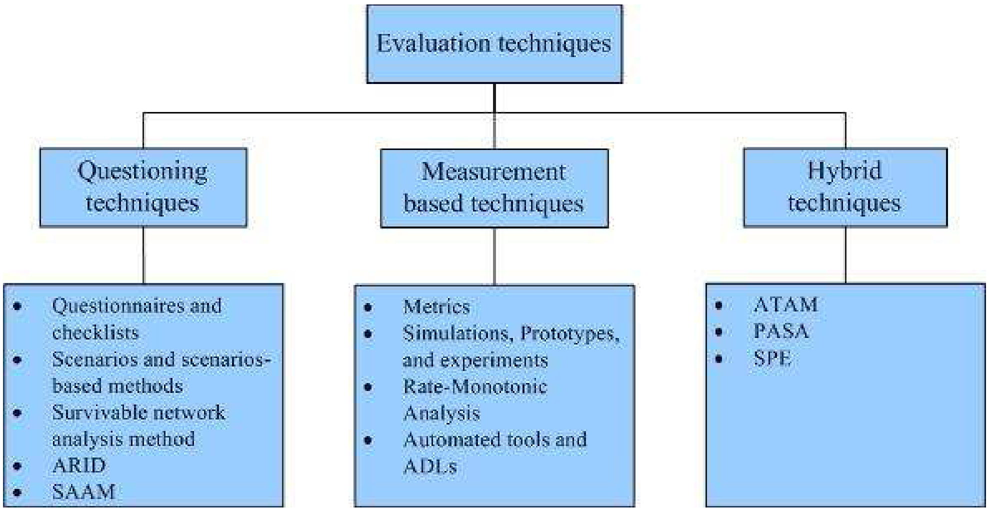
- Benchmark is defined along 3 dimensions
  - Categorization
  - Measurement
  - Experimentation



State of the Art (2)

Software architecture evaluation in SE

- There are mainly 3 evaluation techniques for SA



Reflections on State of the Art

- Most of the approaches are limited to qualitative evaluation
- Benchmarks are limited to pure software environments where there is only limited interaction with the external world, often conducted under artificial loads
- Benchmarks do not consider interrelation of quality attributes.
- SAE methods do often require system specification docs which is difficult for open source robotics projects

Let's talk about "Models"

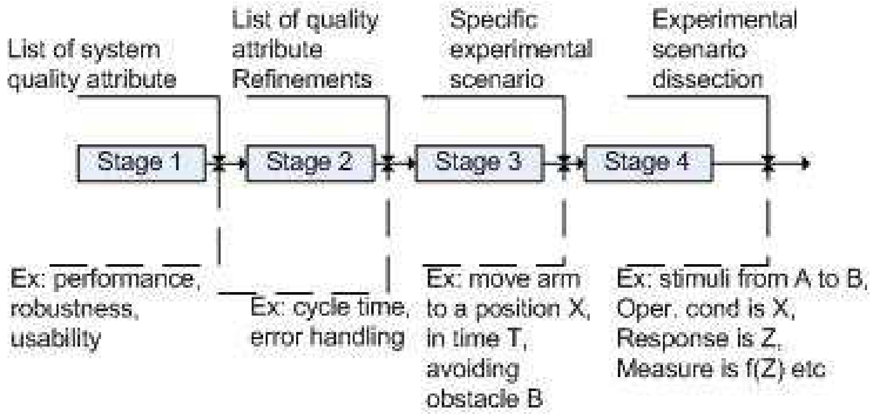
System Model	1. Data exchange model 2. Interface model 3. Distribution model
Control Model	1. Centralized 2. Event-Driven
Decomposition Model	1. Data - flow model 2. OOM\COM
Fault tolerance	System resources, system level robustness
Robustness	Robustness to external dangers

What models do robotic architectures use?

	Architectural Overview			Dependability Aspects	
	System Model	**Control Model**	**Decomposition Model**	**Fault tolerance**	**Robustness**
LAAS	• Distributed data •Client-server (RPC) •3 layered abstract machine (AM)	• Centralized •Event driven	• Functional decomposition, COM	• Resource checker, GenOM, state estimation…,	• Planner/ Supervisor, executor
CLARAty	• Distributed data •Client-server (RPC) •2 layered AM	• Centralized •Event-driven	• Functional decomposition, OOM\COM	• Resource checker, State estimators, verification, test classes…,	• Planner/Scheduler, executor
CIRCA	• Distributed data •Some messaging mechanism •2 layered AM	• Centralized •Event-driven	•Functional decomposition, Not Clear	• State Estimation, Scheduler	Planner (sacrifices completeness for timeliness)
IDEA	•Distributed data •IPC •3 layered AM, Agent based	•Event-driven •Centralized	• COM, where each component is an agent	• RT guarantees	• Planner,
RAX/ Livingstone	•3 layered abstract machine •Distributed Data •Some RPC, not clear	•Centralized •Event-driven	•Functional decomposition, Not Clear	•MIR (Livingstone module)	•Planner/Executor
ORCCAD	•Distributed processor •3 layered abstract machine	• Centralized •Event-driven	• Can be considered COM	•Undergoes V&V process	Not clear

A methodology for comparative evaluation

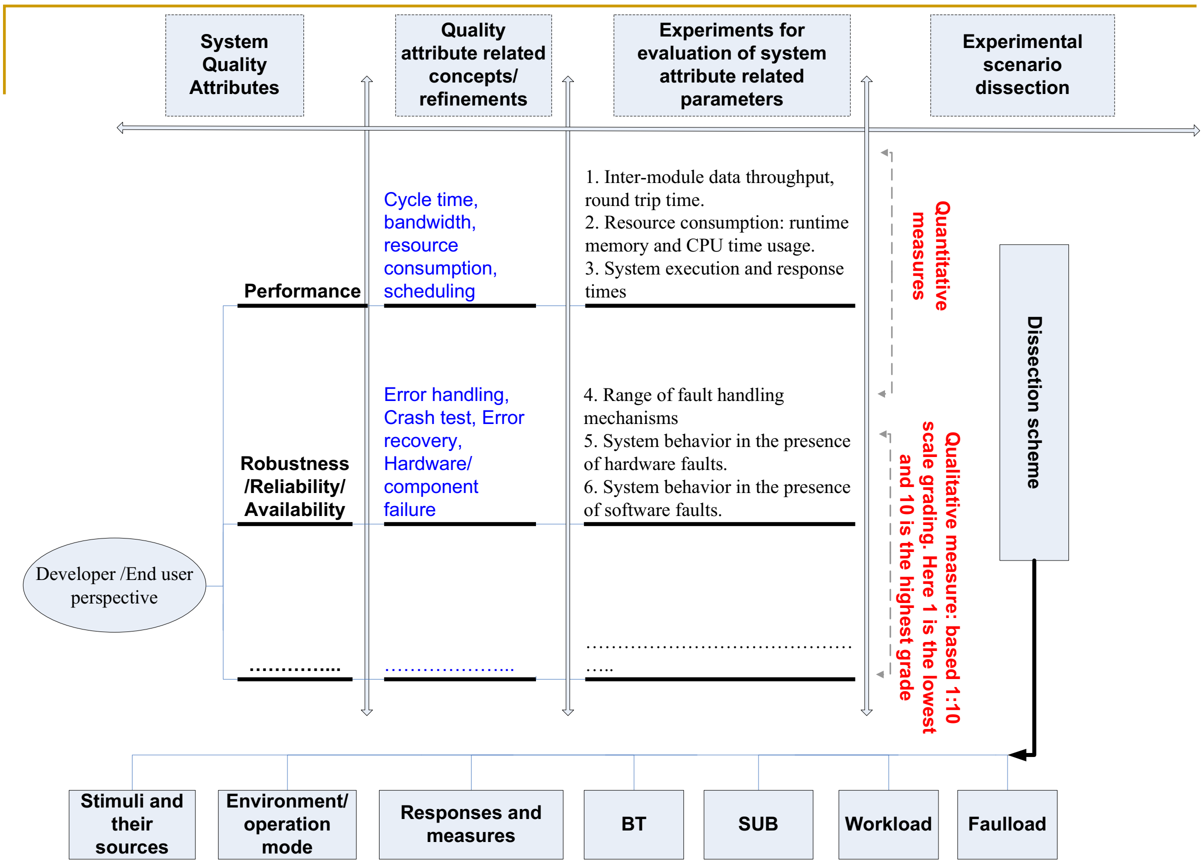
- Combines both architecture evaluation and benchmarking concepts
- Produces results of both qualitative and quantitative character
- Can be viewed as top-down approach, i.e. from general to a specific concepts
- Evaluation is performed in 4 phases



A methodology for comparative evaluation

Four stage evaluation based on experimental scenarios:

- System Quality attributes: performance, robustness, usability etc.
- Quality attribute refinements:
  - Performance – Cycle time, Round trip time etc.
  - Robustness – fault handling mechanisms, monitoring etc.
  - Usability – Documentation, learning curve etc
  - …..
- Definition of experimental scenarios to evaluate attribute related refinements: these are often arising conditions in operational life of a robotic system
- Experiment dissection and measurements:
  - Quantitative measurements
  - Qualitative measurements



Approach (5)

Experimental scenario example

- Most of the the general system features do often exhibit through the specific scenarios
- Specific scenarios are simpler and intuitive to measure

Stimuli	Periodic events of position data generation by one of the software components.
Environment/Operation mode	Normal runtime operation mode.
Responses/Measures	Events are handled by respective components in the system. Experimental data is obtained on: Throughput - byte/sec. Round trip time - sec.
BT	An application of 5 software components based on each SIS.
SUB	IBM Thinkpad laptop, Linux OS, and robotic arm.
Workload	Data from joint position sensors, data to actuators and user commands.
Faultload	None

Approach (6)

Hardware setup

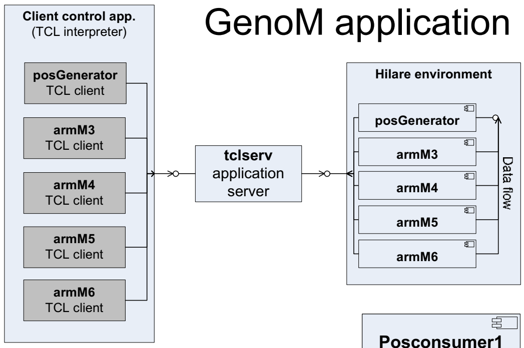
- Three software systems were tested: **GenoM, ORCA2 and GO**
- Tests were conducted both in **simulated** and **real world** environments.
- Real environment was composed of a PC and a robotic arm

Systems under evaluation

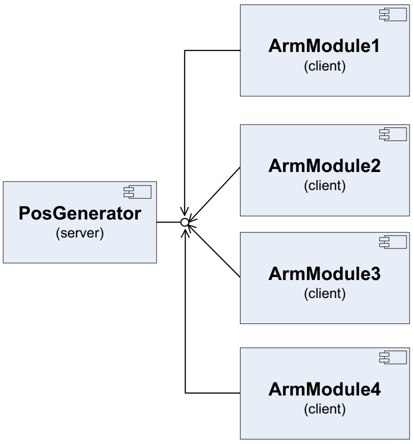
- **GenoM** – developed at LAAS CNRS, RIA Group, France.
  - Used as a functional layer in LAAS 3 tier architecture
  - Uses component-based decomposition model
  - Inter-component communication is based on custom protocol, sockets, using messages and shared memory
- **ORCA2** – developed at department of Field Robotics, University of Sydney, Australia.
  - Uses component-based decomposition model
  - Inter-component communication is based on ICE protocol, sockets, using messages
- **GO** – developed department of Robotics, Fraunhofer IPA, Stuttgart, Germany.
  - Uses component-based decomposition or monolithic program
  - Inter-component communication is based on custom protocol, sockets or Python object references

Software application setup

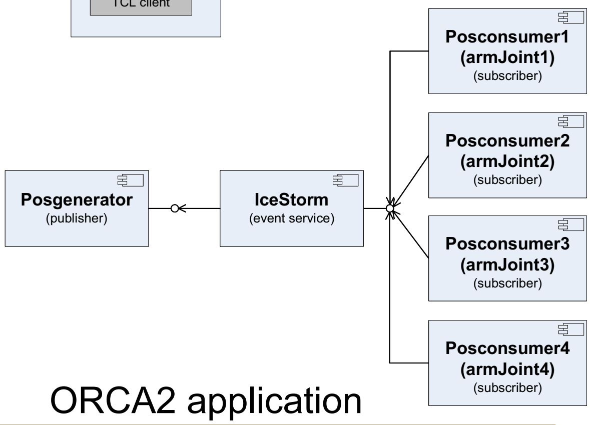
- On real hardware, 5 software components
- 1 server – 4 clients relationship



GenoM application



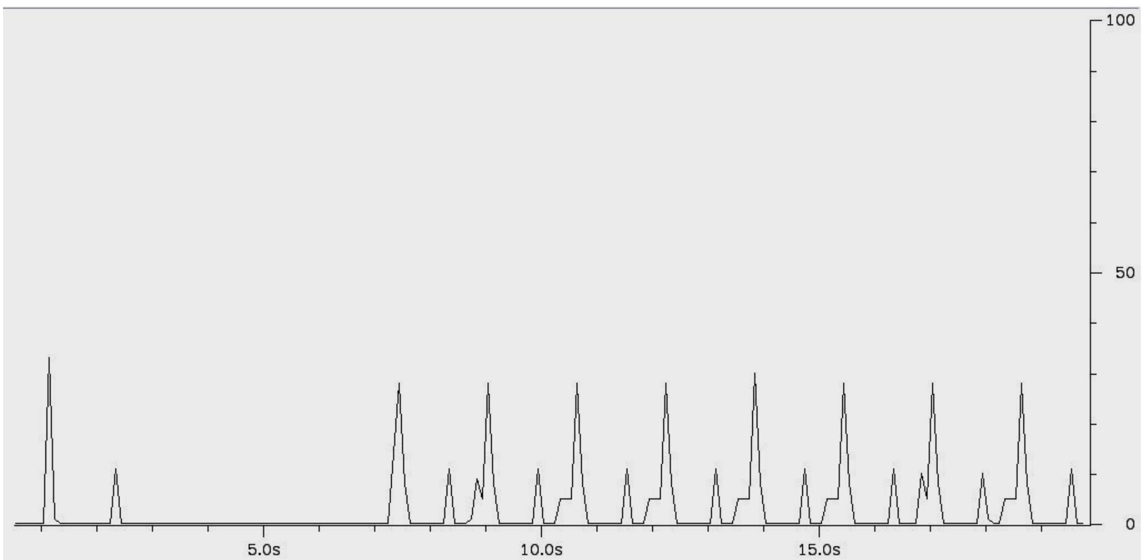
GO application



ORCA2 application

Experimental results

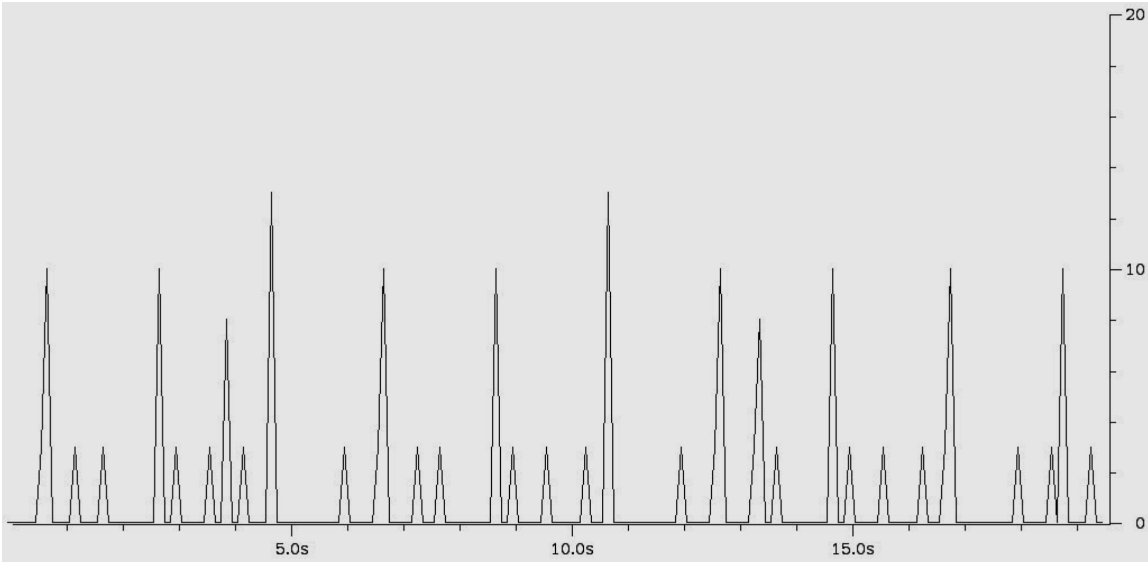
GenoM communication performance



Round trip time = (2xe-4, 5xe-3) sec **Data throughput = (500, 170) bytes/sec**

Experimental results

ORCA2 communication performance



Round trip time = (3.1xe-4, 4.2xe-4) sec **Data throughput = (14.8, 17) bytes/sec**

Experimental results

GO communication performance

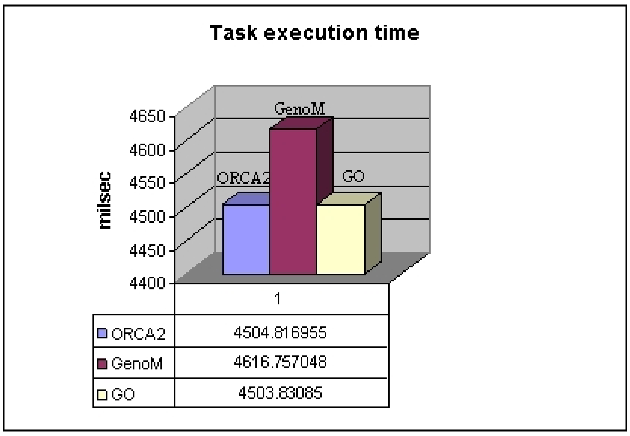
- **Not Applicable: Because it is based on monolithic program approach. This is the usual and efficient communication mechanism in one processor enviroment**

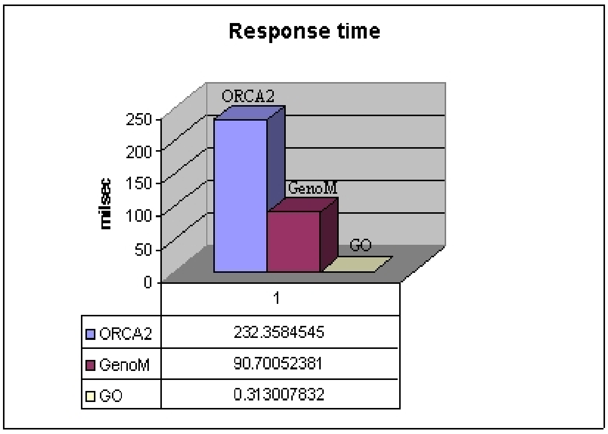
	GenoM	ORCA2	GO
Round Trip Time in seconds	(2xe-4, 5xe-3)	(3.1e-4, 4.2e-4)	N/A
Data Throughput in bytes/sec	(500, 170)	(14.8, 17)	N/A

Inter-component communication summary

Experimental results

Task Execution and Response times





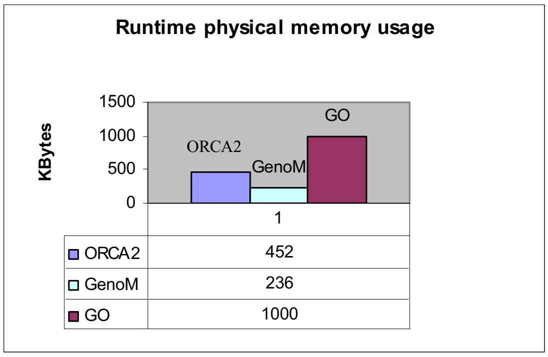
Task execution time

Response time

Experimental results

Resource consumption

	GenoM	ORCA2	GO
Total number of processes	8	6	1
Total number of threads	21	39	5
Average sleep time of a process	94%	68.17%	98%



Processes and threads

Runtime memory usage

Experimental results

System robustness to hardware and software faults

	GenoM	ORCA2	GO
Behavior in the presence of hardware faults	Software application runs, hardware stays irresponsive. Sometimes the TCL interpreter blocks.	Software application runs, hardware stays irresponsive. There is a delay in packet delivery.	Software application runs, hardware stays irresponsive. Sometimes the Python interpreter blocks.
Behavior in the presence of software faults	In TCL based approach, failure/crash of one of the components also stops script execution. Module processes are not affected.	Application works fine even if some components fail/crash.	The application will not run as long as there are errors in the Python script.

Experimental results final

		GenoM	ORCA2	GO
Performance evaluation experiments	1. Inter-component communication	RTT = (2xe-4, 5xe-3) sec DTP = (500, 170) bytes/ sec	RTT = (3.1e-4, 4.2e-4) sec DTP = (14.8 - 17) bytes	N/A
	2. Resource consumption	Memory = 236 Kbytes Proc, Thread, SleepTime = (8,21,94 %)	Memory = 452 Kbytes Proc, Thread, SleepTime = (6,39,68,17%)	Memory = 1000 Kbyes Proc, Thread, SleepTime = (1,5,98%)
	3. Execution and Response time	Texec = 4616.75 msec Tres = 90.7 msec	Texec = 4504.16 msec Tres = 232.36 msec	Texec = 4503.83 msec Tres = 0.31 msec
Robustness, reliability and availability evaluation experiments	4. Fault handling mechanisms	Grade 6	Grade 5	Grade 2
	5. System behavior in presence of hardware faults	Grade 2	Grade 3	Grade 1
	6. System behavior in presence of software faults	Grade 3	Grade 5	Grade 1

Conclusions

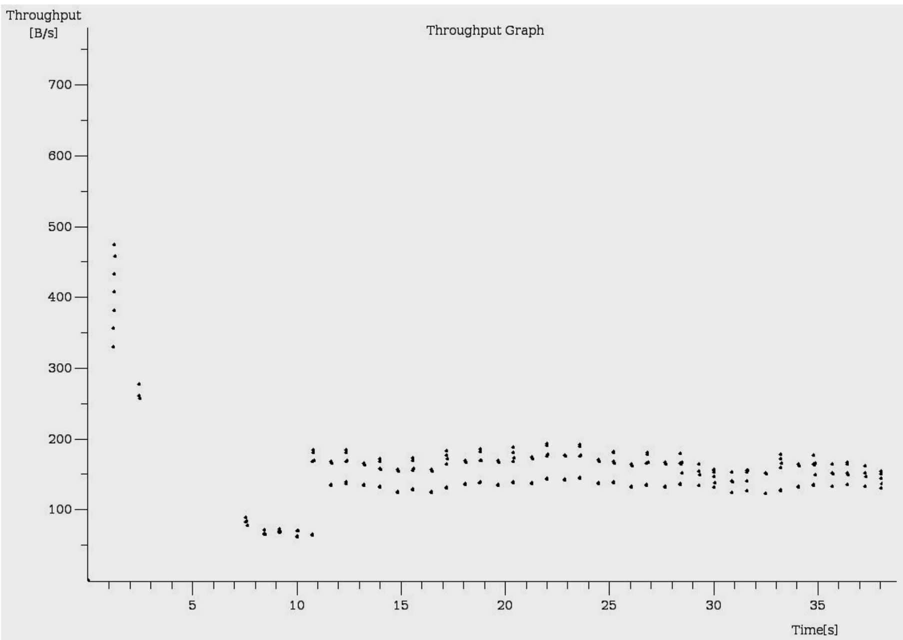
- Evaluation Results:
  - All systems require improvements in robustness aspects.
- Evaluation Approach :
  - Define a complete list of quality attributes for a robotic application
  - Based on operation profile of an application more elaborate experimental scenarios
  - Improved measurement techniques using modeling and simulation
  - One system – one grade – one choice
  - Extension of the framework to assess algorithms, internal design which can be useful for a developer

Thank you for the attention!

BACKUP SLIDES

Experimental results(1)

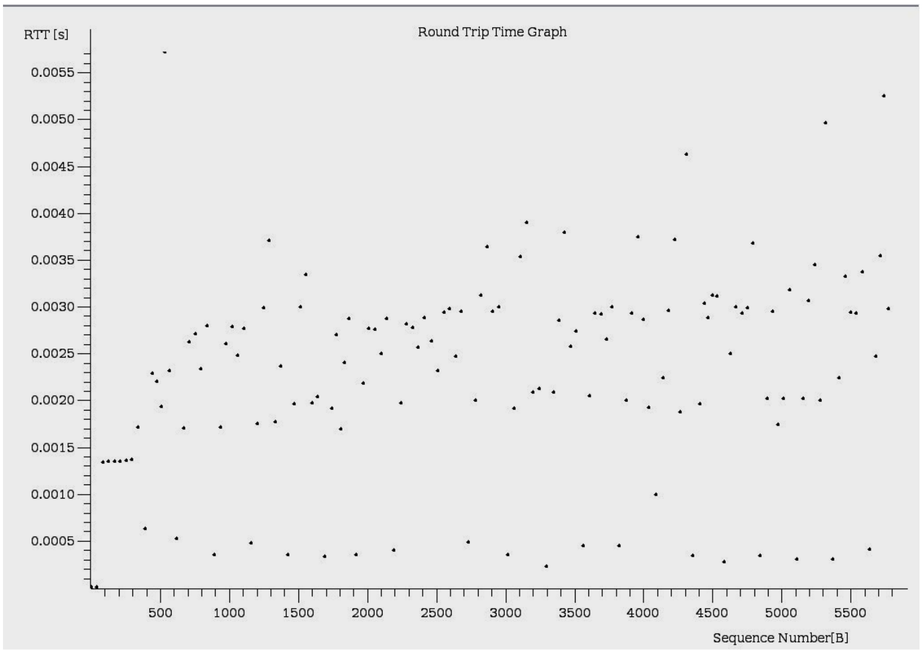
GenoM communication performance



Data throughput

Experimental results(2)

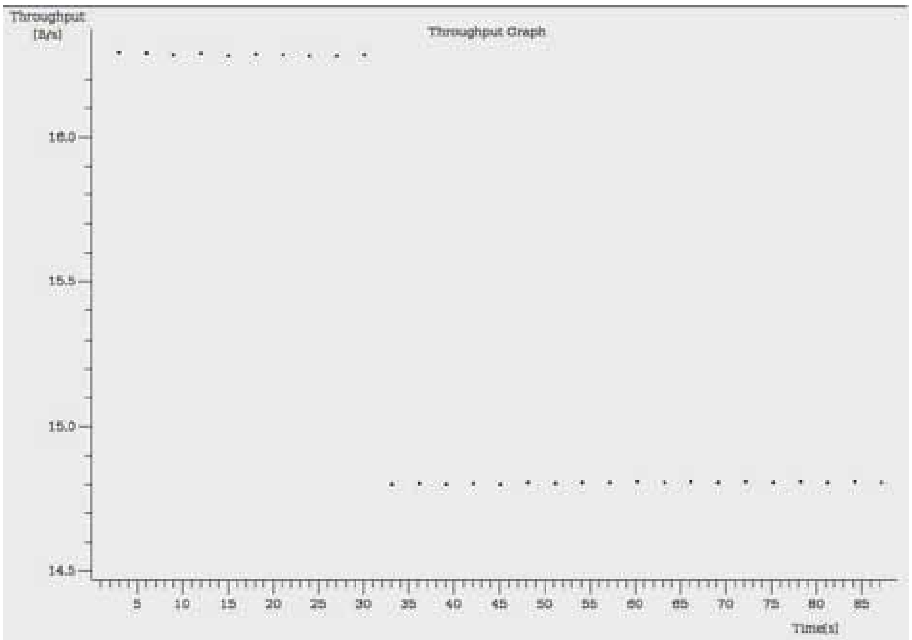
GenoM communication performance



Round trip time

Experimental results(3)

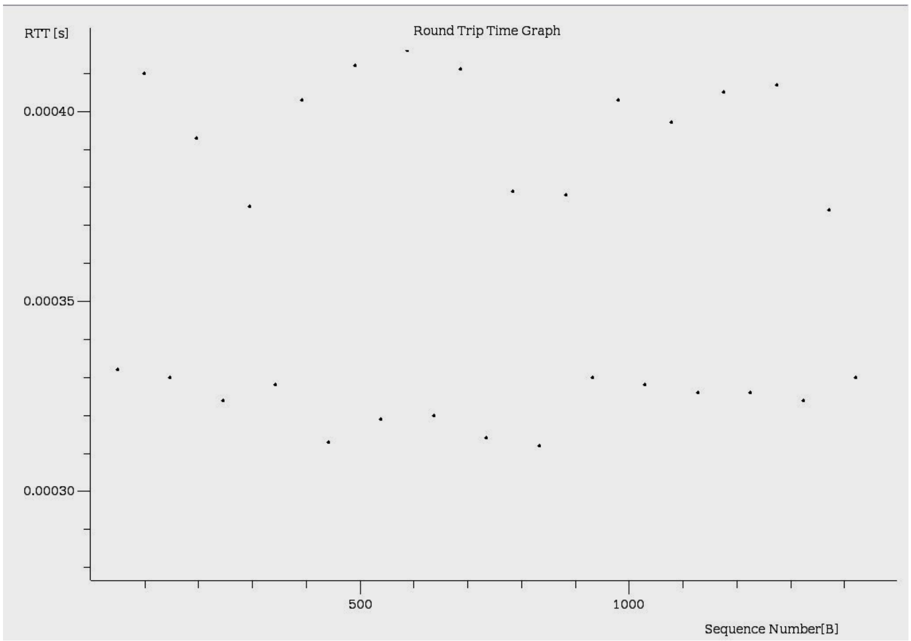
ORCA2 communication performance



Data throughput

Experimental results(4)

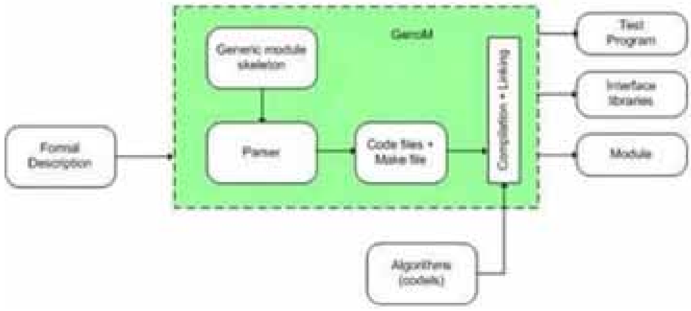
ORCA2 communication performance

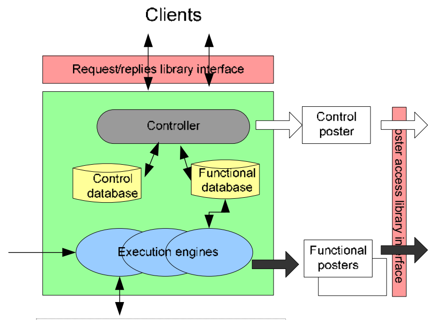


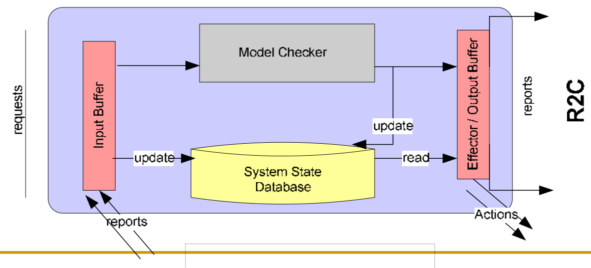
Round trip time

	Architectural Overview			Dependability aspects	
	System Model	Control Model	Modular Decomposition Model	Fault tolerance	Robustness
LAAS	• 3 layered Abstract Machine (AM) • Decentralized Data • Client-Server	• Centralized • Event Driven	• Functional • Component Oriented	R2C, automated code generation (GenOM, ExoGen), codels, component diagnosis	Planner/supervisor pair, execution control (OpenPRS)
CLARAty	• 2 layered AM • Decentralized data • Client-Server	• Centralized • Event Driven	• Functional • Component Oriented	Resources checking, state estimation, verification, test, simulation classes	Planner/scheduler, execution control (TDL), external state estimation classes
ORCCAD	• No specific system model, based on tools, but some aspects are similar to tiered approach	• Applications developed rely on both centralized and event-driven control	• The use of RTs can be considered a component oriented approach	Emphasis on V&V processes, simulation, hardware analysis before generating code, code-hardware resource mapping	On the level of RTs and RPs there are 3 types of exception handling, no notion of planner or executive but should be possible to implement
3T	• 3 layered AM • TCP/IP based messaging • Decentralized data	• Centralized • Event Driven	• Functional • Component oriented on the level of skills	Skill monitoring, comm. monitoring, automated code generation, tools for V&V processes	AP planner, executive, GSR scheduler, event recognition system tracks anomalies in logged data
RAX/Livingtone	• 3 layered AM • Based on BUS system • Decentralized data	• Centralized • Event Driven	• Not clear, bust some features of function oriented pipelining can be observed	Livingstone provides state estimation, fault diagnosis, reconfiguration	Planner/Scheduler, Mission Manager, Executive
Player	• There is no particular architectural constraint • Client – Server • Decentralized data	• Not applicable; but on module level can be considered centralized, since it relies on polling model	• Particular functionalities are implemented as stand alone components	There are no explicit fault handling capabilities, apart from "libplayererror" library, some thread locking mechanim	No explicit planner or executive, but most probably can be implemented
ORCA	• There is no particular architectural constraint • Peer to peer • Decentralized data	• Not applicable; not clear on component level	• Component oriented	There are no explicit fault handling capabilities apart from some dynamic component reconfiguration based on	No explicit planner or executive, but most probably can be implemented
CoolBot	• There is no particular architectural constraint • Peer to peer, client – server • Decentralized data	• On component level both event-driven and centralized control models are adopted	• Component oriented	Different exception handling capabilities on component level based on "continuous plans", adaptation via degradation, promotion, equalization, component monitoring	No explicit planner or executive, but most probably can be implemented

LAAS Architecture

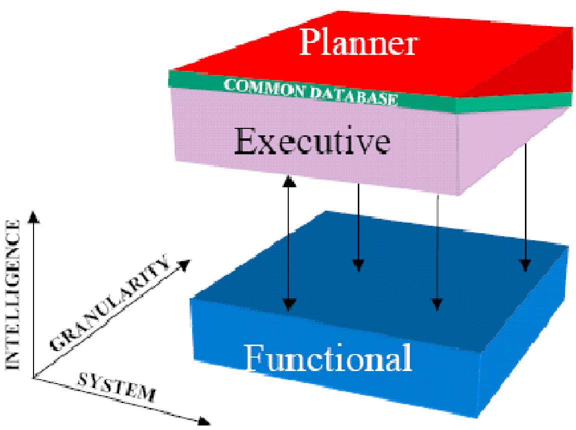


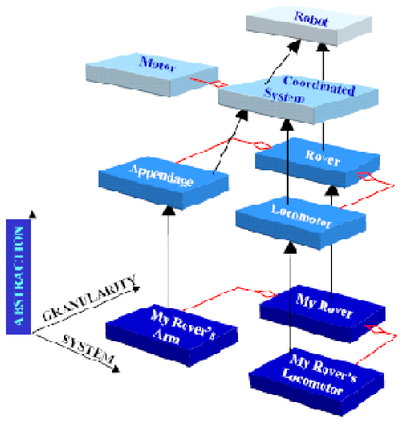




Courtesy of LAAS-CNRS

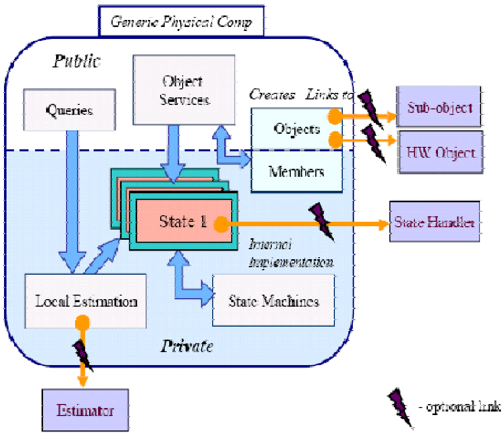
CLARAty Architecture

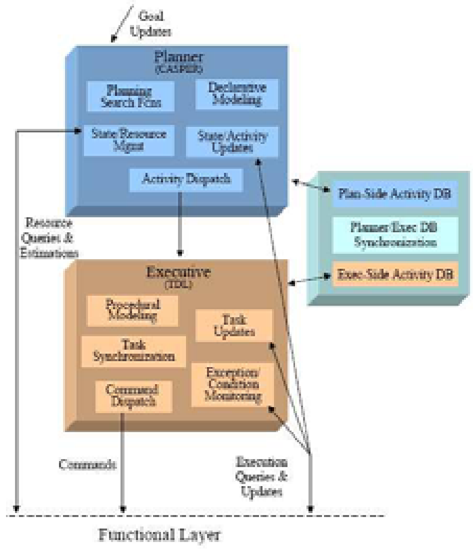




Courtesy of NASA

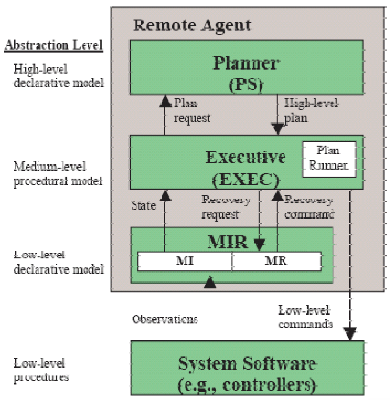
CLARAty Architecture

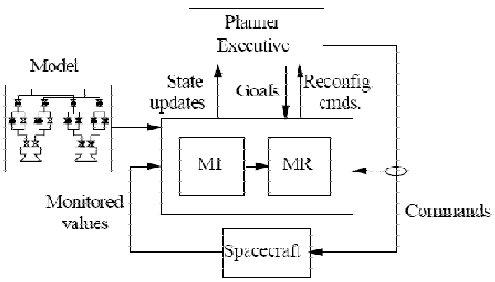


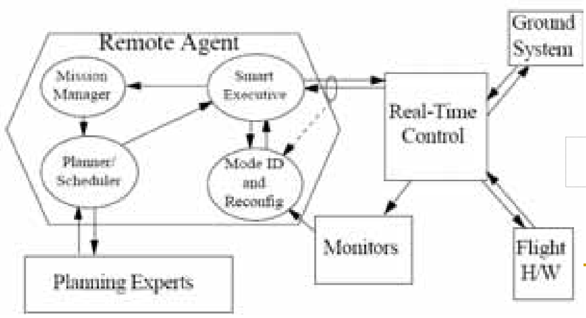


Courtesy of NASA

RAX/Livingstone Architecture

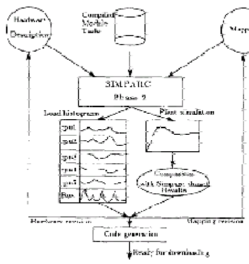


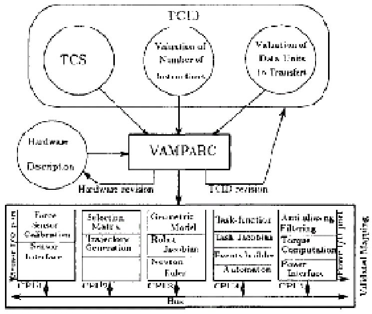




Courtesy of NASA

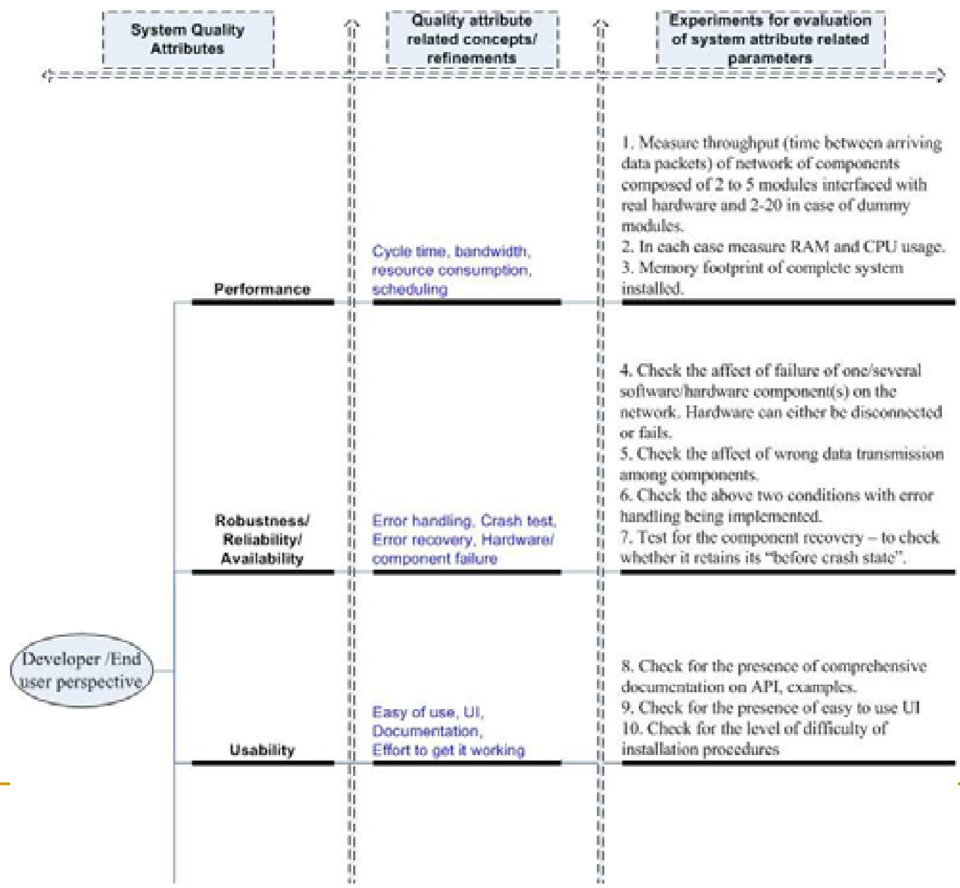
ORCCAD Architecture





Courtesy of National Research Institute of Informatics and Automation, France

Future Work



	Stimuli	Environment/Operation mode	Responses/Measures	BT	SUB	Workload	Faultload
1	Periodic and sporadic events either from robotic hardware or software components.	Normal operation mode or in case of incapacity to handle many components degraded operation mode or system failure.	Events are handled, or system crashes or performance degrades (because of not being able to handle number of components running): throughput - byte/sec.	A particular SIS based network of components.	PC hardware and OS, Robot hardware	Data from sensors, data to actuators, user commands (have to specify packet size)	NOne
2	The same as in experiment 1.	The same as in experiment 1.	Ram - byte, CPU - %	The same as in experiment 1.	The same as in experiment 1.	The same as in experiment 1.	None
3	A user wants to learn about system	Normal operation mode	Memory footprint - byte	The same as in experiment 1.	The same as in experiment 1.	Not applicable	Not applicable.
4	Hardware/software comp. failure.	Initially normal oper. mode after failure of one comp. the mode is degraded or system failure.	System either crashes, while no error handling implemented degrades in performance : number of failed comp., throughput.	The same as in experiment 1.	The same as in experiment 1.	The same as in experiment 1.	Hardware failure, component failure (simulated by disconnecting hardware or stopping running component).
5	Hardware/software comp. transmit wrong data to each other.	Initially normal oper. mode and after some time degraded mode or system failure.	System continues functioning but outputs wrong results, or system crashes or gradually degrades (some parts still provide correct outputs): number of comp. providing wrong data, throughput.	The same as in experiment 1.	The same as in experiment 1.	The same as in experiment 1.	Distort sensor readings and actuator actions by external objects, provide wrong user commands.
6	Combination of the stimuli from experiments 4 and 5.	Normal and degraded modes, system failure.	System handles wrong data and component failures and continues in degraded mode or crashes: number of comp. failed and providing wrong data, throughput.	The same as in experiment 1.	The same as in experiment 1.	The same as in experiment 1.	Combination of faultload from experiments 4 and 5.
7	Either of the stimuli in experiments 4 and 5 or their combination.	Degraded mode if the system was running or normal if it is restarted.	After system crash or component failure, the system starts from the last non faulty state: number of recovered components, component saves its last state (yes/no)	The same as in experiment 1.	The same as in experiment 1.	The same as in experiment 1.	Combination of faultload from either experiment 4 and 5. In case of the restarted system no faultload is present.
8	A user wants to learn about system features, use it efficiently and avoid errors while implementing new features.	Normal operation mode at runtime or before installation.	Presence of through documentation and examples: yes/no	The same as in experiment 1.	The same as in experiment 1.	At runtime as in experiment 1 or none before system installation.	None
9	A user wants to see system runtime data graphically, control via GUI.	Normal operation mode.	Presence of UI: the level of sophistication - High/medium/poor	The same as in experiment 1.	The same as in experiment 1.	The same as in experiment 1.	None
10	A user wants to install a system and try it out.	Not applicable or Normal operation mode.	The level of difficulty to install the software: Complicated/standard/push the button.	The same as in experiment 1.	The same as in experiment 1.	None	None
11	A user wants to use all the fancy hardware he bought with the robot.	Normal operation mode	The variety of hardware and algorithms supported (ready present component repository): High/medium/poor.	The same as in experiment 1.	The same as in experiment 1.	The same as in experiment 1 at runtime or none if one only counts packages.	None
12	A user wants to test/work with different middleware.	Normal operation mode	System allows to change between different middleware: the number and variety of middleware supported.	The same as in experiment 1.	The same as in experiment 1.	The same as in experiment 1 at runtime or none if one only counts packages.	None
13	A user wants to use several operating systems.	Normal operation mode	System can be used with different OS: The portability level: High/medium/poor.	The same as in experiment 1.	The same as in experiment 1.	None	None
14	A user bought new robot with different hardware and software and wants to use his old work.	Normal operation mode	The same as in experiment 11.	The same as in experiment 1.	The same as in experiment 1.	The same as in experiment 1.	None

Robotics DTF and Robotic Technology Components

Rick Warren
Lead Software Engineer, RTI

Brussels, June, 2007

Growth of the Industry

- **Exciting applications**

- **New vendors**
  - *e.g.* Microsoft
- **Growing interest in standards**
  - Super Distributed Objects, Software Radio components
  - DDS, CORBA, Web Services
  - JAUS, STANAG 4586

Robotics Industry Challenges

- Complexity
  - Integrate hardware and software components from multiple vendors
  - Leverage technology across multiple generations and product lines
  - Process data in real time from more sources using more demanding algorithms
  - Distribute subsystems more broadly
  - …and bring it all to market faster

Robotics at the OMG

- Inaugurated as an OMG Domain Task Force (DTF) two years ago
- Active members from many sectors
  - Industry
  - Private and public research
  - Academia
- Around the world
  - Japan
  - Korea
  - United States
  - India
  - EU

In the Works

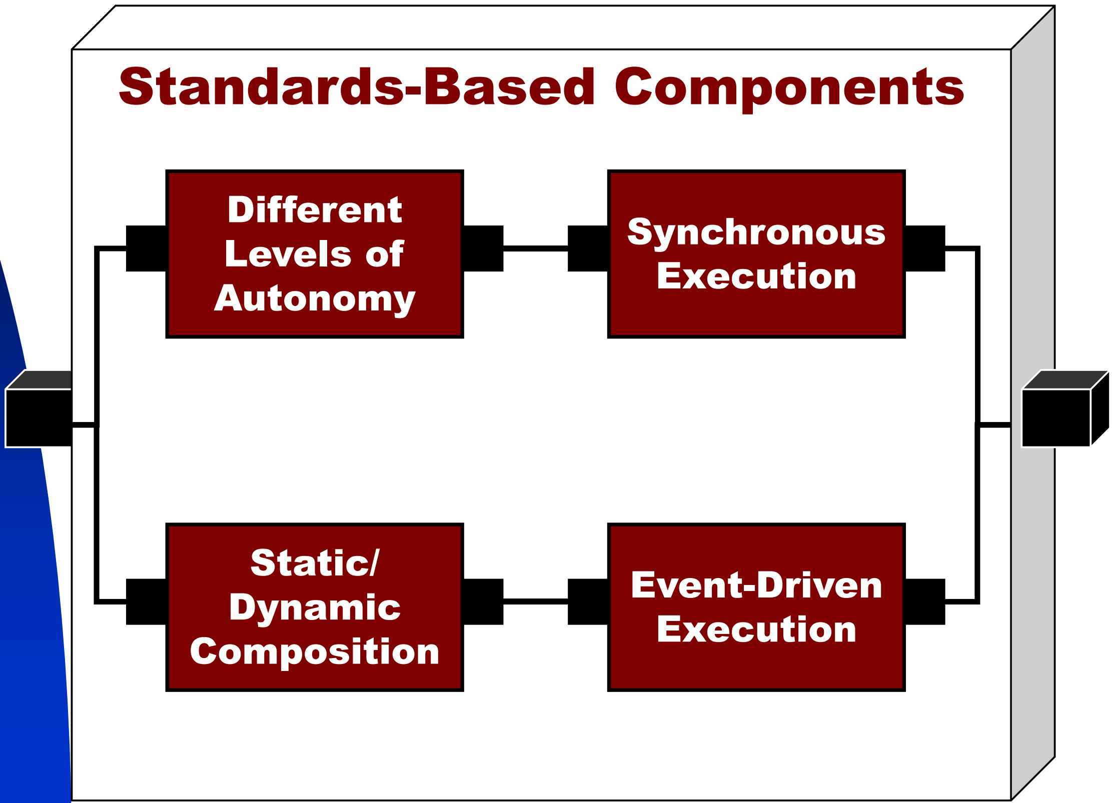
- Robotic Technology Component (RTC) Specification
  - Adopted September 2006[1]
  - In finalization now
- Robotic Localization Service
  - Goal: RFP to be issued this week[2]

1. ptc/06-11-07
2. robotics/2007-06-01

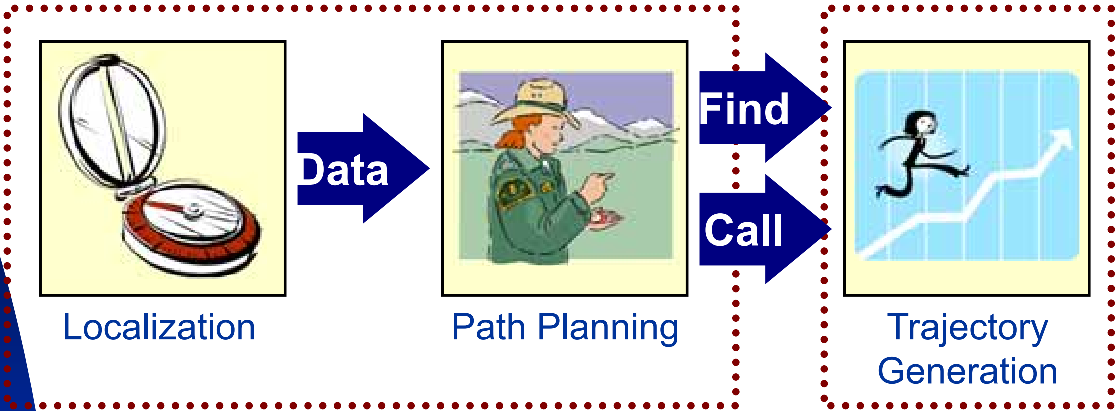
What is RTC?

- Robotic Technology Component (RTC) Specification
  - First robotics-specific effort at OMG
- Component model for robotics
  - Basis for software modularization and integration at infrastructure/ middleware level in this domain
  - Builds on existing standards
    - UML-based language
    - Super Distributed Objects
- Growing adoption
  - Multi-year, multi-million dollar public-private projects in Japan

Benefits of an RTC Architecture

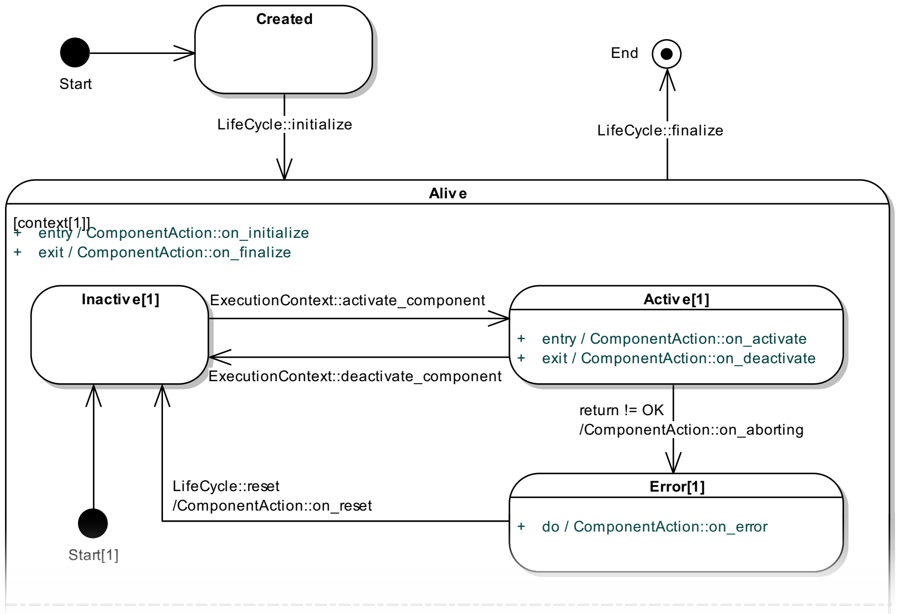


Example: Path Planning



- Localization component streams coordinates to path planning component
- Path planning component chooses trajectory generator component dynamically
- Path planner invokes trajectory generator

Component Lifecycle



- Every component has standard lifecycle
- Each lifecycle transition has callback
  - “Inversion of Control” pattern

Execution Context

- Components that work together to accomplish same task participate in same “execution context”
  - Context corresponds to logical thread
- Behavioral pattern of participating components determined by context’s *execution kind*
  - Periodic ordered execution at a given rate
  - Asynchronous discrete events
  - Ad hoc/vendor extensions

Design Patterns

- Localization component executes periodically
  - In every period, it outputs the current location

- Path planner is event-driven
  - Re-invokes trajectory generator whenever location reaches waypoint

- Trajectory generator operates only when queried by path planner
  - …which dynamically discovers available trajectory generators at runtime

Answering the Challenge

- Integrate hardware and software components from multiple vendors
  - *Standardized interfaces*
- Leverage technology across multiple generations and product lines
  - *Component-based design limits coupling*
- Process data in real time from more sources using more demanding algorithms
  - *Leverage the framework; focus on your application.*
- Distribute subsystems more broadly
  - *Location-agnostic design supports static or dynamic composition*
- …and bring it all to market faster
  - *Buy components off the shelf*
  - *Built-in support for common design patterns*

Speaking of Localization…

- New RFP being issued out of Robotics DTF
- *Proposals sought:*
  - Service for locating robot
    - …in absolute space
    - …in relation to its environment
  - Sensor-agnostic
    - Aggregate multiple data sources
  - Flexible coordinate systems and data formats
  - Real-time performance

Localization Service Benefits

- Critical enabler for a variety of tasks
  - *Navigation*: Robot moves to goal location, and needs locations of obstacles along the way
  - *Manipulation*: Robotic gripper grabs object, identifying relative position of the object
  - *Human-Robot Interaction*: Robot should be aware of locations of human(s) and itself when task involves human interaction
  - *Interaction with Environment*: Recognize physical events in environment and react to them by incorporating location information with each event
- Every application needs these things
  - Purchase off-the-shelf
  - Low-risk integration

Thank You

robotics/2007-06-10

OBJECT MANAGEMENT GROUP

OpenRTM-aist: A reference Implementation of the Robotic Technology Component Specification

Tetsuo KOTOKU
AIST, Japan

Outline:

- Introduction
- OpenRTM-aist
- Simple Demo
- RTC Related Projects in Japan

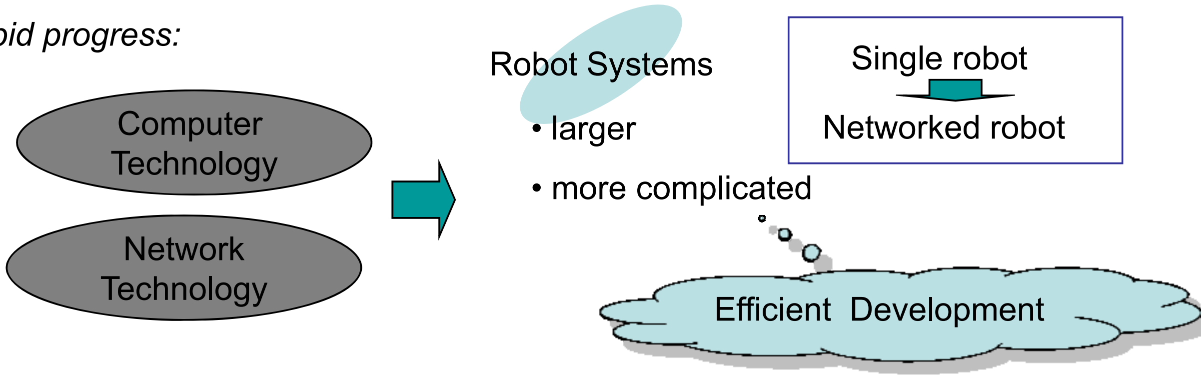
• RTC Specification is just a beginning of standardization in the field of Robotics
• In Japan, RT meddleware (RTC model) is adopted as a framework of new projects

Introduction

Robot Society in the 21st century

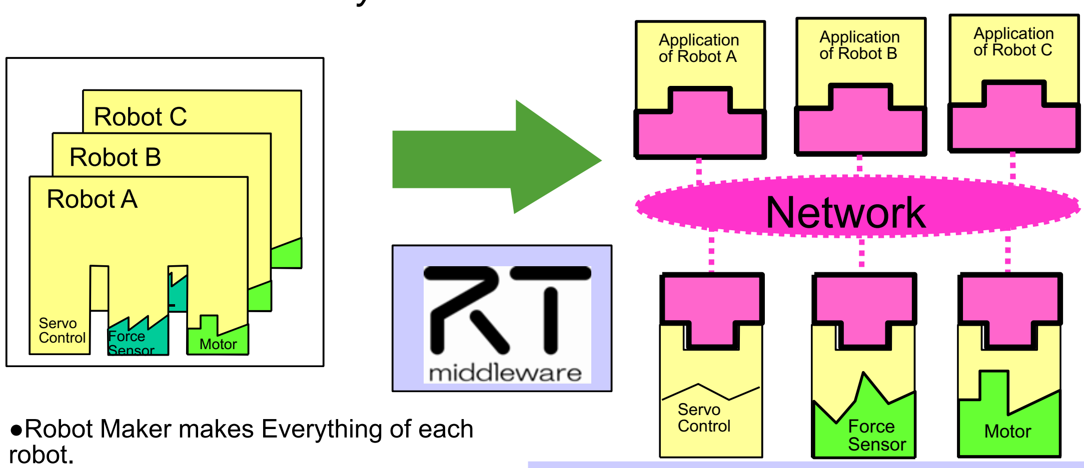
With the rapid progress in computer and communication technology, the robot systems are fast becoming larger and more complicated. Therefore, there is a real need for the software technologies for efficient developments. Now various software technologies are proposed and implemented respectively.

Rapid progress:



RT Middleware Project

Conventional Robot Systems | *Component Based Robot Systems*

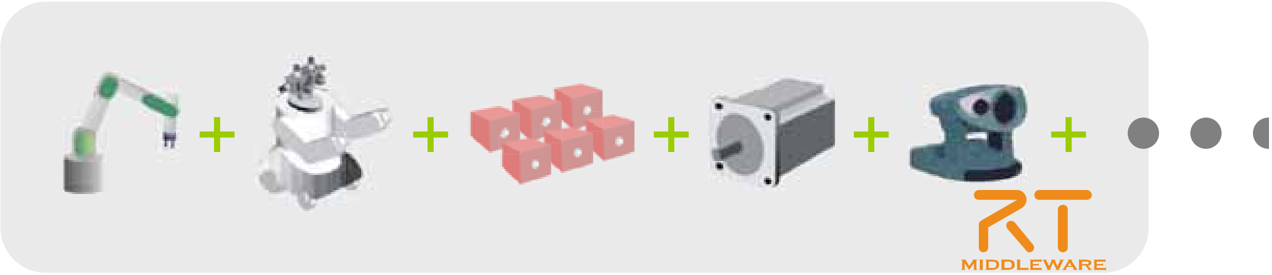


- ●Robot Maker makes Everything of each robot.
- ●Interfaces of modules in each robot are not defined well. So, it is difficult to re-use them in other robot systems.
- ●Cost of development is high.
- ●It is difficult to create a variety of robots

- ●It will be easy to create new robot by re-using existing modules.
- ●Cost of development of new robot will be low.
- ●Module suppliers, software module suppliers and system integrators can join the new robot business.
- ●It will be easy to develop a variety of robots.

What is RT?

- RT = Robot Technology   cf. IT
  - not only standalone robots, but also robotic elements (sensors, actuators, etc.…)



- RT-Middleware
  - middleware and platform for RT-element integration
- RT-Component
  - Basic software unit in RT-Middleware

AIST 2007.06.25 OMG Robotics-DTF Seminar

Roadmap of OpenRTM-aist:

OpenRTM-aist-0.2.0: (2005)

- Simple component model
- Background of initial submission of AIST

OpenRTM-aist-0.4.0: (2007)

- Reference implementation for RTC-FTF discussions

OpenRTM-aist-1.0.0 : (2007 4Q)

- Compliant to formal RTC Specification

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

OpenRTM-aist-0.4.0 (latest version)

- RPM package (for development) (FedoraCore4, FedoraCore5, FedoraCore6, VineLinux3.2, VineLinux4.0)
- Vmware package (for tutorial)
- Based on CORBA PSM (omniORB)

http://www.is.aist.go.jp/rt/OpenRTM-aist/

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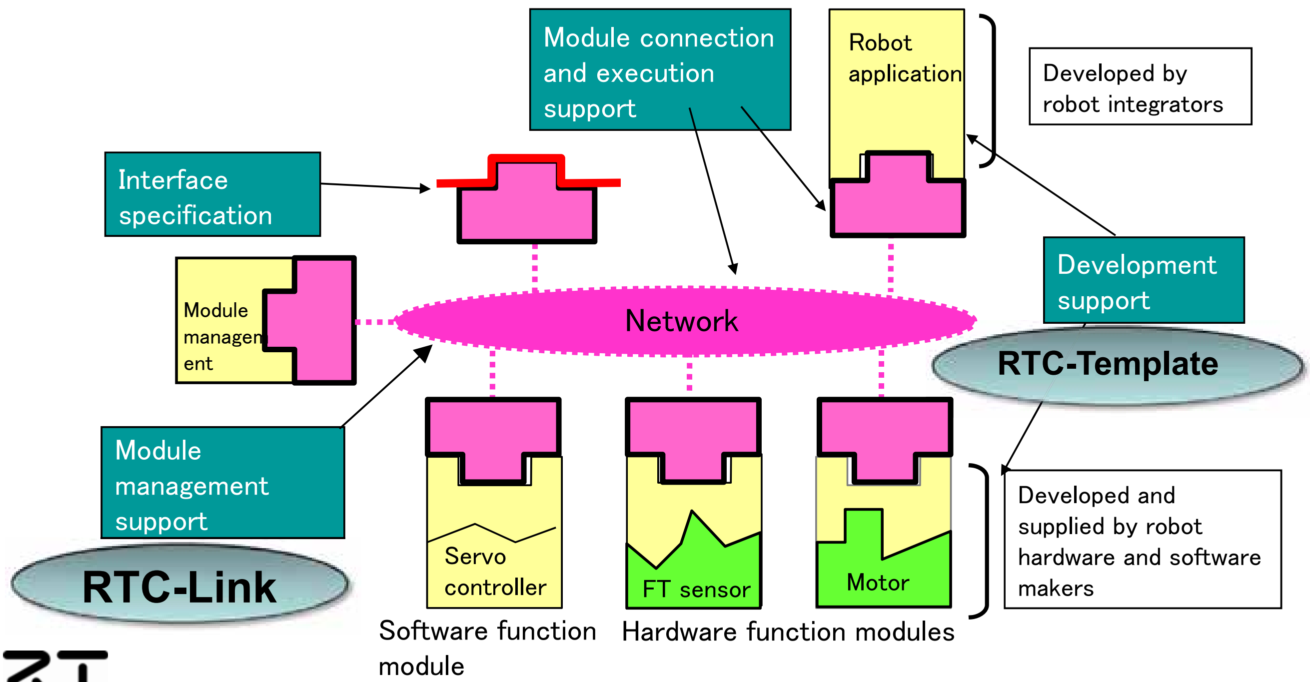
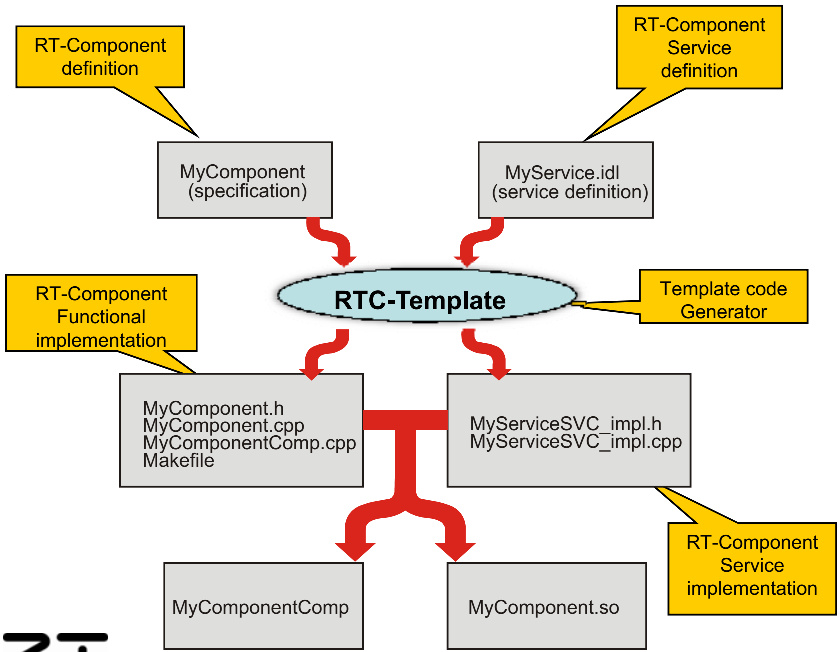
RT middleware project

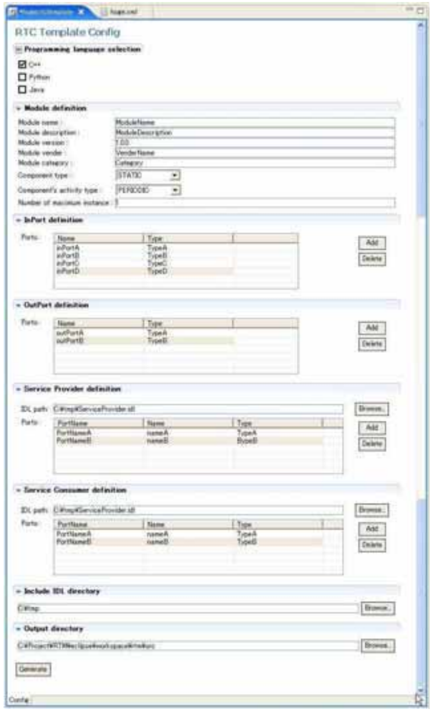
Modularity support with OpenRTM-aist



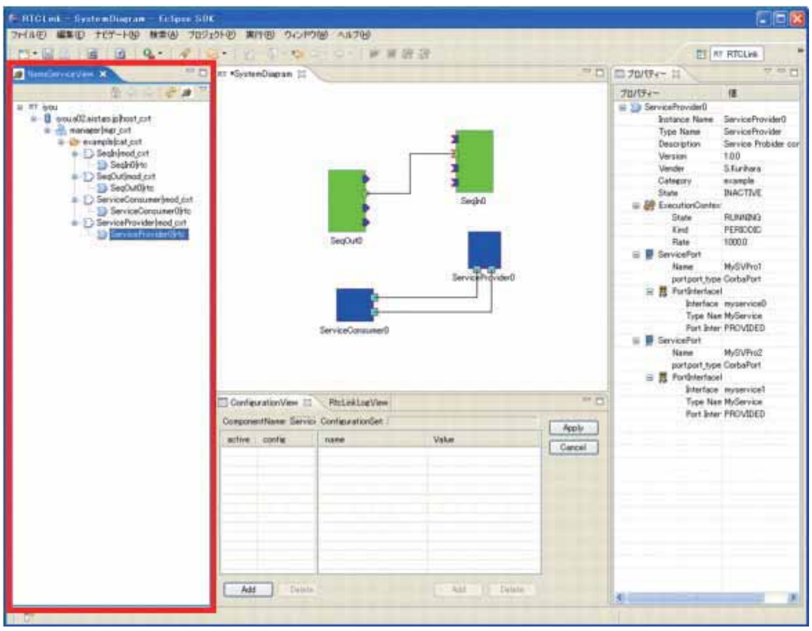
RT middleware
NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST)

RTC-Template:
(RT-Component code generator)

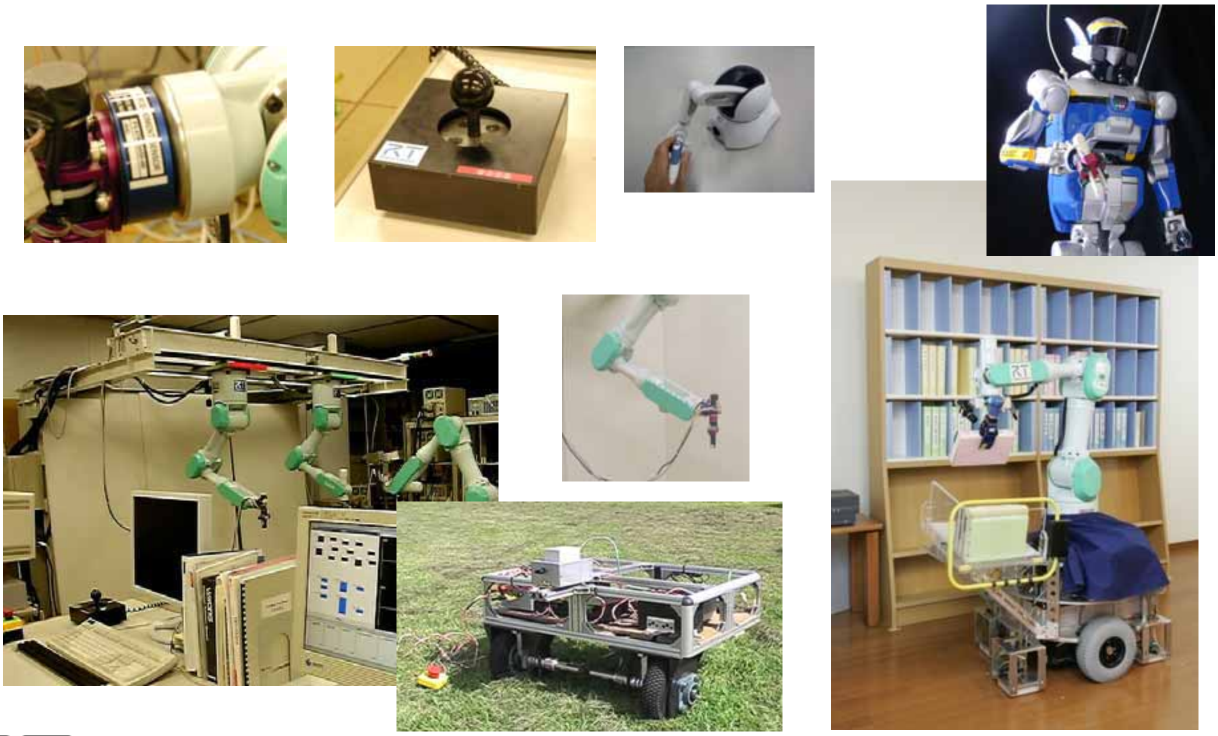




RTC-Link:
(GUI for monitoring and dynamic interaction)



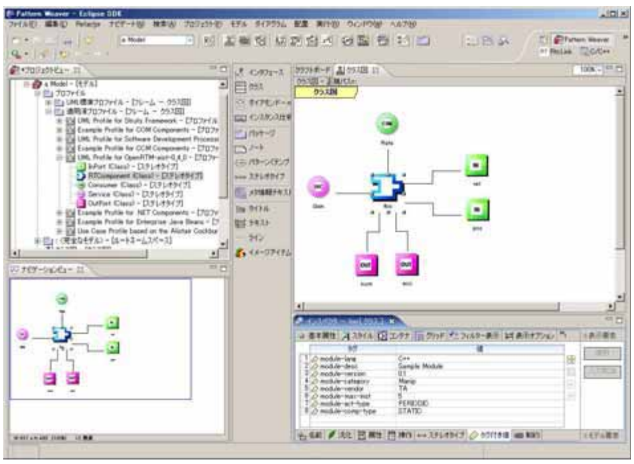
Example of RT-Components



Technologic-Arts

(one of supporters of RTC Specification)

New Business



UML Modeling Tool + RTC-Template (plug-in)

株式会社テクノロジックアート
TECHNOLOGIC ARTS INCORPORATED

Related Robot Projects in Japan

Inter-Ministry Project

- from 2005FY to 2007FY,
- Framework for Robot Simulator (OpenHRP3)
- RT middleware (OpenRTM-aist-0.4.0)

NEDO Project for common components

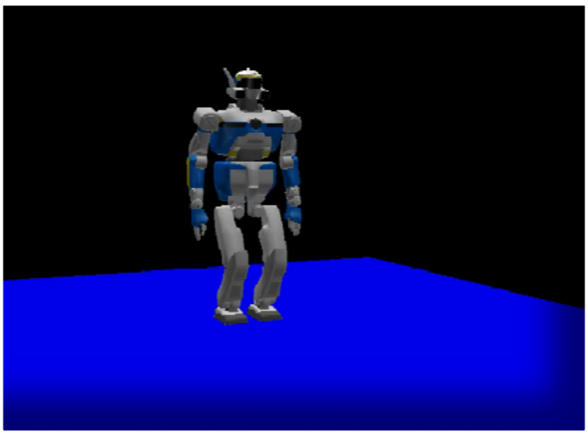
- from 2005FY to 2007FY,
- Hardware module (voice recognition, vision, motion control)

METI Project for Robot intelligence :

- from 2007FY to 2011FY, **~10milion dollars/year**
- Software module and architecture for intelligence
- Software development Tools

AIST 2007.06.25 OMG Robotics-DTF Seminar

OpenRTM-aist + OpenHRP2 (Humanoid Simulator)



→ **OepnHRP3 (General Robot Simulator)**

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

Conclusions:

•AIST is under developing OpenRTM-aist as a reference implementation of OMG RTC Specification.

•RTC Specification is just a beginning of standardization in the field of Robotics.

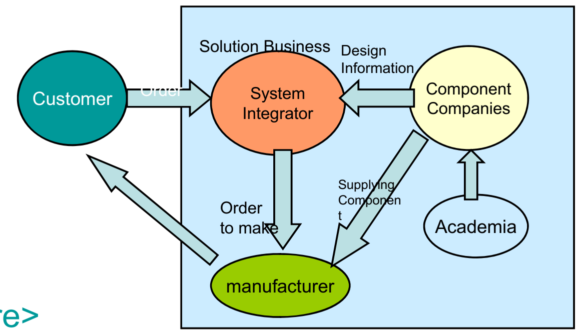
•In Japan, RT meddleware (RTC model) is adopted as a framework of new projects.

Conclusions

< Key Technology of RT >

Module-base Open Architecture

– Inter operability
– reusability
– portability
– development tool



<Development and diffusion of RT middleware>

Standardization → < meet the market needs > New RT Industry

Prof. Kazuo Tanie
passed away on June 9, 2007

OMG Montreal TM 2004
Keynote (IEEE RAS President)

RoboNexus2005
(OMG BoF Meeting)

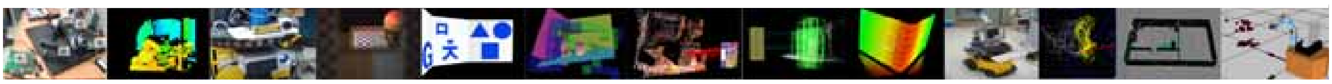
- **May his soul rest in peace.**
- **We would like to make his dream come true.**

robotics/2007-06-11

June 25, 2007

Korean Thrust for Intelligent Service Robot Standards

Sukhan Lee
Professor and President
Intelligent Systems Research Center
Korea Intelligent Robot Standard Forum



SUNG KYUN KWAN UNIVERSITY

Intelligent Service Robot Standards in Korea

SKK UNIVERSITY

Korea Intelligent Robot Standard Forum (KIRSF): Motivation

- ✓ Intelligent service robots chosen as one of the driving engines for future economic growth in Korea
- ✓ An increase of the commercialization of intelligent service robots including cleaning, entertainment, and home service robots dictates a compelling need for establishing standards
- ✓ There needs to provide companies and consumers with performance and interface guidelines as well as certified protection from safety risk and product defect in order to enhance product quality and expand markets

➔ The KIRSF has been formed as a national level organization for group standards on intelligent service robots

Intelligent Service Robots: Scope

- ✓ Service Robot as a Unit Product
  - Cleaning Robot, Entertainment Robot, Education Robot, Guide Robot, Medical Robot, Home Service Robot, Security Robot, Elderly Care Robot






- ✓ Robotic Functions Embedded as System Components
  - Intelligent Vehicle/ITS : Lane Departure Warning, Pedestrian Recognition, Automatic Collision Avoidance, Self Parking
  - Intelligent Building/Security : Face Recognition, Motion Tracking



- ✓ Service & Solution with Networked Robotics
  - Education/Security Systems
  - URC (Ubiquitous Robotic Companion)

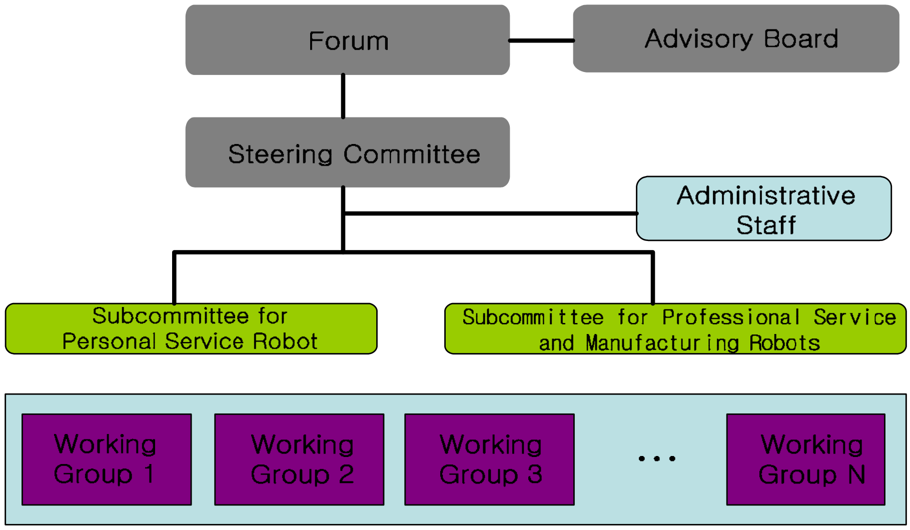
Why Standards for Intelligent Service Robots?

- ✓ Rapid deployment of new products by promoting rapid prototyping with modularization and standardized interface
- ✓ To provide companies with performance and interface guidelines as well as with protection from market contamination by low quality products
- ✓ To protect consumers from safety risk and product defect
- ✓ To speed up opening new markets and services with networked robotics (URC)

Korea Intelligent Robot Standard Forum: (KIRSF)

An Introduction

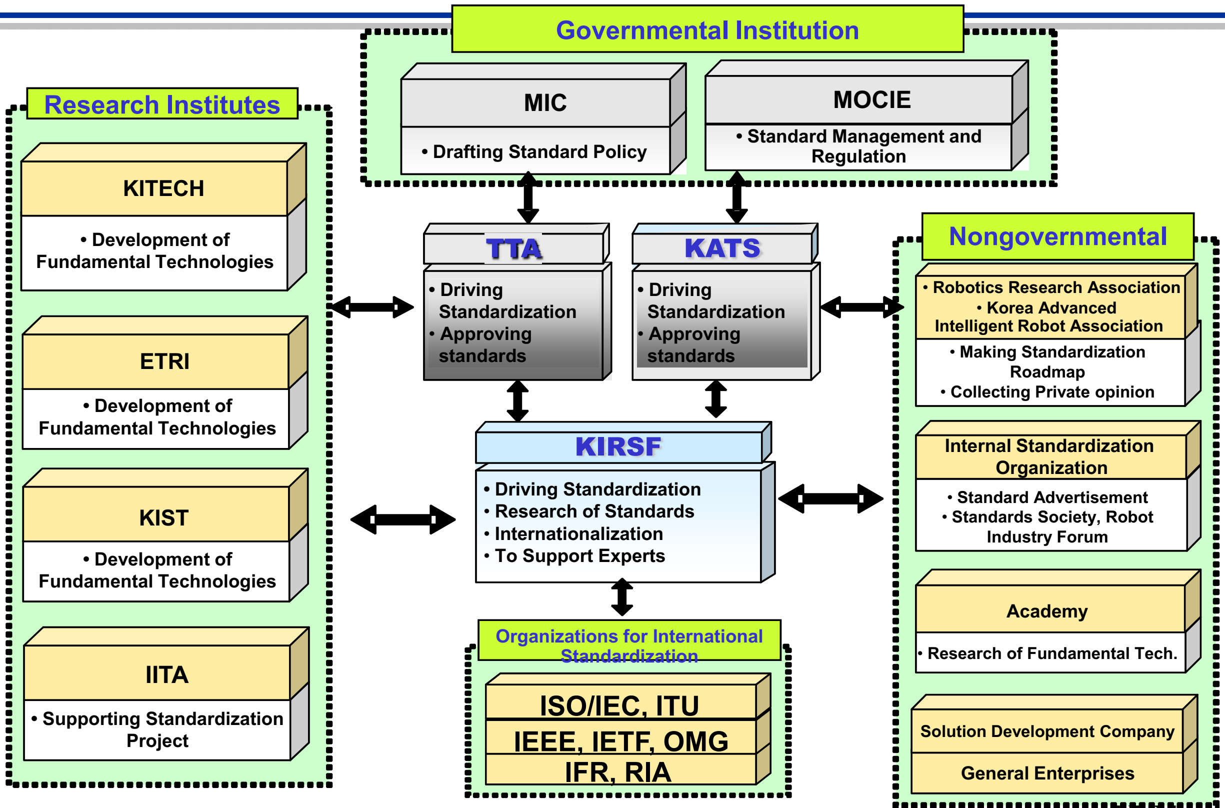
Korea Intelligent Robot Standard Forum: Organization



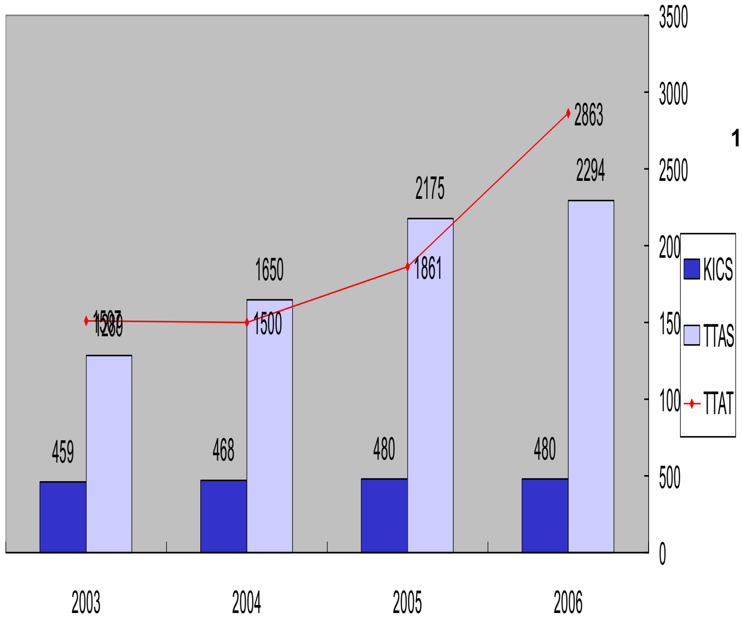
✓ **101 Participating Institutions, 8 Pre-meetings, 2 Workshops**
- **Includes participating institutions in National Robot Projects**

✓ **27 Participating Institutions for Steering Committee**
- ✓ **16 Companies, 3 Universities, 6 Institutes, 6 from industrial agencies**

Relationship among Organizations in Standardization Process



Statistics of Korean Standards in IT and Communications



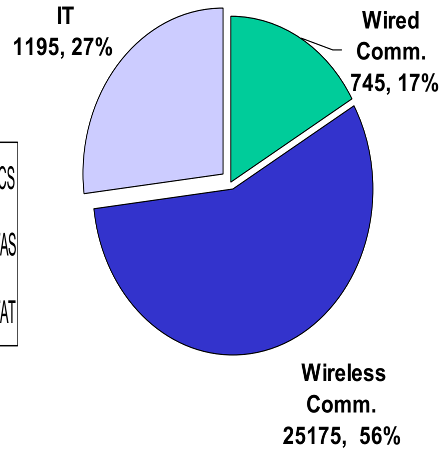


Table 1. Standards statistics adopted during 2003 ~ 2006 in IT & Comm, Korea (source: TTA)

Table 2. Classification of Standards in 2006 (4,457 standards)

Subcommittees

✓ **Objective : Status Analysis in Intelligent Robot Standards, Selection of Standardization Scope and Subjects and Making Research Basis**

Subcommittee		Institutions
Personal Service Robot Chair: Dr. Yeon Koo Chung, ETRI	Companies	Daewoo Elec., Micro robot, Samsung Elec., Yujin Robot, LG Elec., EZ Robotics, Robotiz, KT, SKT, Hanwool Robotics
	Institutes	KATS, KTL, KETI, KITECH, ETRI
Public Service Robot Chair: Soongeol Lee, KHU	Companies	Dasa Tech, Robo Tech, Samsung Elec., Yujin Robot, KT, Hanwool Robotics, Hyundai
	Institutes	TTA, KATS, KIST

✓ **Main roles**

- To Establish and Execute Subcommittee's Plan
- To Propose Standardization Projects for Making Forum Standards
- To Present, Modify and Abolish Working Group Standards
- To Compose and Abolish of Working Groups

Working Groups

✓ **Objective :** Organizing groups with members who would like to participate in drafting the standards. The working group can be abolished just after publishing the standard.

Working Groups	Group Leaders
Robot Service Modeling	Dr. Young-kuk Ha
Robot Server-Client Protocol	Dr. In-Cheol Jung, ETRI
Service Robot HRI	Dr. Byung-Tae Jeon, ETRI
Navigation	Dr. Yeon-Ho Kim, SAIT
Intelligent Robot Middleware	Dr. In-Cheol Jung, ETRI
Service Robot Vocabulary	Prof. Dong-Yup Choi, Daerim College
Evaluation of Robot Performance and Safety	Prof. Sung-Soo Lim, KHU
Intelligent Robot H/W Interface	Dr. Hun-Chan Park, KTL

✓ Main Roles : Being in charge of practical research to make intelligent robot standards (draft)

ISRC

Korea Intelligent Robot Standard Forum: Group Standards

SK UNIVERSITY

Technologies To Be Standardized

Technology	Sub Technology (examples)
Intelligent Robot Component and Module Technology	✓ Interface among robot hardware modules ✓ Robot hardware architecture ✓ Intelligent cleaning robot hardware module
Intelligent Robot Platform Technology	✓ Robot software architecture ✓ Brainy cleaning robot software library API technology ✓ Brainy cleaning robot software architecture technology ✓ Intelligent software technology for learning and evolution
Human-Robot Interface Technology	✓ User identification and representation modeling for intelligent robot ✓ Human-robot interface modeling technology ✓ Related video image interface technology for intelligent robot ✓ Gesture recognition technology for intelligent robot
Robot working Space and Network	✓ Network communication QoS complement and security / protocol technology to support QoS ✓ Integrated working space standard for intelligent robot ✓ Network conformance and connection technology among services ✓ Ubiquitous situation/behavior recognition and locomotion technology
Performance Guarantee and Safety	✓ Function and performance testing and evaluation technology ✓ Guarantee of reliable/stability and evaluation technology ✓ Self-control and intelligence evaluation technology
Service and Security Authentication	✓ Network and system security technology ✓ Intelligent robot user authentication technology ✓ Intelligent robot service, authentication and charge technology

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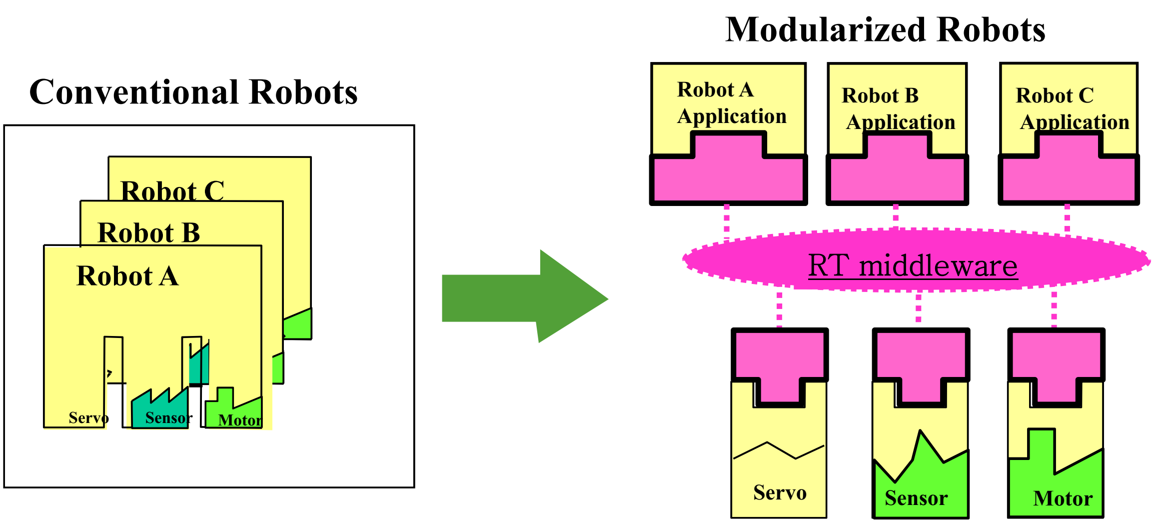
Modularization Concept for Robot Standardizations



Source: OMG Standardization Activity, 2005

ISRC

Ongoing Group Standardizations in 2006-2007:
4 WG, 10 Cases

✓ Performance and Safety

- Mobile type robot's hill climbing ability
- Stability and performance for Cleaning robot
- General safety rules of service robots

✓ Glossary

- Vision related glossaries for service robot
- Glossaries for network based intelligent robot

✓ H/W Interface

- Module type actuator for intelligent robot
- Tentacle sensor for robot gripper
- Mechanical connection to recharging battery in service robot
- Standardization of test method for low illumination camera in robot

✓ Robot Navigation

- Standards for representation of environment map for service robot

ISRC

Ongoing Group Standardizations in 2006-2007:
4 WG, 8 Cases

✓ Intelligent Robot Middleware

- UPnP based Robot Middleware
- Abstracted common interface for mobile robot's device

✓ Robot Server/Client Protocol

- Sensor and control data format for USN client/server based situation recognition
- Interface between home service robot and smart home instrument
- Sensor network routing protocol for intelligent mobile robot

✓ Robot Service Modeling

- Description language for robot functions' profile
- Mobile robot's resource data description profile

✓ Service Robot HRI

- Test methods for voice recognition for service robot

ISRC

Standardization Progress in 2006

Target Tech. in 2005	Target Tech. in 2006	Difference	Progress
Module Interface Technology **Sensor Communication Interface**	Intelligent Robot HW Component and Module	It Includes HW Component and Module tech.s	Projects on Sensor Oriented I/F standard are On-going
Robot Software Platform Technology	Intelligent Robot Platform Technology	It Includes Middleware & Software Modules	Under Development of URC Server/Client Architecture
Human-Robot Interaction Technology **Human-Robot Communication Tech.**	Human-Robot Interface Technology	Comprehensive Interface and User Modeling	Modeling of User and Interface in Basic Step
Ubiquitous Robot Agent Technology	Robot Working Space and Network Technology	Integrated Working Space including Human and Network Communication	NW Communication project between Server and Intelligent Robots
Technology for Guaranteeing Performance and Safety	Technology for Guaranteeing Performance	Target Robot and Safety Technology and Actualization	Performance Evaluation for cleaning robots
Service and Security Authentication	Service and Security Authentication	Network Related Security and Authentication	Projects on authentication reference of URC robots

Issues of Robot S/W

- ✓ Although robots have many common properties in H/W and System S/W, many companies develop all kinds of S/W independently
- ✓ Human resource on robot area is limited compared to US and Japan
- ✓ Various types of robots will be commercialized in the future

Standard Classification of Robot S/W

1. Robot Operating System
   – General OS (Linux, windows, etc), Embedded OS, Real-time OS, etc
2. Robot Algorithm APIs
   – Recognition Component (Algorithm), Navigation Component, Intelligence Component, Interaction Component, Communication Component, Manipulation Component, etc
3. Robot Middleware
   – Distribution, Arrangement, Combination, Cooperation
4. Robot S/W Development Kit
   – Editor, Simulation, Real-time Monitoring, Robotic Language Complier and Linker, etc
5. Robot Application
   – Common Application Part, Cleaning, Security Guard, Information Service, Medical, Health Care, Entertainment, Agricultural, Industrial, etc
6. Other Robot Software
   – Performance Test, Administration, Configuration, etc

S/W Standardization Principles and Standards Sharing Plan

✓ The Principles of S/W Standardization

- Component Classification and Decomposition
  - ✓ Functional definition and abstraction
- Interface Standardization
  - ✓ Hardware abstraction layer, I/O, API
- OS and CPU Independent Standards

✓ Standards Sharing Plan

- To Build Databases for Sharing (similar to SoC IP Business): Classification Code Based Management
- To Establish Circulating Market for Public S/W and Management System
  - ✓ License Agreement (similar to MPEG-LA): Cheap trade among the members of association
  - ✓ Evaluation and Authentication of Performance and Safety

Established Group KIRSF Standards

1. Service Robot Glossary
2. Performance Measurement Methods for Home Cleaning Robot
3. Localization Performance Evaluation Method for Autonomous Mobile Robot
4. Service Modeling Language and Object Model for URC
5. Service Command Language for URC
6. Message for Client/Server Communication Protocol for URC
7. Client/Server Communication Protocol for URC
8. Object Information and Communication Protocol for URC Client/Server based Mobile Robot
9. Common Robot Interface Framework for URC Device Abstraction
10. User Recognition S/W Component APIs for URC
11. Basic Voice Command Glossary for Personal Service Robot

ISRC

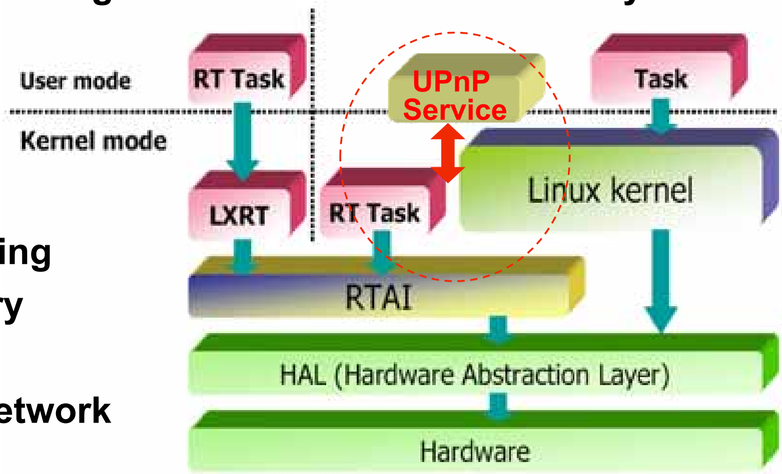
Intelligent Service Robot Standards in Preparation

SK UNIVERSITY

UPnP Based Robot Middleware

✓ **UPnP Architecture**

- defines *a base set of standards* for all devices to adhere to and *conventions* for describing devices and the services they provide

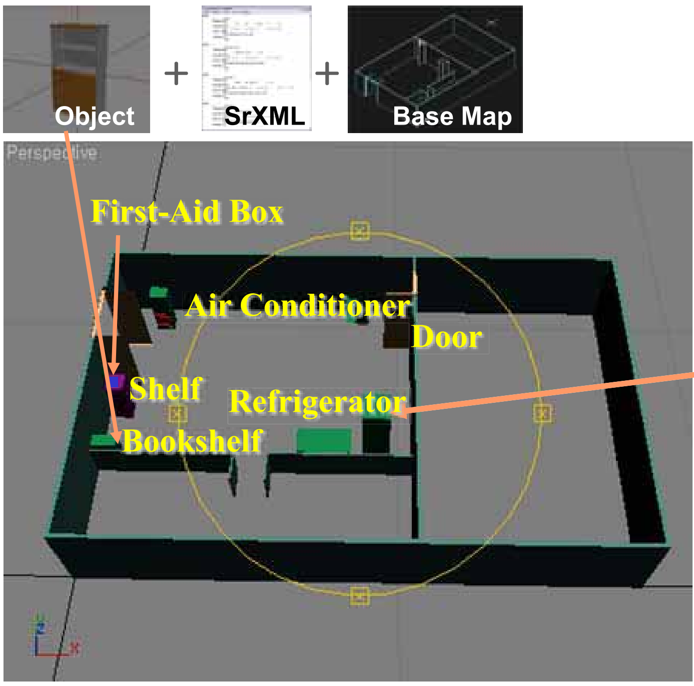


✓ **UPnP's Features**

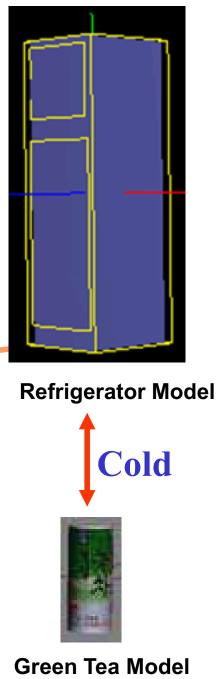
- Zero-configuration
- "Invisible" networking
- Automatic discovery
- Support dynamic Joining/leaving a network
- Standard based
  - IP, TCP, UDP, XML and web technology
  - UPnP uses common protocols instead of device drivers

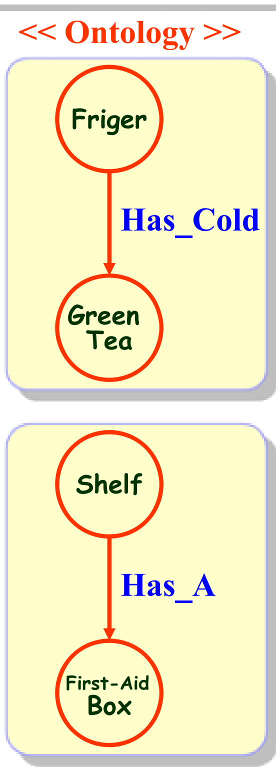
ISRC

Service Robot Information System: Environment Map for Robot Navigation



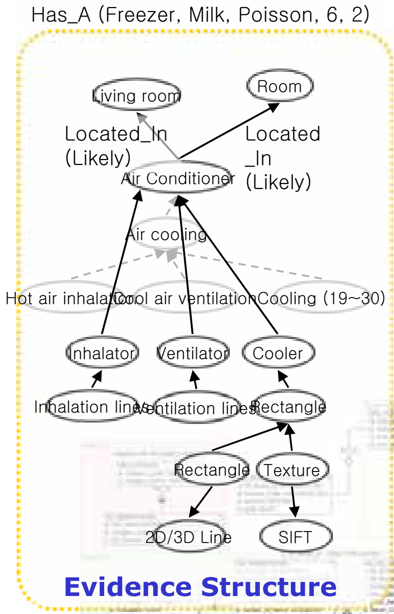
By using CAD tool (3D MAX or AutoCAD)



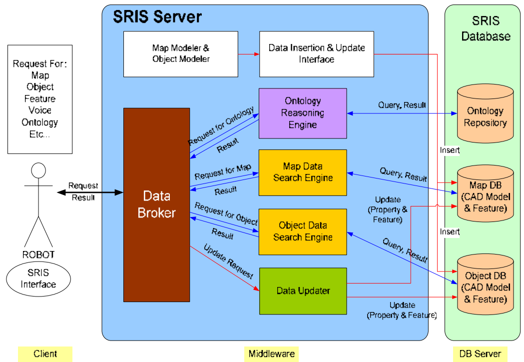


ISRC

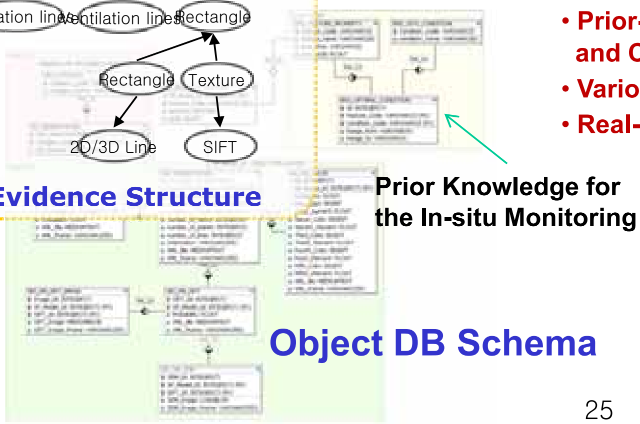
Service Robot Information System :
Object DB for Robot Recognition



- MySQL 5.0
- Client API
- SrXML

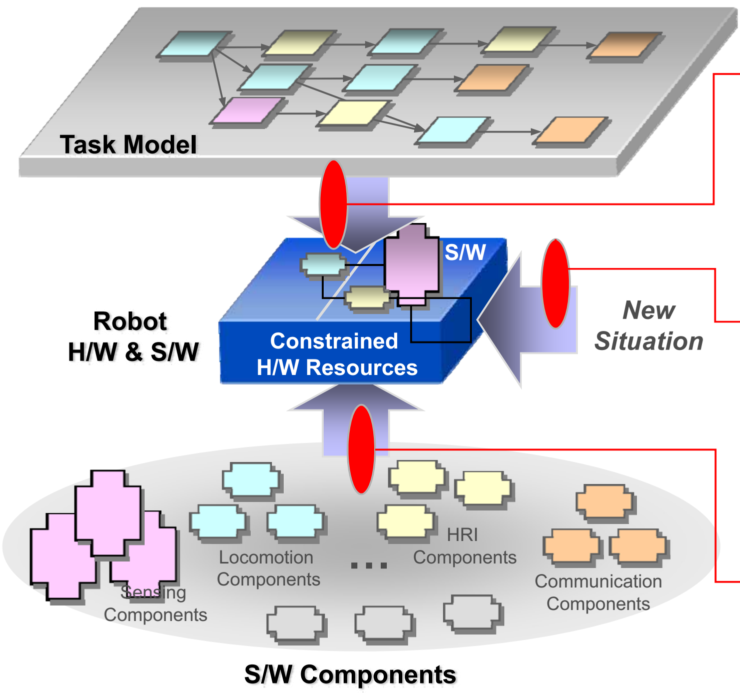


- Prior-Knowledge DB for Evidence Selection and Collection
- Various Feature Model Data: SIFT, Line, Color, etc.
- Real-time Data Search



ISRC

Self Healing/Adaptation/Growth in Robot S/W



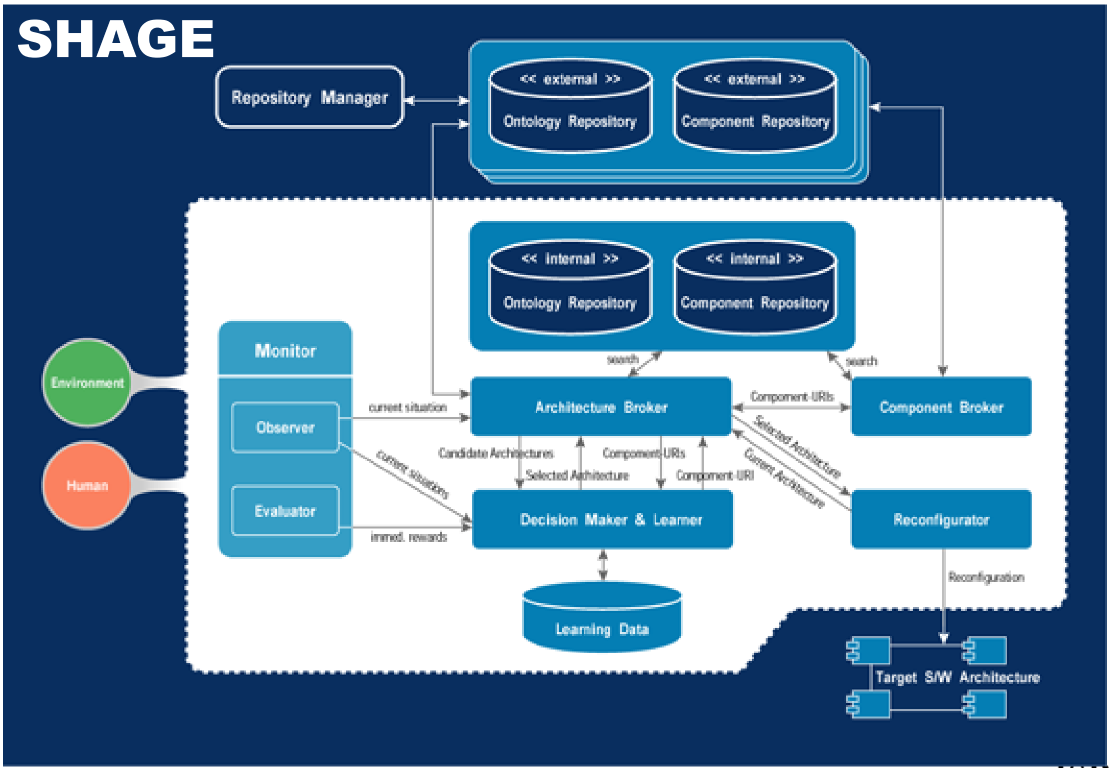
Adaptation for Optimizing Resource and Quality: To Convert a Plan Issued by Task Manager to an Executable S/W by Optimizing Limited Resource and QoS Adaptively

Repair/Reconfiguration: To Reconfigure S/W Functions in order to Provide Robotic Services Continuously, Although Unexpected Problems are Occurred by a New Service Request

Growth: Abilities for Searching and Collecting Necessary Functions to Adapt to A new environment, Satisfy User's New Requirements, and To Use Improved Functions

ISRC

Self Healing, Adaptation, and Growing softwarE: Framework



ISRC

Thank You !

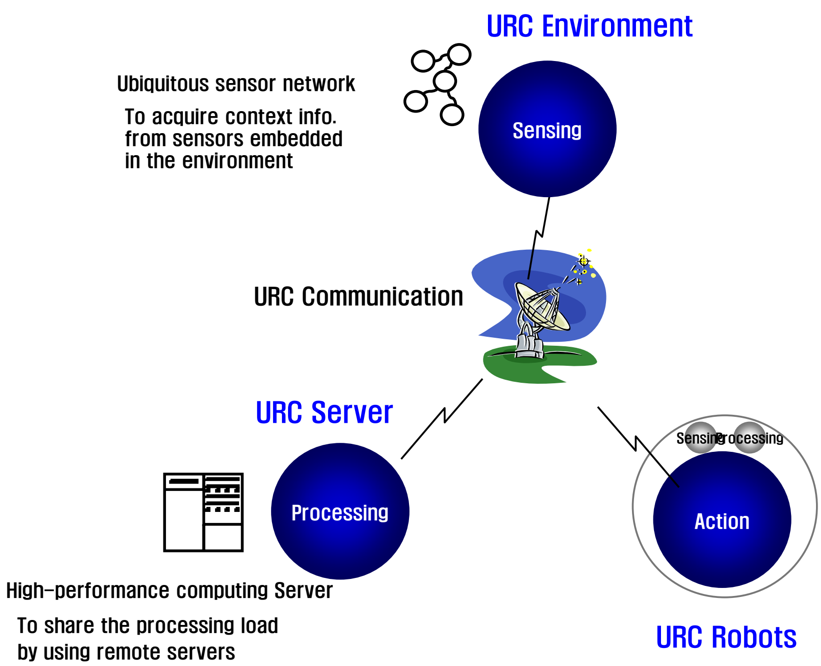
ISRC

Implementation and Application of URC and its standardization

2007. 6.

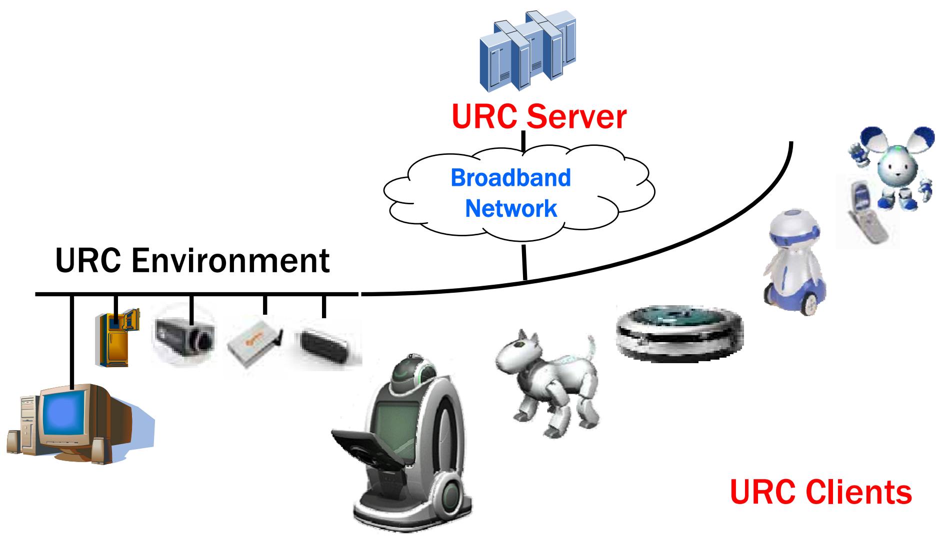
Hyun Kim
Intelligent Robot Server Research Team
ETRI 한국전자통신연구원
Electronics and Telecommunications Research Institute

Basic Concept of URC



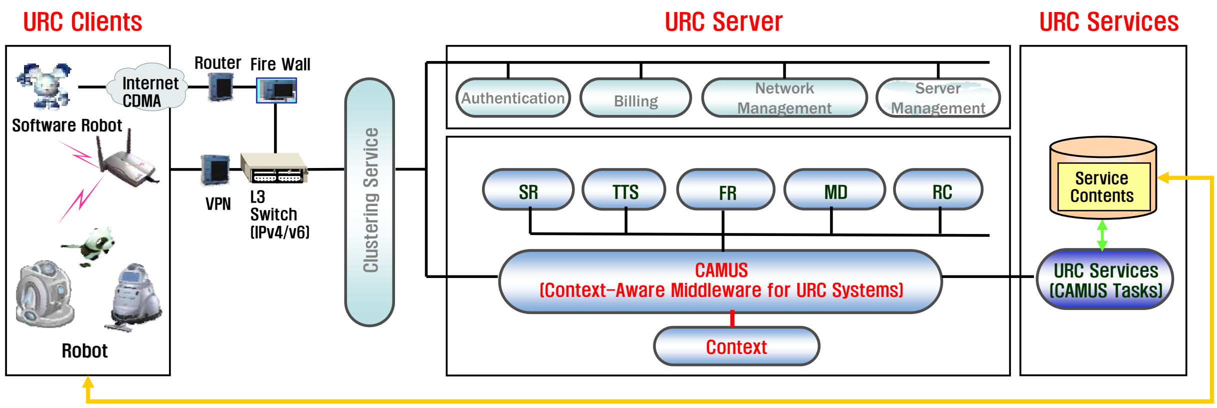
URC Clients

- Any kind of robotic devices can be a URC client as long as it can be connected to the URC server
  - URC clients comply to standard communication and interface of URC

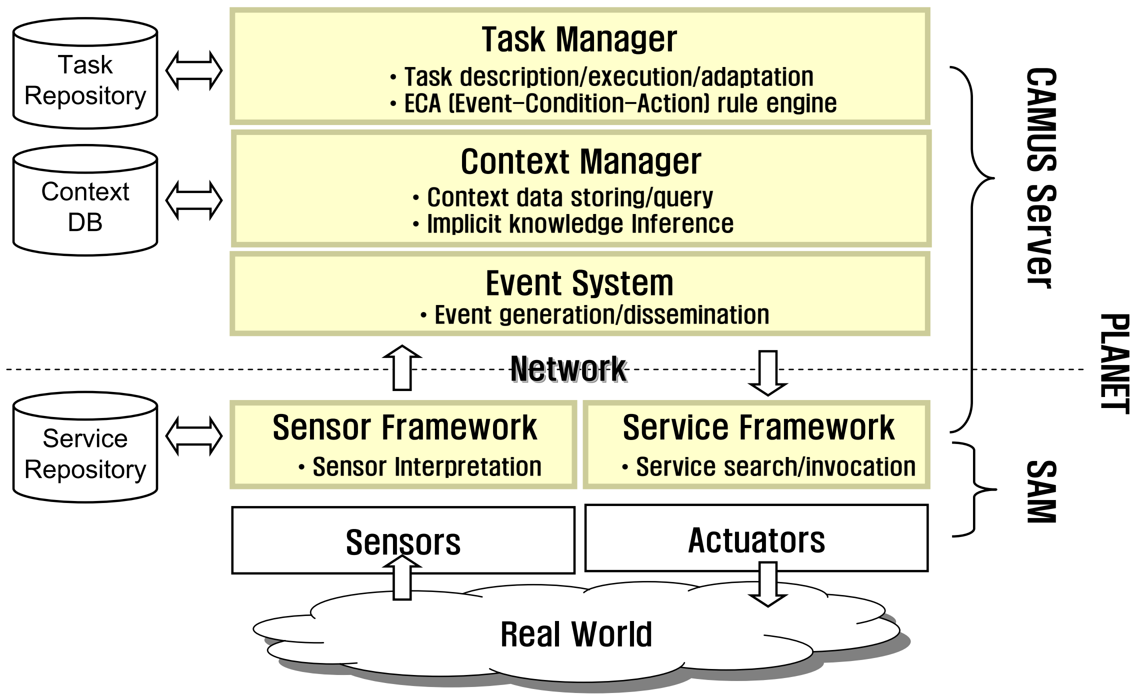


URC Server

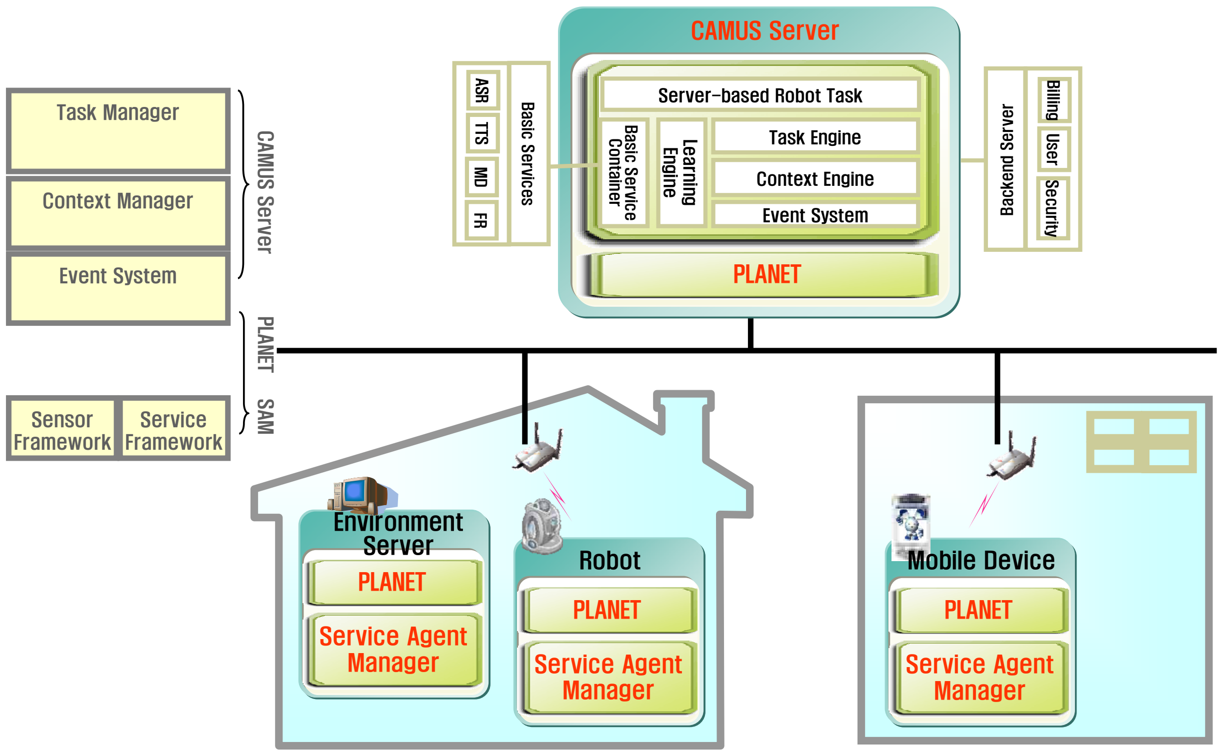
- It acquires sensing information from robots and the environment, plans tasks based on the current situation and finally sends command messages to robots.
- It also provides some functions including speech recognition, voice synthesis and image recognition, which has been heretofore executed in a robot itself.
- CAMUS (Context-Aware Middleware for URC Systems) is a server middleware which plays most important role in the URC Server.



Conceptual Architecture of URC C/S Framework



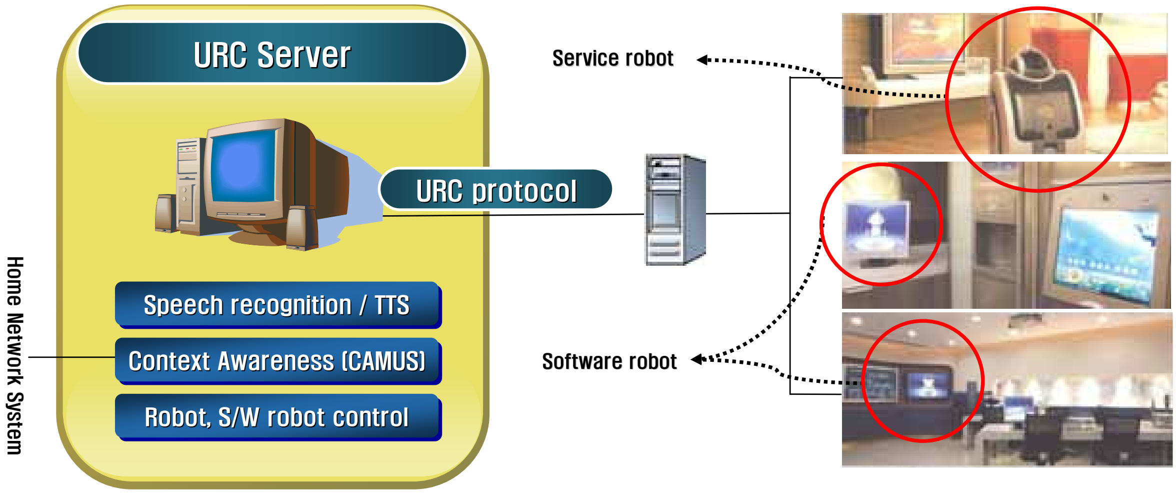
System Configuration



Implementation & Application – 1st Step (2004)

1st Step (2004): URC Concept Verification

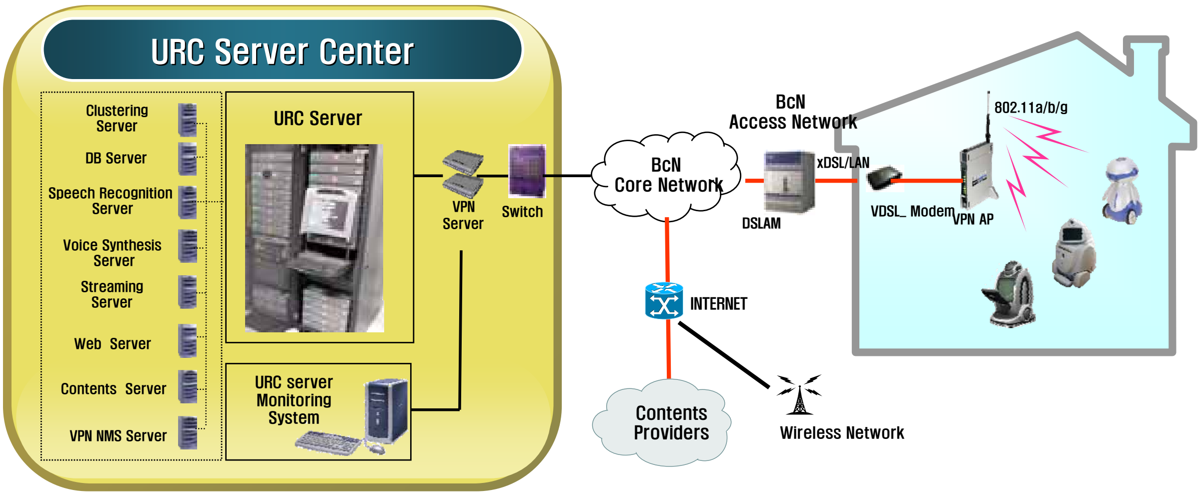
- Developed proof-of-concept applications for URC and applied them to u-Dream Exhibition Hall in MIC



Implementation & Application – 2nd Stage (2005)

2nd Stage (2005): URC Field Test

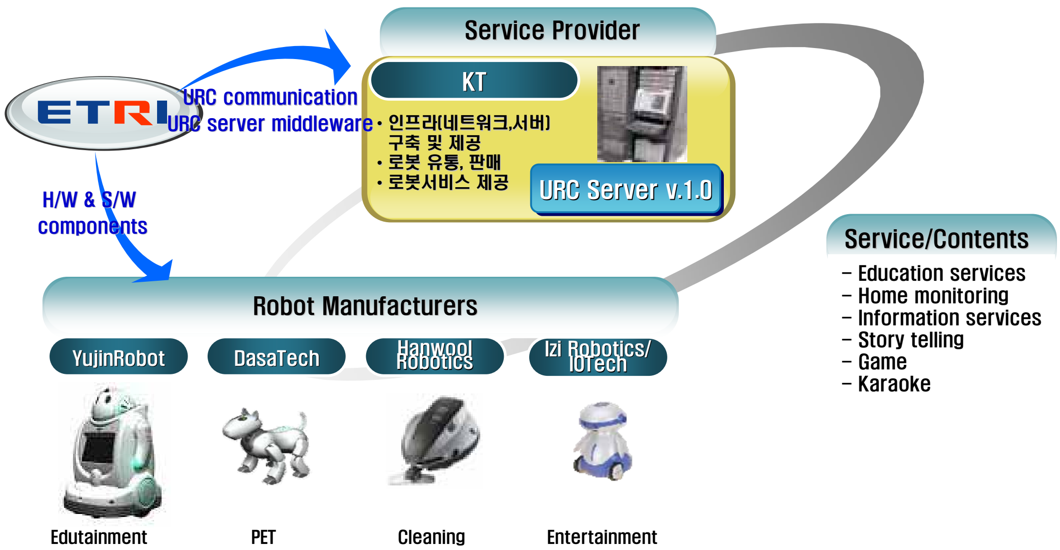
- Applied the system to URC field test services during 2 months
  - 3 kinds of robots were offered to 64 households



Implementation & Application – 3rd Stage (2006)

3rd Stage (2006): URC Pilot Business

- Transferred technology to industries and applied to URC Pilot Business
  - 4 kinds of robot were offered to 850 households and 20 kindergartens



Some Results

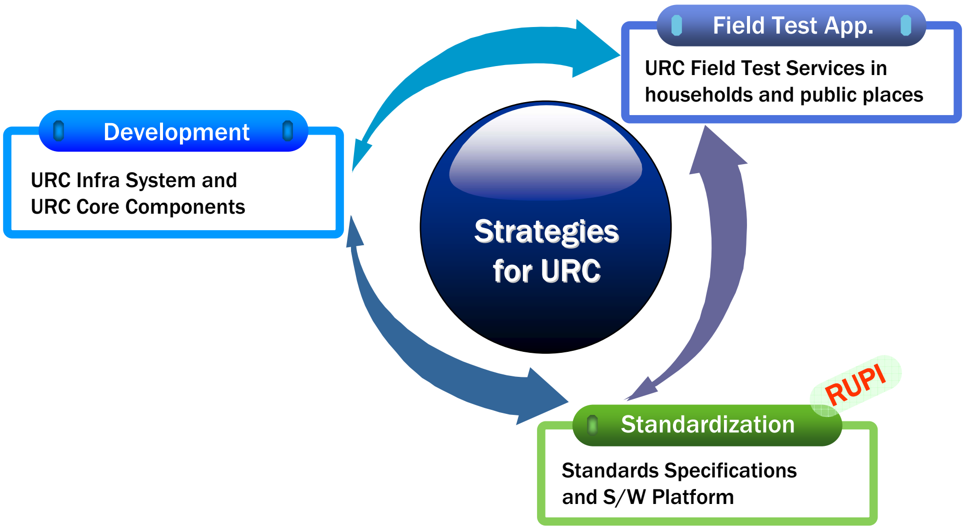
- Customer Satisfaction Survey
  - A survey data was collected by "a face to face personal Interviews" and "Web-surveys"
    - Total 748 people (households: 691 people, kindergarten: 57) were selected
    - Response rate : 89.6%
  - Usage rates
    - Main users
      - Children (80%)
    - Households
      - about 3~4 times per a week
      - Average time is about 1 hour at one time.
    - Kindergartens
      - about 2~3 times per a week
      - Average time is about 85 minutes at one time.
  - Satisfaction rates
    - Households: 57% satisfied (good or fair)
    - Kindergarten: 75% satisfied (good or fair)

RUPI

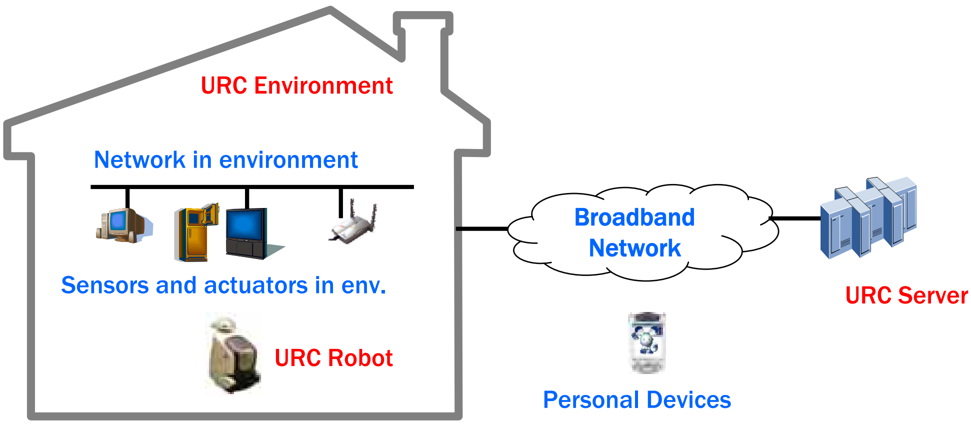
RUPI (Robot Unified Platform Initiative)

RUPI is an open standards for network based robots (URC), which supports various robot services to many different kinds of robots.

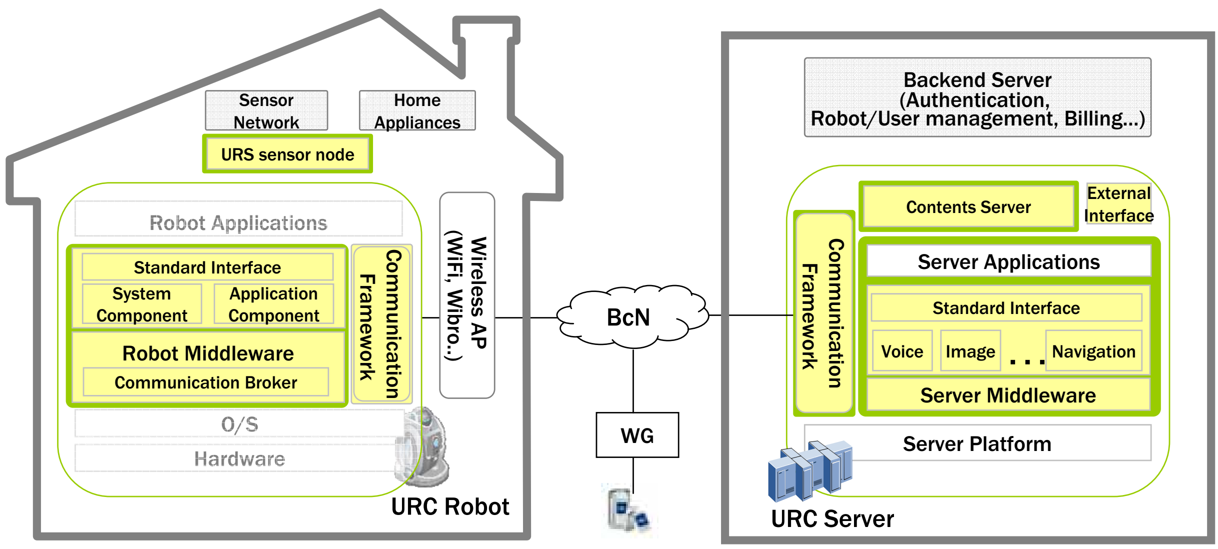
- Interoperability and reusability of robot S/W components
- interconnectivity with different network infrastructures



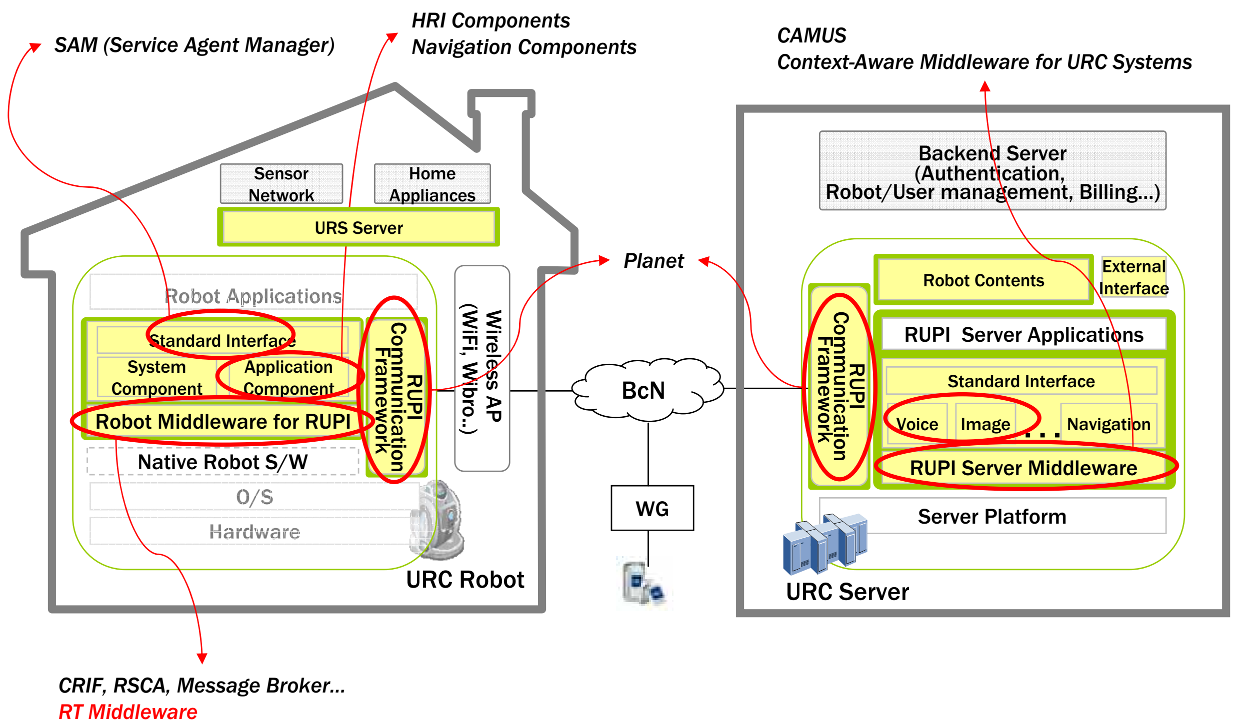
Scope of RUPI



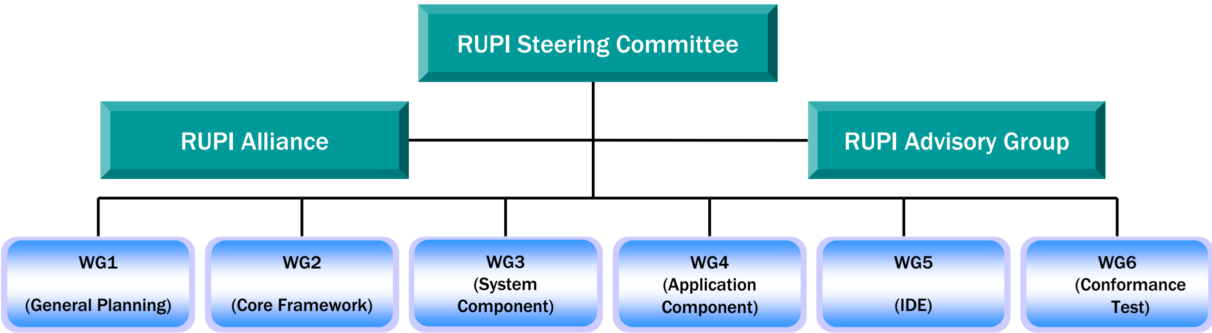
Conceptual Architecture of RUPI



Some on-going systems for RUPI



RUPI Organization



RUPI Steering Committee	▪ Coordination of RUPI development strategies and policies ▪ To make final review and decision for standards
RUPI Advisory Group	▪ To advise RUPI interoperability and interconnectability ▪ To advise RUPI standards policy
RUPI Alliance	▪ RUPI technology adapters from industries and research groups ▪ To propose RUPI requirements and Evaluation of RUPI results
RUPI Working Group	▪ RUPI development groups ▪ To propose RUPI standards

Schedule

1st Stage (2006)

Target: Develop RUPI v.1.0 and apply it to URC pilot business

- Develop RUPI v.1.0 based on the previous URC results
- Apply RUPI v.1.0 to URC pilot business
- Establish the development strategies for RUPI v.2.0

2nd Stage (2007~2009)

Target: Develop and implement RUPI v.2.0

- Develop and implement full-fledged RUPI standards v.2.0 (Core framework, System Components and Application Components)
- Build up the environment for RUPI conformance test
- Promote RUPI to International standards
  Distribute RUPI standards platforms to international societies

3rd Stage (2010~2011)

Target: Spread and propagate RUPI

- Establish the RUPI Technology Center
- Introduce open source strategies
- Stabilize and optimize RUPI standard platforms

Considerations for Planet

Premise

- The URC is a distributed system which consists of different kinds of robotic clients and servers.

Considerations

- It needs to support various programming languages over the different kinds of OS platforms.
- It includes not only general computing systems but also embedded systems whose computing resources are relatively limited.
- It needs a long duration (multi-seconds) operation such as navigation, speech synthesis and so on.
- It needs the efficient way to transmit large data such as voice and images
- It uses the wireless network which is not guarantee for the perfect connection.

Remark

- Related Technology: DCOM, CORBA, RMI, XML Web Services

PLANET v.1.0

Specifications

- Multiple language supports: Java, C/C++, .NET C#
- Different kinds of O/S supports: Win32, Unix/Linux (Embedded Linux)

Functions

- Remote object call based on TCP (Socket)
- Light-weight protocol using the binary message encoding
- Efficient asynchronous operations (operation queuing)
- Fault-tolerance for network disconnection
- Good local transparency
- RTT (Round Trip Time) in 80% of CORBA

Related Results

- It has applied to most of URC robots in Korea
  Samsung Electronics, YujinRobot, DasaTech, HanwoolRobotics, IziRobotics, MostITech, ED, KIST Maru/Ara and so on
- Standardization in TTA in Korea

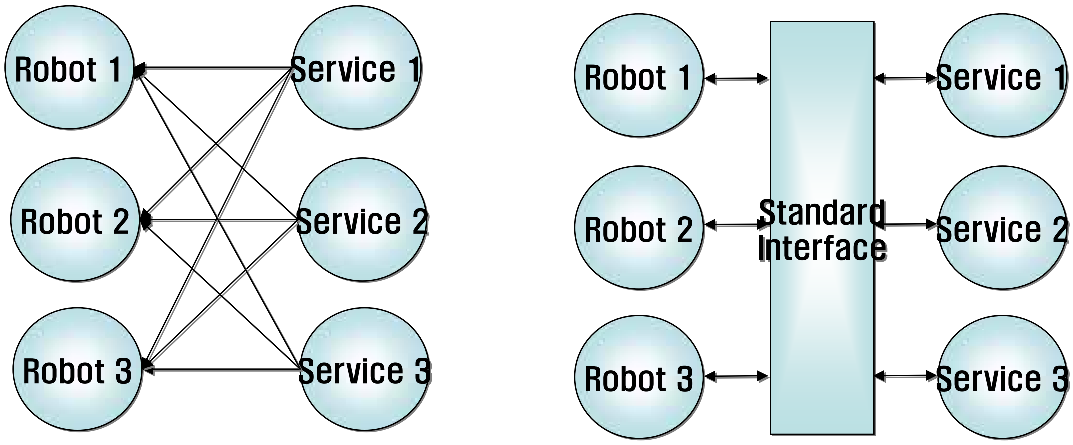
Considerations for Standard Interfaces

Premise

- In the URC, various robot services are provided to many different kinds of robots

Considerations

- It is based on the URC communication framework
- It standardizes the minimum set of URC robots functions
- It supports the inheritance and extension for additional functions



2(mxn) (m+n)

Standard Interface for SA

- Audio related
  - Microphone
  - Voice Synthesis: TextToSpeech, TextToWave
  - Speech Recognition: SpeechSensor
  - Wave Play: WavePlayer, MP3Player
- Image related
  - Camera
  - Image Recognition: MotionSensor, FaceSensor
  - Movie Play: AVIPlayer (including mpeg)
- Robot related
  - Wheel: MoveWheel, Navigation
  - Head: MoveHead
  - Sensor: TouchSensor, MotionSensor
  - Others: RobotNativeService
- Location
  - RFIDSensor

< Standard interfaces for URC robots applied to the pilot business>

SAM (Service Agent Manager) v.1.0

Specifications

- Comply to URC communication standards
- Multiple OS supports : Win32, Unix/Linux (Embedded Linux)
- System requirements: CPU 200MHz, Memory 20Mb (SAM/PLANET: 5.9Mb)

Functions

- Gateway between robot and URC server (CAMUS)
- Management of service agents in robot platform
- Service Agent lifecycle management
- Sensor Interpreter / Event Publisher
- Connection Monitor

Related Results

- It has applied to most of URC robots in Korea
  Samsung Electronics, YujinRobot, DasaTech, HanwoolRobotics, IziRobotics, MostITech, ED, KIST Maru/Ara and so on
- Standardization in TTA in Korea

Conclusions

- Introduce the URC and URC Experiences in Korea
- Introduce URC-related standards
- We are preparing the 2nd URC Pilot Business
  - Participants: 30 companies
    - SI companies(6), contents providers(4), solution providers (4), robot manufacturers (12), part manufacturers (4)
  - Robots: 12 kinds of URC robots
  - All participants should apply RUPI v.1.2 as a URC standard


감사합니다

Reviewing RFP for Robotic Localization Service

2007.06.26

Robotic Functional Service WG

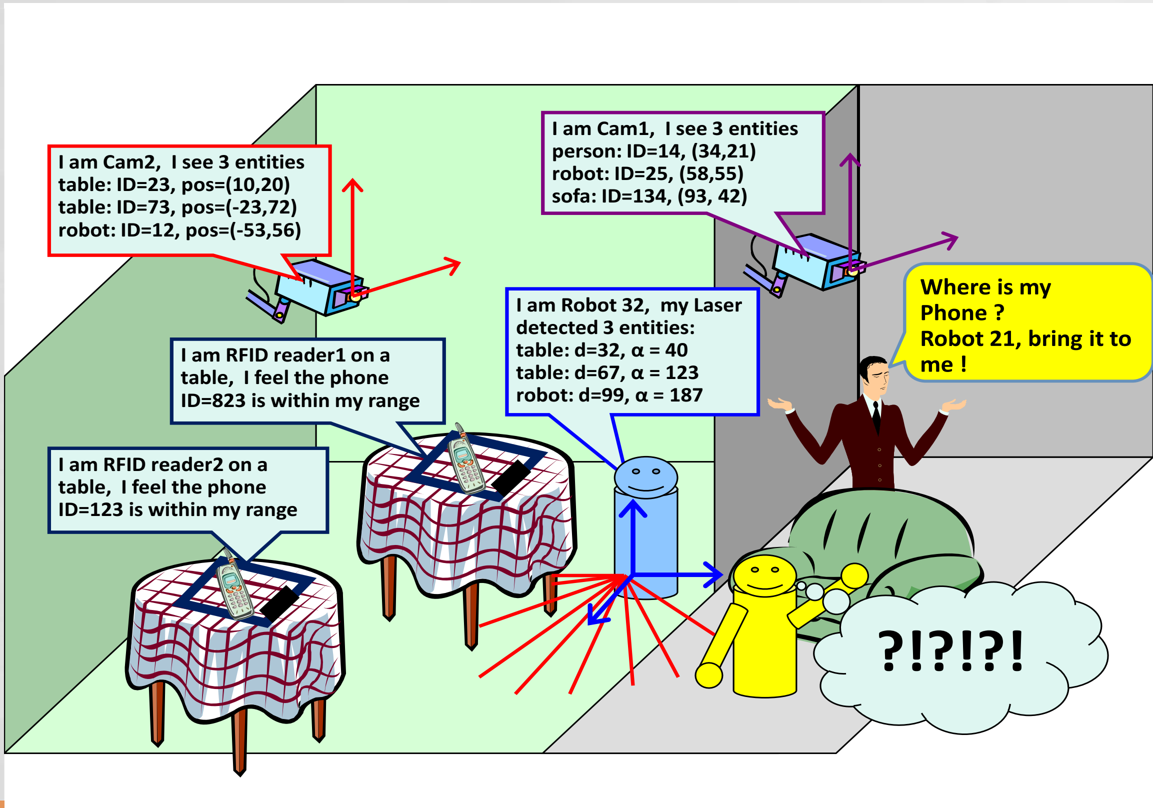
Problem Statement

- A robotic system is commonly defined as an apparatus equipped with a function of interacting with physical entities in a given environment.
- A robot requires geometric association between physical entities of interest and the robot itself
- There are two important attributes for describing a physical entity in space: shape and location
  - Location information plays a key role in carrying out tasks involving robots

Problem Statements

- Localization can be referred to as a systematic approach to determine the current location of physical entities including robots in question by utilizing uncertain data from sensors in the robot or in the environment.
- To achieve flexibility and robustness of localization in robotic systems, it is important to standardize functionalities and associated interfaces for localizing robots and entities as a service. We call such a service as ***"Localization Service (LS)"***

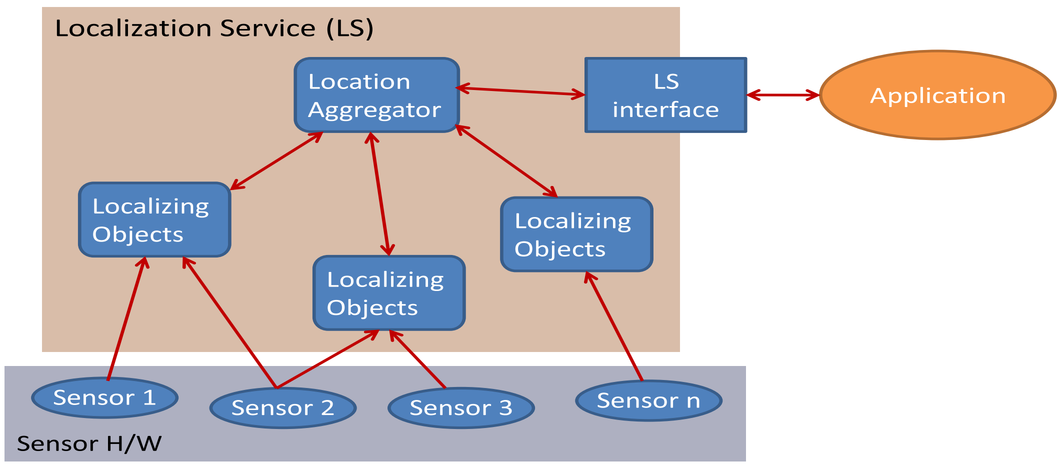
Robotic Localization Environment



Problem Statement

- The location information provided by the robotic entities may only be *partial, incomplete information*.
- The location information provided by the robotic entities may be based on the *local coordinate system* of each robotic entity. In order to combine these responses, the provided location information needs to be translated into some common coordinate system.
- The ID information in the location information provided by the robotic entities may be based on the local ID system of each robotic entity. In order to combine these responses, the provided ID information needs to be translated into some common ID system.

An Example of LS structure



An Example of LS Structure

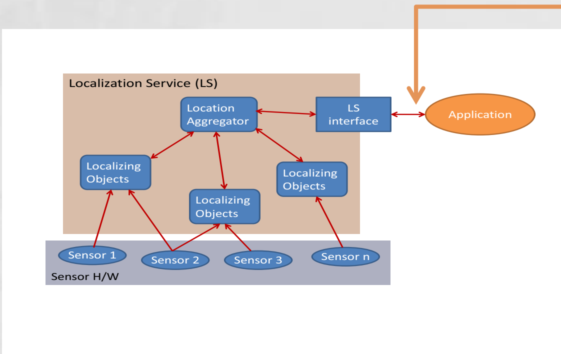
- ***An interface***
  - Accepting requests and for publishing localization results.
  - Publishing its localization result to applications even if there were no requests from them.
- ***A Localizing Object***
  - An actual localization component which determines locations of entities by converting raw data from more than one localization sensor into specific location information.
- ***A Location Aggregator***
  - A means to aggregate various location data from Localizing Objects to produce an integrated response to applications in a synergistic manner.

Mandatory Requirements

1. Proposals shall specify a general mechanism for accessing location information of physical entities to be localized.
   - Proposals shall specify a set of necessary data and/or their structures to represent location information of entities.
   - Proposals shall specify a set of methods and/or their parameters to access location information of entities.

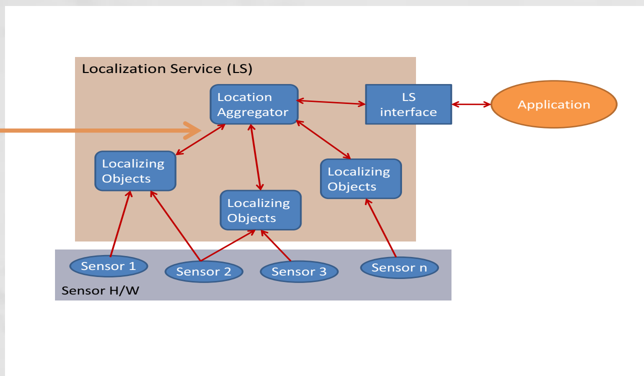
Mandatory Requirements

2. Proposals shall specify generic interface for modules that perform location calculation.
   - Proposals shall specify each module that shall provide interfaces to supply its generated location data to other modules.
   - Proposals shall specify the interface being able to accept localization request.
   - Proposals shall specify the interface being able to publish the localization process result.



Mandatory Requirements

3. Proposals shall specify the interface of a facility that provides functionalities related to:
   - Providing a conversion of a location from one coordinate system to another.
   - Providing a functionality for aggregating multiple Localizing Object outputs into one final location.



Optional Requirements

- Proposals shall specify the interface being able to advertising what type of entity and/or what entity can be localized.
- Proposals shall specify the interface being able to advertise what kind of sensor data can be used and/or what sensors are used.
- Proposals shall specify the interface being able to register new entities
- Managing the different coordinate systems and frames defined in a robotic system, as well as the physical relationship.
- Managing the different *Localizing Objects* in the robotic system.
- Managing the different instances of *Localization Service* present in the system
- Aggregating multiple location sources into one final location, using pluggable location fusion algorithm.

Issues to be discussed

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

Face Recognition Service Component API for Intelligent Robots

2007. 6. 26.
Suyoung Chi
ETRI Intelligent Robot Research Division

Contents

- Why need to standardize Face Recognition Service Component API
- A definition of Face Recognition service
- Scope of a successful proposal for Face Recognition service
- Issues to be discussed

Robotic Functional Services WG

This is what you may hear people talk about when you join their Working Groups :

Robotic Infrastructure WG

Component Model / Encapsulation / Event Management
Data Flow / Data Distribution / Command Flow
Security Management / Activity Monitoring
Code Mobility / Deployment
Execution Synchronization / Prioritization
Capability Modeling / Description / Advertisement
Capability Composition / Hierarchization
Resource Allocation / Management
Safety Management / Safety Procedure / Safety Policies
Fault Tolerances / Recovery Strategies
System Configuration / Dynamic Reconfiguration ...

Tools / Facilities WG

Behavior Language
Internal Component Configuration
Application Deployment
Physical World Repository
Evaluation Metrics / Conformance Test
Modeling Language
Remote Monitoring
Simulation ...

Robotic Profiles WG

Common Device Definition
Composite Device Management
Sensing Devices
Actuating Devices
Rendering Devices
Communication Devices

Common Data Structure
Data Adaptation Mechanism / Data Relation Management
Data Semantics / Onthology ...

Robotic Services WG

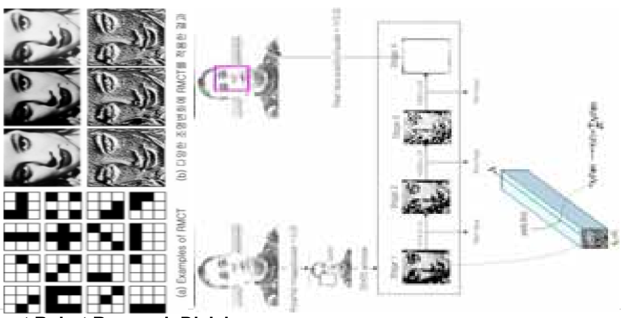
Localization / Positioning
Navigation / World Mapping
Path-Planning / Motion Control / Kinematics
Task Planning
Object Recognition / Person Recognition
Object Tracking / Person Tracking
Visual Processing
Audio Processing
Sensor Fusion
Human Interface
Energy Management ...

Why need to standardize Face Recognition

What is Face Recognition in mobile robotics?

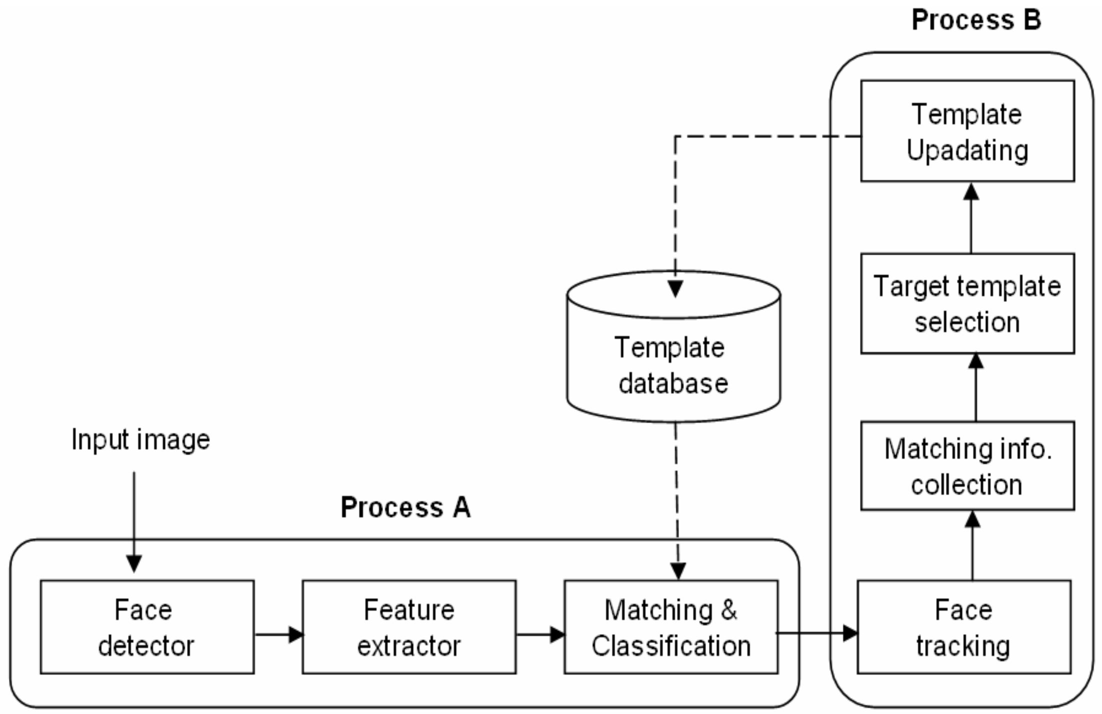
Face Recognition

- The Face Recognition Component APIs for Intelligent Robots provide application program interfaces for users or developers to develop application services by using the face recognition. The design of the face recognition service API is focused on providing easy interfaces **for the developer that concerns not detailed mechanisms and algorithms but results of face recognition. This document defines data types and face recognition application program interfaces. learning based face recognition system was proposed for user identification in robot environments.**



Why need to standardize Face Recognition

Categorization of Face Recognition technology



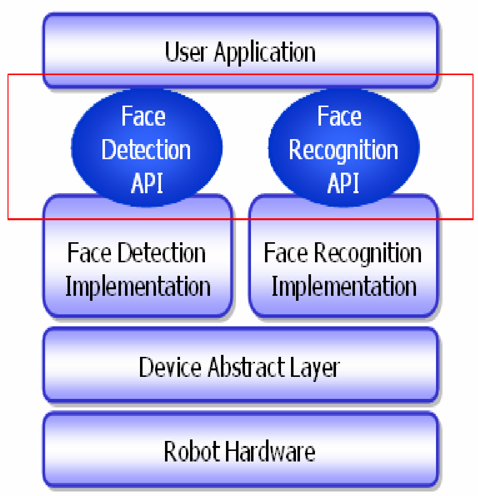
A definition of face recognition service

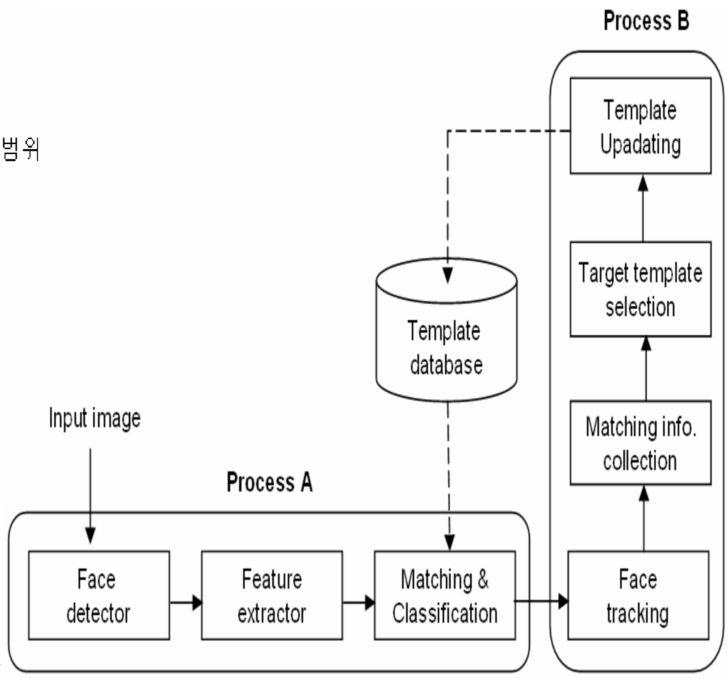
Needs for face recognition service

- A face recognition service is needed
  - To be applied to an intelligent mobile robot for human-level face recognition ability
  - To handle inherent complexity and heterogeneity of target environments and applications
  - To embody interoperability and reusability for different H/W and S/W platforms
  - Therefore, to ease development cost and achieve wide applicability to various tasks based on face information

A definition of face recognition service

Conceptual structure of a face recognition service component

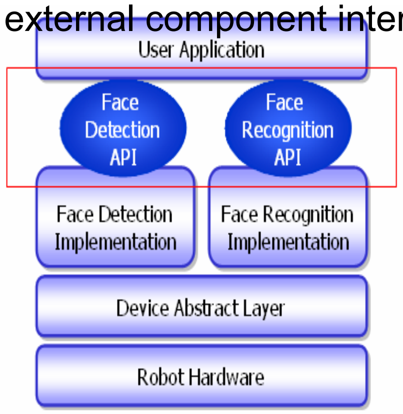




Scope of a successful proposal for face recognition service

A face recognition service component (FRSC) should...

- Describe a general structure of FRSC
- Satisfy interoperability and reusability to cope with myriad of robotic applications based on face recognition
- Describe how it is connected to an external application component and vision and audio sensors
  - Input/output data specification for external component interface



Scope of a successful proposal for face recognition service

A face recognition service component (FRSC) should...

- Describe how it is connected to data type
  - A mechanism to handle data type and result data type, too
- Describe how it implements a face recognition interface module
- This standard document includes definitions of data types and service Application Programming Interfaces (API)
  - Data Types define result data type of face recognition.
  - Service APIs include face detection APIs and face recognition APIs.
- In this standard, we do not define specific algorithms and detailed implementations on face recognition.

Issues to be discussed

- A proposal shall
  - Demonstrate its feasibility by using a specific application based on the proposed FRSC
  - Discuss how the proposed FRSC works seamlessly with RTC specification

Thank you!
Any questions?
Welcome any comments and opinions!!!

Object Management Group

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Facsimile: +1-781-444-0320

Request For Proposal

Robotic Localization Service

OMG Document: robotics/2007-06-15~~<robotics/2007-06-01~~

Letters of Intent due: September 15, 2007
Submissions due: November 12,~~19,~~ 2007

Objective of this RFP

This RFP solicits proposals for a Platform Independent Model (PIM) and at least one CORBA Platform Specific Model (PSM) or C++ PSM of Localization Service that specify

- common interfaces for Localization Service to transfer data and commands
- a set of common information to represent location

In the context of this RFP the word "localization" means "to find the location of some physical entities through analysis of sensor data", consistent with the common use of this term in Robotics.

For further details see Chapter 6 of this document.

6.0 Specific Requirements on Proposals

6.1 Problem Statement

A robotic system is commonly defined as an apparatus equipped with a function of interacting with physical entities in a given environment. Navigation, manipulation and human-robot interaction are typical features including physical interaction of a robot, which make a robotic system distinguished from an information appliance.

A robot requires geometric association between physical entities of interest and the robot itself for implementing a task scenario given to the robot.

There are two important attributes for describing a physical entity in space: shape and location. Of the two attributes, location information plays a far more fundamental role in carrying out various tasks involving a robot.

The following are some typical~~a few of~~ robotic tasks which employ location information.

- Navigation: a robot moves from its current to goal location. The robot should know the two locations and at the same time, it should know relative locations of obstacles it may meet along a moving path.
- Manipulation: a robotic gripper grabs an entity~~object~~ in a sequence of a task, identifying relative position of the entity~~object~~ with respect to a task in a reference coordinate system.
- Human robot interaction: a robot should be aware of the location of human(s) and itself when a given task involves interaction with a human.
- Communication with environments: a robot should recognize physical events in an environment and react to them by incorporating location information of each individual event.

Besides these examples, the number of location-based robotic tasks is continuously increasing as personal or service robot fields are ~~is~~ gradually expanded. Since types of location-based applications are varied along with localization methods, it is necessary to build a unified way of localization to support a wide range of location-based robotic tasks.

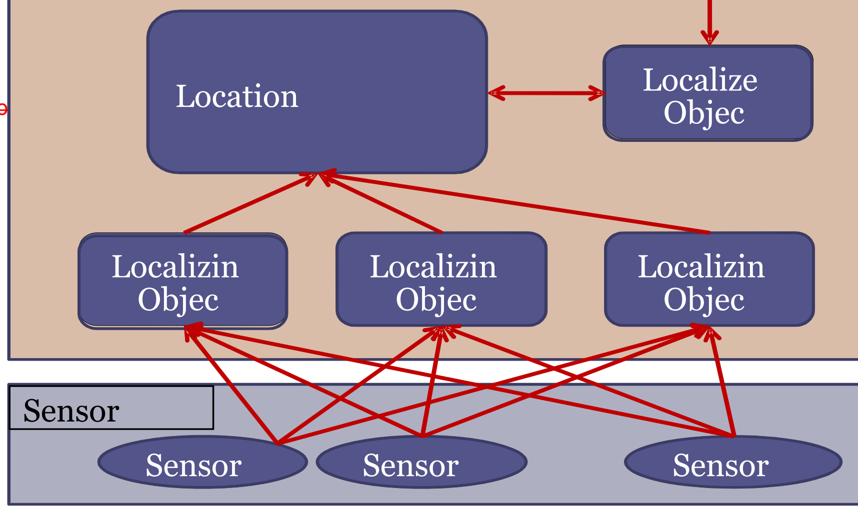
In the context of this RFP the word "localization" means "to find the location of some physical entities through analysis of sensor data", consistent with the common use of this term in Robotics. Here the location to be found may include not only the position in the space, but also heading orientation of the entity, or additional information such as error estimation or timestamp. Also, the word "physical entity" (or "entity" in short) is used to describe the target to be localized, including robots, humans or other objects.

Localization technology may be classified into two categories: relative and absolute localization. Odometry and inertial navigation are typical examples utilizing relative localization, where the current location of a mobile robot is measured with respect to the initial location of the robot. Typical sensors used in relative localization are encoders, gyroscopes, accelerometers,encoder, gyroscope, accelerometer, and so on, which are usually installed within the body of a robot.

Absolute localization utilizes beacons or landmarks whose locations are known with respect to a predefined reference frame. Localization of a mobile robot is initiated by recognizing beacons or landmarks. Map matching method also belongs to this category, utilizing range scan data of an environment as a natural landmark. GPS (Global Positioning System) may be the most successful commercial solution for absolute localization in outdoor environment. Recent applications utilizing sensors installed in the environment such as networked cameras, RF tag readers, and floor sensors may also fall into this category.

Localization solutions differ from one another in accordance with employed sensors, working environment and strategic use for a specific application. Since a specific sensor usually measures a physical quantity of a single kind, it is a common practice that developers of a localization solution utilize multiplecombine different sensors for compensating one another, which means that an unlimited number of localization solutions can be brought about. A variety of existing software and hardware platforms further increases the complexity and difficulty to develop a localization solution.

Therefore, localization can be referred to as a systematic approach to estimatedetermine the current location of robots or physical entities in question by utilizing uncertain data from sensors installed in the robot or in the environment.



~~Figure 1. An Example of Localization Service Structure~~

With an ever-increasing need for a location solution applicable to a wide range of robotic tasks, it is necessary to create a much more flexible way to provide location information irrespective of characteristics of employed sensors, algorithms, and so on. Once such a capability is provided to a localization solution, it can be easily adopted to the vast majority of robotic tasks including localization of robots and related entities.

To achieve flexibility and robustness of localization in robotic systems, it is important to standardize functionalities and associated interfaces for localizing robots and entities as a service. We call such a service as "Localization Service (LS)".

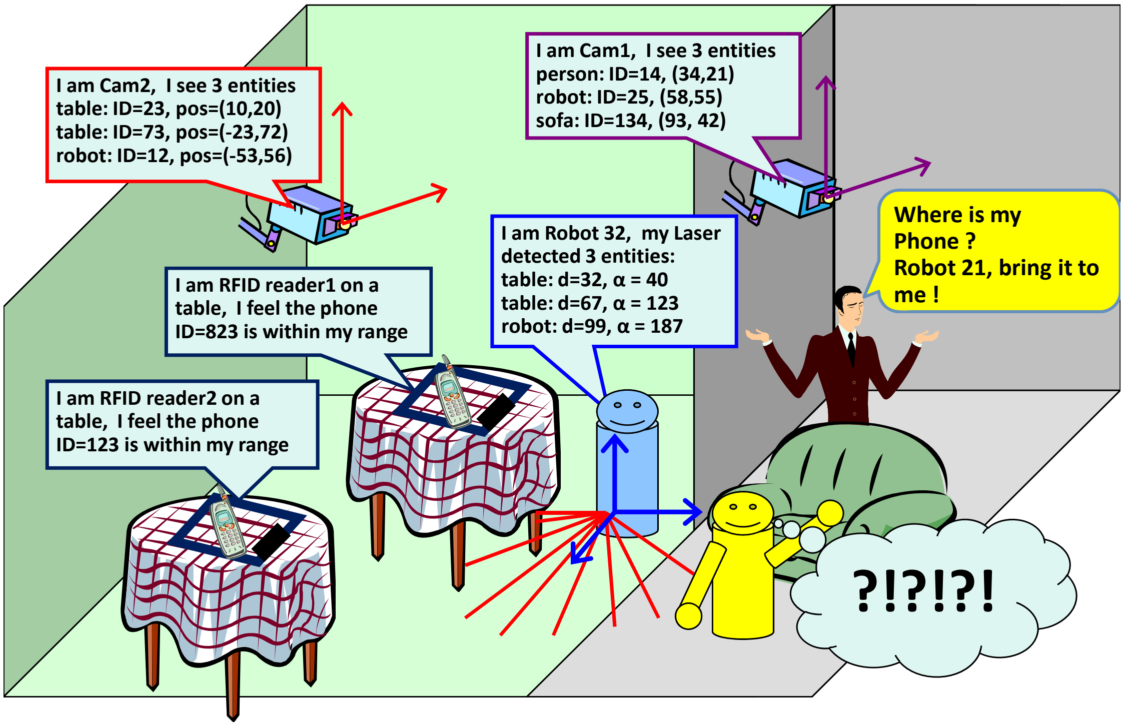


Figure 1 Example of a typical robotic service situation requiring localization of an entity

The LS is a framework of software modules which supports the functionalities for localizing robots or entities in the physical world including robots, regardless of specific sensors and algorithms. Figure 1Figure 1 illustrates a typical situation in a robot service where localization of an entity is required. Here, a robot in service needs to obtain the location of a cellular phone, utilizing information from various robotic entities in the environment. These robotic entities have the ability to estimate the location of the entities within their sensing range. Thus, the problem here is to aggregate the location estimations from the robotic entities, and to localize the cellular phone in target. Here, three major issues arise.

- The location information provided by the robotic entities may be incomplete information. For example, Cam2 in figure 1 provides only 2D information for the entities within its sensing range. This location information shall be compensated by responses from other robotic entities, in order to make 3D location information required for the robotic service.

- The location information provided by the robotic entities may be based on the local coordinate system of each robotic entity. In order to aggregate these responses, the provided location information needs to be translated into some common coordinate system, such as the global coordinate system or the local coordinate system of the robot in service.

- The ID information in the location information provided by the robotic entities may be based on the local ID system of each robotic entity. In order to aggregate these responses, the provided ID information needs to be translated into some common ID system, such as the global ID system or the local ID system of the robot in service.

The LS shall hold the functionality to provide a solution to the above issues. Figure 2 illustrates an examplebasic structure of LS. In this example, to realize the descriptions above. The LS is composed of thehas following three functionalities:characteristics:

- An interfaceThe LS has interfaces for accepting requests and for publishing localization results. For example, an applicationapplications can send a requestrequests to the LS asking for the current location of a robot and then the LS responds to the requestm via a predetermined interface protocol. Also, the LS can publish its localization result to applications even if there were no request from them.s from them. "Localized Object" in Figure 1 shows a component providing an entry point of LS dealing with various forms of requests from applications.

- A *Localizing Object* is anThe LS supports actual localization components which findsdetermine locations of physical entities by convertingrobots and objects. "Localizing Object" in Figure 1 is one instance of a localization component which converts raw data from more than one localization sensor(s) into specific location information. Each individual "Localizing Object" embodies a specific localization algorithm as well as input and output interfaces to take sensor data and provide a localization result.

- A *Location Aggregator* isThe LS provides a means to aggregate various location data from "Localizing Objects" to produce an integrated

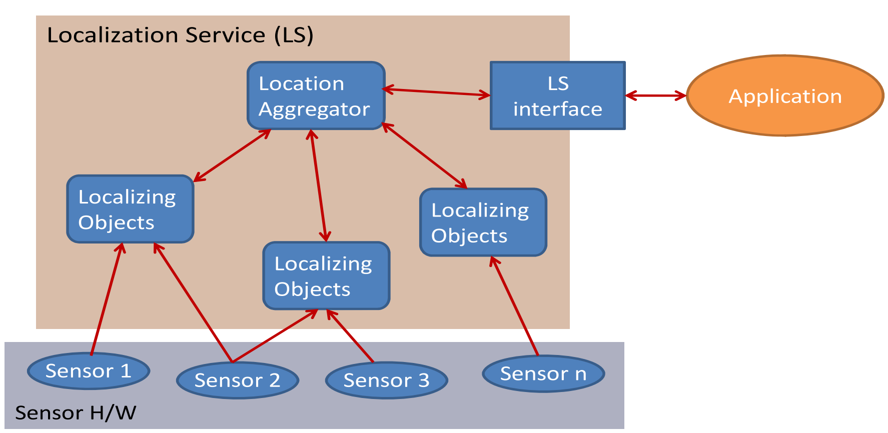


Figure 2 An Example of Localization Service Implementation Structure

response to applications. requester. "Location Aggregator" in Figure 2Figure 1 realizes the process of combining multiple location data from each "Localizing Object" into a single location in a synergistic manner.

6.2 Scope of Proposals Sought

This RFP seeks proposals that specify a localization service, on top of which various robotic applications are developed.

It is necessary to consider the followings in the specification of thea localization service (LS).

~~(1) The LS specification should provide a framework for supporting flexible configuration of its own functionalities.~~

(2)(1) The LS specification must be general enough to incorporate various localization sensors and algorithms.

(3)(2) The LS specification should provide the data representation for its external application interface as well as its internal functionalities.

- The data representation may includes elements for specifying location such as location format, coordinate system, measurement unit, etc.
- The location format may include auxiliary information, such as identification, time stamp, error estimate, etc.

(4)(3) The LS specification should satisfy interoperability and reusability, such by providing common interfaces and common data formats. Areusability. An LS implemented by one vendor should be able to be replaced with LSs provided by other vendors with little efforts.

(5)(4) The LS specification should provide a minimum set of functionalities to satisfy the following:

- Providing an interface for acceptingin order to accept requests and for publishingto publish localization results.
- Providing meansa mean for initialization of the LS and for adjustment of the localization result.service.

- Providing a mean for specifying the data format, such as the coordinate system for the location data, the identification system for the identification data, or the format for the error data.

- Providing an interface for accepting location informationin order to accept translation requests and publishing the results.

(6)(5) Real-time operations are especially important for the LS.localization service. The LS specification should be able to demonstrate its real-time support.

6.3 Relationship to Existing OMG Specifications

Submitters should examine the following OMG specifications for possible benefit:

- Platform Independent Model (PIM) and Platform Specific Model (PSM) for super Distributed Objects (SDO) Specification version 1.0 [formal/2004-11-01]

- Unified Modeling Language: Infrastructure version 2.0 [formal/07-02-06ptc/2004-10-14]

- Unified Modeling Language: Superstructure version 2.1.1 [formal/07-02-052.0 [formal/ 2005-07-04]

- Lightweight CORBA Component Model V4.0 [formal/2006-04-01[ptc/2004-06-10]

- Robotic Technology Component specification version 1.0 [ptc/06-11-07ptc/2005-09-01]

- OMG Systems Modeling Language (SysML) specification version 1.0 [ptc/07-02-04]

- Smart Transducers Interface specification version 1.0 [formal/03-01-01]

- Data Distribution Service for Real-time Systems specification version 1.2 [formal/2007-01-01]

- Data Acquisition from Industrial Systems (DAIS) specification version 1.1 [formal/2005-06-01]

- Historical Data Acquisition from Industrial Systems (HDAIS) specification version 1.0 [formal/2005-06-02]

- Distributed Simulation System specification version 2.0 [mfg/2001-10-01]

6.4 Related Activities, Documents and Standards

Proposals may include existing systems, documents, URLS, and standards that are relevant to the problems discussed in this RFP. They can be used as background information for the proposal.

Example:

- IEEE Robotics and Automation Society, Technical Committee on Network Robot

- IEEE Robotics and Automation Society, Technical Committee on Programming Environment in Robotics and Automation

- SAE AS-4 Unmanned Systems Committee or JAUS: Joint Architecture for Unmanned Systems, *http://www.jauswg.org/*

- URC (Ubiquitous Robotic Companion) Project

- URS (Ubiquitous Robotic Space) Project

- NRF (Network Robot Forum), *http://www.scat.or.jp/nrf/*

- OGC (Open Geospatial Consortium): OpenGIS Location Service (OpenLS) Implementation Specification: Core service [IS/05-016]

- ISO/ TC 211 Geographic Information/Geomatics : ISO 19116:2004 Geographic Information – Positioning Service

- ISO/TC 211 Geographic Information/Geomatics : ISO 19111:2004 Geographic information – Spatial referencing by coordinates

- ~~ISO/ TC 211 Geographic Information/Geomatics : ISO 19111:2004 Geographic information – Spatial referencing by coordinates~~

6.5 Mandatory Requirements

Proposals shall provide a Platform Independent Model (PIM) and at least one CORBA-specific model of Localization Service (LS) or C++ -specific model of LS. The models shall meet the following requirements.

1. Proposals shall specify a general mechanism for accessing location information of physical entities to be localized.objects.

   - Proposals shall specify a set of data and/or their structures necessary to represent location information of entities.
   - Proposals shall specify a set of methods and/or their parameters to accessrepresent the location information of entities.objects including position and associated entries.
   - Proposals shall specify the format of the structures used to present, such as location data, coordinate systems, and reference frame.

2. Proposals shall specify interfacesgeneric interface for modules that perform location calculation.

   - Proposals shall specify the interface for acceptingeach module that shall provide interfaces to supply its generated location data to other modules.
   - Proposals shall specify the interface being able to advertising what type of object and/or what object can be localized.
   - Proposals shall specify the interface being able to register new objects.
   - Proposals shall specify the interface being able to accept localization request.
   - Proposals shall specify the interface for publishingbeing able to publish the localization process result.
   - Proposals shall specify the interface being able to advertise what kind of sensor data can be used and/or what sensors are used.

3. Proposals shall specify the interface of a facility that provides functionalities related to:

   - ConversionManaging the different coordinate systems and frames defined in a robotic system, as well as the 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 information from one coordinate system~~, reference frame, and/or unit system tuple~~ to another.
- Aggregation of~~Aggregating~~ multiple location information outputs~~sources~~ into one final ~~position, using pluggable~~ location.~~ fusion algorithm.~~

6.6 Optional Requirements

Proposals may specify interfaces for the functionalities listed below.

- Advertising what types of entities can be localized and/or what entities are being localized.
- Advertising what kind of sensor data can be used and/or what sensors are used.
- Incorporating additional information for localization or aggregation, such as for notifying the LS about some entities that moved in/out of its range.
- Managing the different coordinate systems and frames defined in a robotic system, as well as their physical relationship.
- Managing the instances of *Localizing Object* or *Localization Service* present in the robotic system.
- Controlling the internal parameters for the location fusion algorithms used in aggregating locations. With this interface, the algorithm used for location aggregation can be implemented as a module. In this way, developers can easily exchange this algorithm module by modules with other algorithms when necessary.

~~None~~

6.7 Issues to be discussed

These issues will be considered during submission evaluation. They should not be part of the proposed normative specification. (Place them in Part I of the submission.)

- Proposals shall demonstrate its feasibility by using a specific application based on the proposed model.

- Proposals shall demonstrate its applicability to existing technology such as RTLS (Real-Time Location System).

- Proposals shall discuss simplicity of implementation.

- Proposals shall discuss the possibility to apply the proposed model to other existing fields/projects of interest that utilize location information, such as “Sensor Network Project” [SensorNet].~~.~~

- Proposals shall discuss the possibility of providing standard mechanism to access map data.

- Proposals shall discuss their relation and dependency to existing~~specify on-the-wire protocol~~ communication protocols or middleware standards, such as CORBA [CORBA] or DDS [DDS].~~technology independent.~~

6.8 Evaluation Criteria

Proposals will be evaluated in terms of consistency in their specifications, feasibility and versatility across a wide range of different robot applications.

6.9 Other information unique to this RFP

None

6.10 RFP Timetable

The timetable for this RFP is given below. Note that the TF or its parent TC may, in certain circumstances, extend deadlines while the RFP is running, or may elect to have more than one Revised Submission step. The latest timetable can always be found at the OMG *Work In Progress* page at http://www.omg.org/schedules/ under the item identified by the name of this RFP. Note that “<month>” and “<approximate month>” is the name of the month spelled out; e.g., January.

Event or Activity	Actual Date
Preparation of RFP by TF	*June 1, 2007*
RFP placed on OMG document server	*June 4, 2007*
Approval of RFP by Architecture Board Review by TC	*June 28, 2007*
TC votes to issue RFP	*June 29, 2007*
LOI to submit to RFP due	*September 15, 2007*
Initial Submissions due and placed on OMG document server (“Four~~(“Three~~	*November 12,~~19,~~ 2007*

week rule")	
Voter registration closes	*December 3, 2007*
Initial Submission presentations	*December 10, 2007*
Preliminary evaluation by TF	
Revised Submissions due and placed on OMG document server ("Four("Three week rule")	*May 26,2008February18,2008*
Revised Submission presentations	*June 23,March 10, 2008*
Final evaluation and selection by TF *Recommendation to AB and TC*	
Approval by Architecture Board *Review by TC*	
TC votes to recommend specification	*September 26,March 13, 2008*
BoD votes to adopt specification	*December,June, 2008*

Appendix A References and Glossary Specific to this RFP

A.1 References Specific to this RFP

[DDS] Data Distribution Service for Real-time Systems Specification, *http://www.omg.org/technology/documents/formal/data_distribution.htm*

[IS/05-016] OGC (Open Geospatial Consortium): OpenGIS Location Service (OpenLS) Implementation Specification: Core service, http://www.opengeospatial.org/standards/olscore

[SensorNet] UNS (Ubiquitous Network Society) Sensor Network Project, *http://www.ubiquitous-forum.jp/*

None

A.2 Glossary Specific to this RFP

None

Appendix B General Reference and Glossary

B.1 General References

The following documents are referenced in this document:

[ATC] Air Traffic Control Specification, *http://www.omg.org/technology/documents/formal/air_traffic_control.htm*

[BCQ] OMG Board of Directors Business Committee Questionnaire, *http://www.omg.org/cgi-bin/doc?bc/02-02-01*

[CCM] CORBA Core Components Specification, *http://www.omg.org/technology/documents/formal/components.htm*

[CORBA] Common Object Request Broker Architecture (CORBA/IIOP), *http://www.omg.org/technology/documents/formal/corba_iiop.htm*

[CSIV2] [CORBA] Chapter 26

[CWM] Common Warehouse Metamodel Specification, *http://www.omg.org/technology/documents/formal/cwm.htm*

[DAIS] Data Acquisition from Industrial Systems, *http://www.omg.org/technology/documents/formal/dais.htm*

[EDOC] UML Profile for EDOC Specification, *http://www.omg.org/techprocess/meetings/schedule/UML_Profile_for_EDOC_FTF.html*

[EJB] "Enterprise JavaBeans™", *http://java.sun.com/products/ejb/docs.html*

[FORMS] "ISO PAS Compatible Submission Template". *http://www.omg.org/cgi-bin/doc?pas/2003-08-02*

[GE] Gene Expression, *http://www.omg.org/technology/documents/formal/gene_expression.htm*

[GLS] General Ledger Specification , *http://www.omg.org/technology/documents/formal/gen_ledger.htm*

[Guide] The OMG Hitchhiker's Guide,, *http://www.omg.org/cgi-bin/doc?hh*

[IDL] ISO/IEC 14750 also see [CORBA] Chapter 3.

[IDLC++] IDL to C++ Language Mapping, *http://www.omg.org/technology/documents/formal/c++.htm*

[MDAa] OMG Architecture Board, "Model Driven Architecture - A Technical Perspective*", http://www.omg.org/mda/papers.htm*

[MDAb] "Developing in OMG's Model Driven Architecture (MDA)," *http://www.omg.org/docs/omg/01-12-01.pdf*

[MDAc] "MDA Guide" (*http://www.omg.org/docs/omg/03-06-01.pdf*)

[MDAd] "MDA "The Architecture of Choice for a Changing World™"", *http://www.omg.org/mda*

[MOF] Meta Object Facility Specification, *http://www.omg.org/technology/documents/formal/mof.htm*

[MQS] "MQSeries Primer", *http://www.redbooks.ibm.com/redpapers/pdfs/redp0021.pdf*

[NS] Naming Service, *http://www.omg.org/technology/documents/formal/naming_service.htm*

[OMA] "Object Management Architecture™", *http://www.omg.org/oma/*

[OTS] Transaction Service, *http://www.omg.org/technology/documents/formal/transaction_service.htm*

[P&P] Policies and Procedures of the OMG Technical Process*, http://www.omg.org/cgi-bin/doc?pp*

[PIDS] Personal Identification Service, *http://www.omg.org/technology/documents/formal/person_identification_service.htm*

[RAD] Resource Access Decision Facility, *http://www.omg.org/technology/documents/formal/resource_access_decision.htm*

[RFC2119] IETF Best Practices: Key words for use in RFCs to Indicate Requirement Levels, (*http://www.ietf.org/rfc/rfc2119.txt*).

[RM-ODP] ISO/IEC 10746

[SEC] CORBA Security Service, *http://www.omg.org/technology/documents/formal/security_service.htm*

[TOS] Trading Object Service, *http://www.omg.org/technology/documents/formal/trading_object_service.htm*

[UML] Unified Modeling Language Specification, *http://www.omg.org/technology/documents/formal/uml.htm*

[UMLC] UML Profile for CORBA, *http://www.omg.org/technology/documents/formal/profile_corba.htm*

[XMI] XML Metadata Interchange Specification, *http://www.omg.org/technology/documents/formal/xmi.htm*

[XML/Value] XML Value Type Specification, *http://www.omg.org/technology/documents/formal/xmlvalue.htm*

B.2 General Glossary

Architecture Board (AB) - The OMG plenary that is responsible for ensuring the technical merit and MDA-compliance of RFPs and their submissions.

Board of Directors (BoD) - The OMG body that is responsible for adopting technology.

Common Object Request Broker Architecture (CORBA) - An OMG distributed computing platform specification that is independent of implementation languages.

Common Warehouse Metamodel (CWM) - An OMG specification for data repository integration.

CORBA Component Model (CCM) - An OMG specification for an implementation language independent distributed component model.

Interface Definition Language (IDL) - An OMG and ISO standard language for specifying interfaces and associated data structures.

Letter of Intent (LOI) - A letter submitted to the OMG BoD's Business Committee signed by an officer of an organization signifying its intent to respond to the RFP and confirming the organization's willingness to comply with OMG's terms and conditions, and commercial availability requirements.

Mapping - Specification of a mechanism for transforming the elements of a model conforming to a particular metamodel into elements of another model that conforms to another (possibly the same) metamodel.

Metadata - Data that represents models. For example, a UML model; a CORBA object model expressed in IDL; and a relational database schema expressed using CWM.

Metamodel - A model of models.

Meta Object Facility (MOF) - An OMG standard, closely related to UML, that enables metadata management and language definition.

Model - A formal specification of the function, structure and/or behavior of an application or system.

Model Driven Architecture (MDA) - An approach to IT system specification that separates the specification of functionality from the specification of the implementation of that functionality on a specific technology platform.

Normative – Provisions that one must conform to in order to claim compliance with the standard. (as opposed to non-normative or informative which is explanatory material that is included in order to assist in understanding the standard and does not contain any provisions that must be conformed to in order to claim compliance).

Normative Reference – References that contain provisions that one must conform to in order to claim compliance with the standard that contains said normative reference.

Platform - A set of subsystems/technologies that provide a coherent set of functionality through interfaces and specified usage patterns that any subsystem that depends on the platform can use without concern for the details of how the functionality provided by the platform is implemented.

Platform Independent Model (PIM) - A model of a subsystem that contains no information specific to the platform, or the technology that is used to realize it.

Platform Specific Model (PSM) - A model of a subsystem that includes information about the specific technology that is used in the realization of it on a specific platform, and hence possibly contains elements that are specific to the platform.

Request for Information (RFI) - A general request to industry, academia, and any other interested parties to submit information about a particular technology area to one of the OMG's Technology Committee subgroups.

Request for Proposal (RFP) - A document requesting OMG members to submit proposals to the OMG's Technology Committee. Such proposals must be received by a certain deadline and are evaluated by the issuing task force.

Task Force (TF) - The OMG Technology Committee subgroup responsible for issuing a RFP and evaluating submission(s).

Technology Committee (TC) - The body responsible for recommending technologies for adoption to the BoD. There are two TCs in OMG – *Platform TC* (PTC), that focuses on IT and modeling infrastructure related standards; and *Domain TC* (DTC), that focus on domain specific standards.

Unified Modeling Language (UML) - An OMG standard language for specifying the structure and behavior of systems. The standard defines an abstract syntax and a graphical concrete syntax.

UML Profile - A standardized set of extensions and constraints that tailors UML to particular use.

XML Metadata Interchange (XMI) - An OMG standard that facilitates interchange of models via XML documents.

- OMG Robotics DTF-

- Robotic Functional Services Working Group -

Meeting Report

- Brussels WG Meeting -

Brussels (Belgium) – June 27, 2007

Co-chairs : Su Young Chi (chisy@etri.re.kr) / Shuichi NISHIO (nishio@atr.jp)

Schedule

- **Sunday**
- PM 13:00 - 18:30 : Localization Service for Robotics RFP pre-review meeting(1st)
- **Monday**
- AM 08:00 - 09:00 : Localization Service for Robotics RFP pre-review meeting(2nd)
- AM 09:00 - 10:00 : Robotics Steering Committee
- AM 10:00 - 10:15 : *Joint Plenary Meeting*
- AM 10:15 - 12:00 : *Localization Service for Robotics RFP Review*
- PM 16:00 - 16:40 : *Architecture Board Plenary*
- PM 13:00 - 18:00 : *Robotics-DTF Seminar (Information Day)*

- **Tuesday**
- AM 09:00 – 12:00 : 2nd review comments presentation and discussion
- AM 10:30 – 11:00 : *Joint Session: Localization Service for Robotics RFP(C4I)*
  - Coffee Break
- PM 13:00 – 14:00 : Face Recognition Service Component API
- PM 14:00 – 17:00 : Discussion (con't) Localization Service RFP 2st Review

- **Wednesday**
- AM 09:00 – 10:00 : WG Reports and Roadmap Discussion
- **Thursday**
- AM 09:00 – 10:15 :Joint Session: Localization Service for Robotics RFP(ManTIS)
- AM 10:15 – 12:00 :Localization Service for Robotics RFP Review(2nd review voting)

Discussion Topics

Localization Service for Robotics

- 2nd Review Comments and update
- Joint Session Comments(C4I)

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

Comments & Suggestions for New item about Service WG

- Prof. Takashi Tsubouchi
  - We might as well take more pragmatic way to decompose the problems.
  - We should consider the background framework to support each robotic application service in total.
  - I wonder if the face recognition itself were too much application oriented material.
- Dr. Miwako Doi

  The interaction between human robots is the most important element of the robot services.

  Before focussing the face recognition service, we must clarify the problems of intaractive services between human and robots.
- Mr. OZAKI, Fumio
  - What is the difference between the standard face recognition system and the proposed system?
  - Standardization is to define the API not Implementation, face recognition systems should have the same interface both in the standard one and the one for mobile robots.

Comments & Suggestions for New item about Service WG

- Dr. Yeonho Kim
  - We should consider an hierarchical structure for the human identification including face or voice recognition and definitions for the interfaces between the modules in the structure
  - We should consider what functions will be required for robots as well as functions that are commonly required in other area.
- Dr. Seokwon Bang
  - We need to investigate much more the other standard related to Face recognition.
  - Nowadays, multimedia application area deal with movie or drama image for detecting who is the actor.
  - So, both of the cases (Robot and Multimedia) deal with the same dynamic images.
- Dr. Kwang hyun Park
  - Define what a face is.
  - Survey other results, methods, and standards in vision technology area because they already deal with motion aspects. What is unique aspects in this WG?
  - Data types may not be restricted. If we wish, make the inputs clear. For example, we can restrict the inputs as images and video.
  - Face detection and recognition is not on the same level in the diagram. We can divide them or make a hierarchy.

Schedule for next meeting (Tentative)

- **Monday**
- **Tuesday**
- **Wednesday**
- **Thursday**

Robotics Functional Service WG Mail List

- Please use the WG mail list for all robotics functional service communication, by sending to:

  omg-service@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.

Brussels 2007 Jun 24-29

OMG Robotics DTF
Robotic Devices & Data Profile WG
Progress Report (Brussels Meeting)

Seung-Ik Lee and Bruce Boyes, co-chairs

2007 Brussels Meeting Summary

- Meeting:
  - Samsung, SEC, SIT, TTA, KAIRA, ETRI
  - 26 Jun, 207 (9:00- 12:00)
- Key topics
  - One combined RFP or separate RFPs
  - More candidate submitters

2007 Brussels Meeting Summary

- We decided to make two separate RFPs
  - Programmer's view on device: device abstraction APIs
  - Transducer's view
- We need more volunteers
  - Currently, candidate submitters: ETRI, KAIRA, SAMSUNG(?)
  - We request every volunteers to actively participate in preparing the RFP
- we worked on a draft RFP

Robotics Devices and Data Profiles WG Road Map

Item	Washington DC Dec, 2006	Brussels Jun, 2007	Florida Sep, 2007	Burlingame Dec, 2007	Burlingame Dec, 2007
Programmers API: Typical device abstract interfaces and hierarchies	RFP discussion	RFP discussion	1st review	2nd review & issue	Response
Hardware-level Resources: define resource profiles	RFP discussion	No discussion	TBD	TBD	TBD

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.

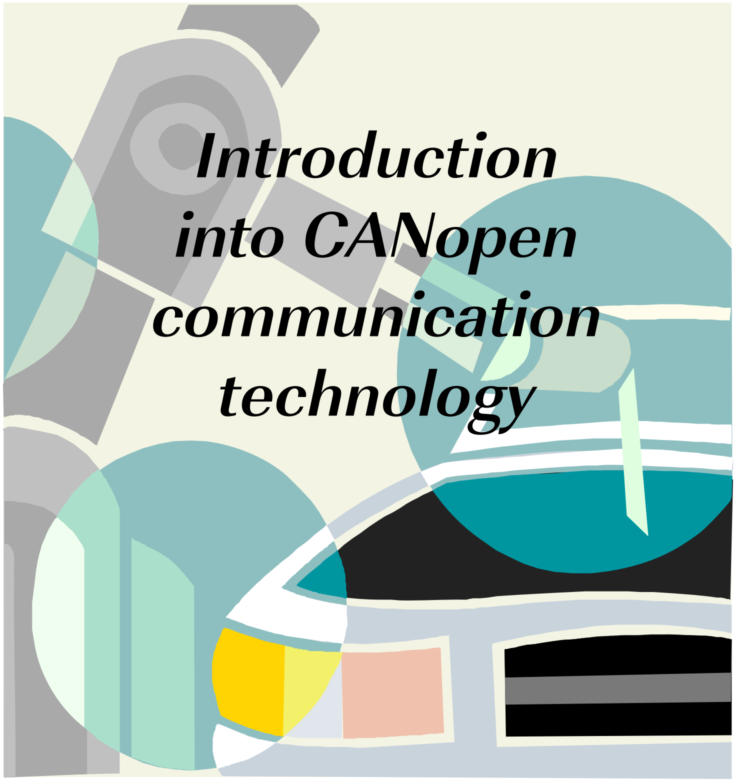
Mandatory requirements

1. **Propose a device categorization that is used for abstracting ro botic devices**
2. **By using the proposed categorization, define abstract interfac es for robots and their devices including remote transducers which interact with robots**
3. **Profiles which describe capabilities and properties of the devi ces**
4. **Enumeration and management of robotic devices**

Optional requirements

1. **Propose a process or guideline for facilitating the adoption of new devices**

Holger Zeltwanger



Introduction into CANopen communication technology

CANopen reference model

Device application software

Layer	Implementation
CANopen device *or* application profile	Protocol software
CANopen application layer	Protocol software
CAN data link layer	CAN controller
CAN physical layer	CAN transceiver

OSI layers: CANopen application layer, CAN data link layer, CAN physical layer

Letter

Layer	Implementation
Dictionary	Text building blocks
Grammar	Text building blocks
Character set	Printer
Writing material	Paper + ink

CANopen history

- 1993: ESPRIT project ASPIC (CAL-based communication profile)
- November 1994: CAL-based communication profile version 1.0
- January 1995: CAL-based communication profile version 1.1
- September 1995: CANopen CiA 301 version 2.0 (DSP)
- October 1996: CiA 301 version 3.0 (DS)
- June 1999: CiA 301 version 4.0 (DS)
- October 2006: CiA 301 version 4.1 (DSP)

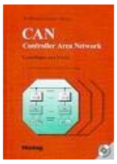
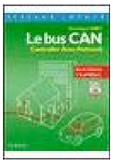
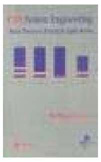
CANopen specifications

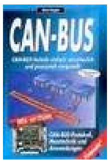
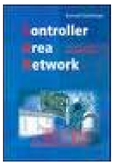
CiA301 CiA302 CiA303 CiA304 CiA305 CiA306
CiA307 CiA308 CiA309 CiA310 CiA311 CiA312
CiA313 CiA401 CiA402 CiA404 CiA405 CiA406
CiA408 CiA410 CiA412 CiA413 CiA414 CiA415
CiA416 CiA417 CiA418 CiA419 CiA420 CiA421
CiA422 CiA423 CiA424 CiA425 CiA426 CiA427
CiA428 CiA429 CiA430 CiA431 CiA432 CiA433
CiA434 CiA435 CiA436 CiA438 CiA439 CiA440
CiA441 CiA ... 445 CiA446
CiA447 CiA ... 451 CiA452

1995: 60 DIN A4 pages

2007: 4000 DIN A4 pages

CAN books

DE	DE	FR	EN	FR	EN
					
1994	1994	1996	1997	1999	2000

DE	EN	DE	EN	JP	CN
					
2000	2001	2001	2003	2004	2005

CiA 301 bit-timing

Bit rate Bus length [1]	Nominal bit time t_b	Location of sample point	Range for location of sample point	Index for Layer setting services
1 Mbit/s 25 m	1 µs	87.5% (875 ns)	75 to 90%	0
800 kbit/s 50 m	1.25 µs	87.5% (1.09375 µs)	75 to 90%	1
500 kbit/s 100 m	2 µs	87.5% (1.75 µs)	85 to 90%	2
250 kbit/s 250 m [2]	4 µs	87.5% (3.5 µs)	85 to 90%	3
125 kbit/s 500 m [2]	8 µs	87.5% (7 µs)	85 to 90%	4
50 kbit/s 1,000 m [3]	20 µs	87.5% (17.5 µs)	85 to 90%	5
20 kbit/s 2,500 m [3]	50 µs	87.5% (43.75 µs)	85 to 90%	6
10 kbit/s 5,000 m [3]	100 µs	87.5% (87.5 µs)	85 to 90%	7

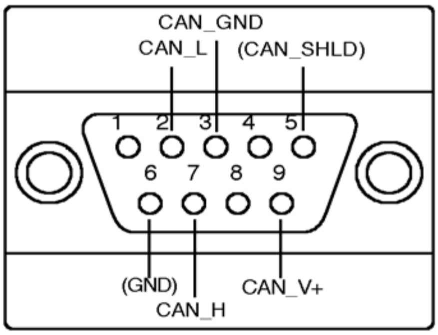
Note: The total device internal delay is considered as 210 ns @ 1 Mbit/s and 800 kbit/s; 310 ns (includes 2 x 40-ns optocoupler) @ 500 and 250 kbit/s; 450 ns (2 x 100-ns optocoupler) @ 125 kbit/s; 1.5 TQ @ ≤ 50 kbit/s

Stub length limits

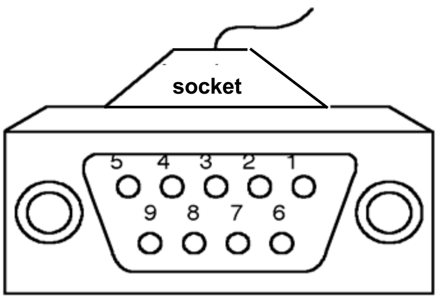
Data rate bus length	Bus length	Max. stub length	Accumu-lated stub length
1 Mbit/s	25 m	1,5 m	7,5 m
800 kbit/s	50 m	2,5 m	12,5 m
500 kbit/s	100 m	5,5 m	27,5 m
250 kbit/s	250 m	11 m	55 m
125 kbit/s	500 m	22 m	110 m
50 kbit/s	1000 m	55 m	275 m
20 kbit/s	2500 m	137,5 m	687,5 m
10 kbit/s	5000 m	275 m	1375 m

9-pin D-sub connector

plug

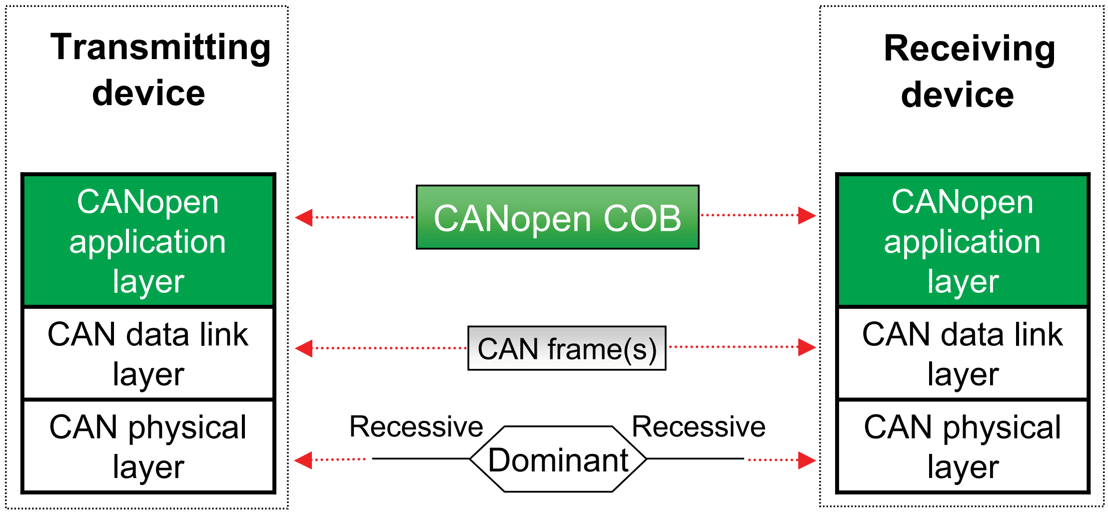


DIN 41652



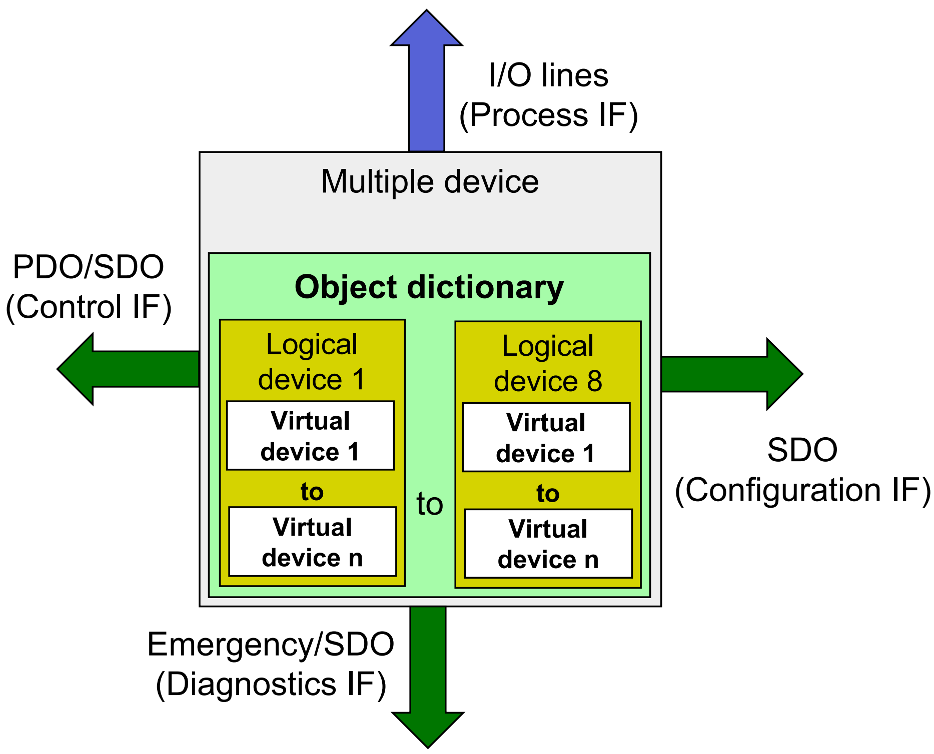
Pin	Signal	Description
1	-	Reserved
2	CAN_L	CAN_L bus line dominant low
3	CAN_GND	CAN Ground
4	-	Reserved
5	(CAN_SHLD)	Optional CAN Shield
6	GND	Optional Ground
7	CAN_H	CAN_H bus line dominant high
8	-	Reserved
9	(CAN_V+)	Optional CAN external positive supply

Protocol layer interactions



COB = communication object

CANopen device model



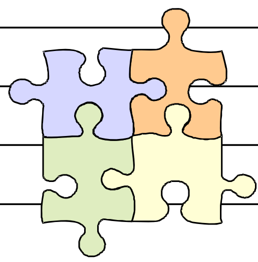
Object dictionary layout

Index[1] range	Description
0000_h	Reserved
0001_h to $025F_h$	Data types
0260_h to $0FFF_h$	Reserved
1000_h to $1FFF_h$	Communication profile area
2000_h to $5FFF_h$	Manufacturer-specific profile area
6000_h to $9FFF_h$	Standardized profile area
$A000_h$ to $AFFF_h$	Network variables
$B000_h$ to $BFFF_h$	System variables
$C000_h$ to $FFFF_h$	Reserved

[1] **16-bit index plus 8-bit sub-index**

Logical devices

Index range	Description
6000_h to $67FF_h$	Logical device 1
6800_h to $6FFF_h$	Logical device 2
7000_h to $77FF_h$	Logical device 3
7800_h to $7FFF_h$	Logical device 4
8000_h to $87FF_h$	Logical device 5
8800_h to $8FFF_h$	Logical device 6
9000_h to $97FF_h$	Logical device 7
9800_h to $9FFF_h$	Logical device 8

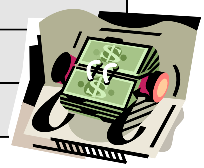


Remark: The device type object for the logical device 1 is accessible at $67FF_h$, for logical device 2 at $6FFF_h$ and so on.

CAN

Communication profile area

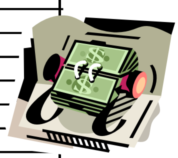
Index range	Description
1000_h to 1029_h	General communication objects
1200_h to $12FF_h$	SDO parameter objects
1300_h to $13FF_h$	CANopen safety objects
1400_h to $1BFF_h$	PDO parameter objects
$1F00_h$ to $1F11_h$	SDO manager objects
$1F20_h$ to $1F27_h$	Configuration manager objects
$1F50_h$ to $1F54_h$	Program control objects
$1F80_h$ to $1F89_h$	NMT master objects



CAN

Communication objects

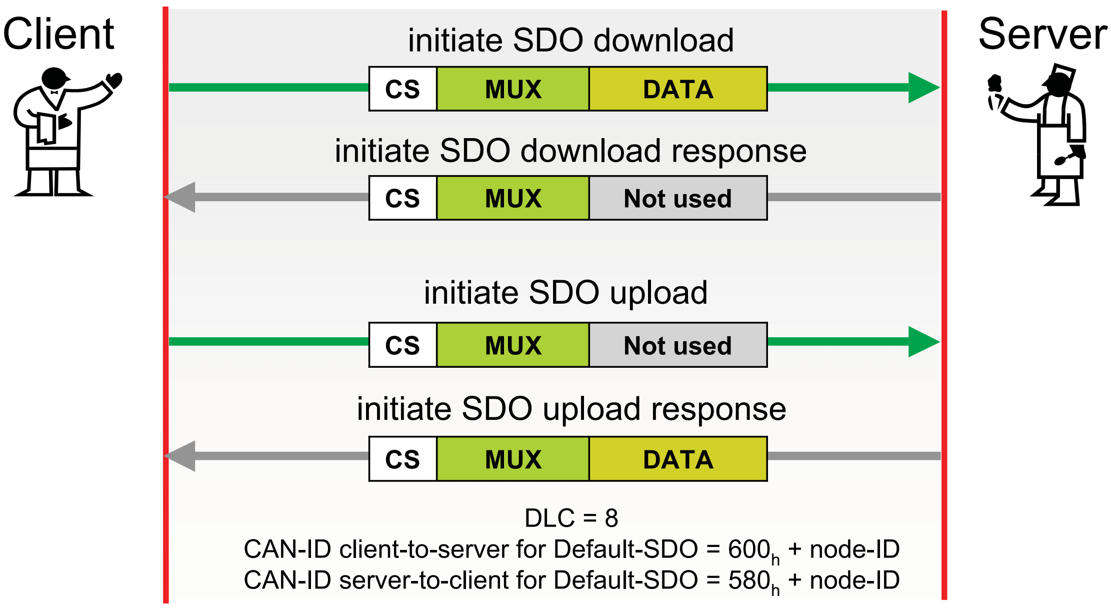
Index (hex)	Object	Name
1000	VAR	Device type
1001	VAR	Error register
1002	VAR	Manufacturer status register
1003	ARRAY	Pre-defined error field
1005	VAR	COB-ID SYNC-message
1006	VAR	Communication cycle period
1007	VAR	Synchronous window length
1008	VAR	Manufacturer device name
1009	VAR	Manufacturer hardware version
100A	VAR	Manufacturer software version
100C	VAR	Guard time
100D	VAR	Life time factor
1010	VAR	Store parameters
1011	VAR	Restore default parameters
1012	VAR	COB-ID time stamp
1013	VAR	High resolution time stamp
1014	VAR	COB-ID Emergency
1015	VAR	Inhibit Time Emergency
1016	ARRAY	Consumer Heartbeat Time
1017	VAR	Producer Heartbeat Time
1018	RECORD	Identity object
1020	ARRAY	Verify Configuration
1021	VAR	Store EDS
1022	VAR	Storage Format
1023	RECORD	OS Command
1024	VAR	OS Command Mode
1025	RECORD	OS Debugger Interface
1026	ARRAY	OS Prompt
1027	ARRAY	Module List
1028	ARRAY	Emergency Consumer
1029	ARRAY	Error Behaviour



Communication protocols

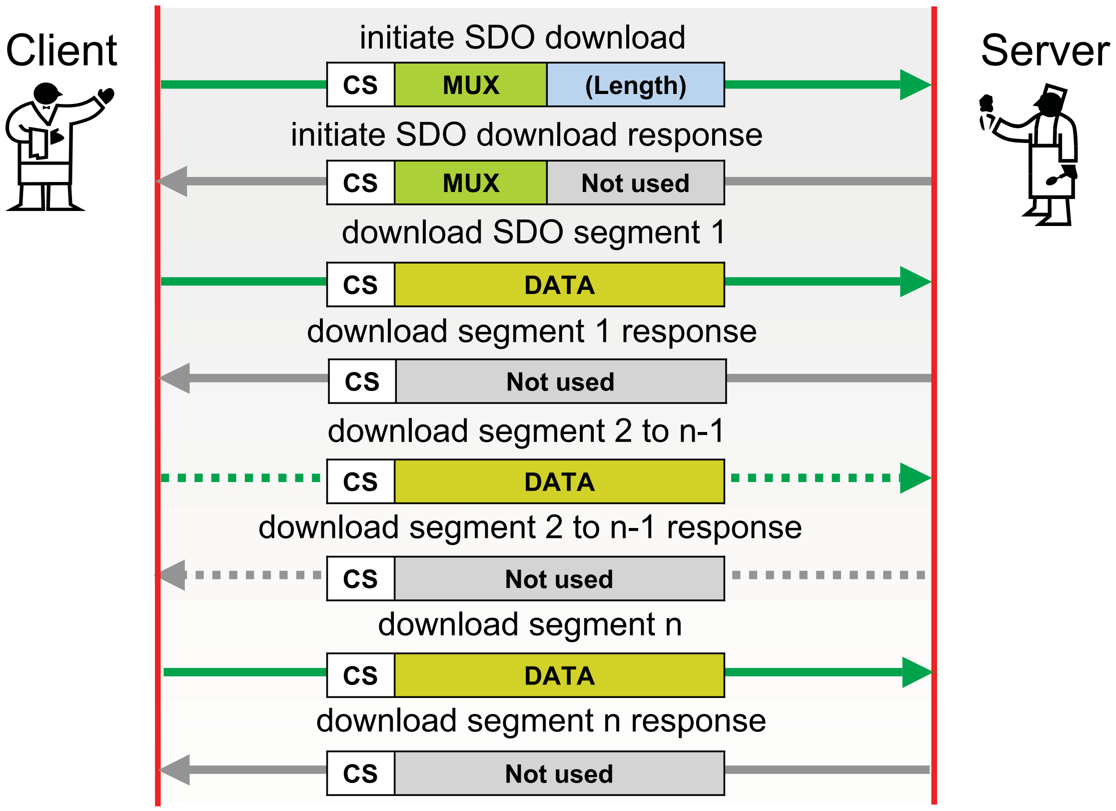
- Service Data Object (SDO) protocols
  - Expedited SDO protocol
  - Normal SDO protocol (segmented)
  - SDO block protocols
- Process Data Object (PDO) protocol
- Special object protocols:
  - Synchronization (SYNC) protocol
  - Time Stamp (TIME) protocol
  - Emergency (EMCY) protocol
- Network Management protocols:
  - NMT Message protocol
  - Boot-Up protocol
  - Error Control protocols
    - Heartbeat protocol
    - (Node guarding protocol)

Expedited SDO protocol



CS = command specifier
MUX = 16-bit index and 8-bit sub-index

Normal SDO protocol



SDO parameter set

Server SDO Parameter					
1200	RECORD	1st Server SDO parameter	SDOParameter	ro	O
1201	RECORD	2nd Server SDO parameter	SDOParameter	rw	M/O**
:::::	:::::	:::::	:::::	:::::	:::::
127F	RECORD	128th Server SDO parameter	SDOParameter	rw	M/O**
Client SDO Parameter					
1280	RECORD	1st Client SDO parameter	SDOParameter	rw	M/O**
1281	RECORD	2nd Client SDO parameter	SDOParameter	rw	M/O**
:::::	:::::	:::::	:::::	:::::	:::::
12FF	RECORD	128th Client SDO parameter	SDOParameter	rw	M/O**

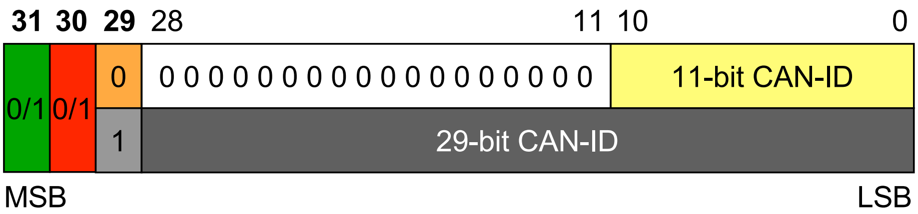
** If a device supports SDOs, the according SDO parameters in the Object Dictionary are mandatory

SDO parameter record

Index	Sub-Index	Description	Data type
$12XX_h$	00_h	Number of entries	Unsigned8
	01_h	COB-ID client-to-server	Unsigned32
	02_h	COB-ID server-to-client	Unsigned32
	03_h	Node-ID of server/client	Unsigned8

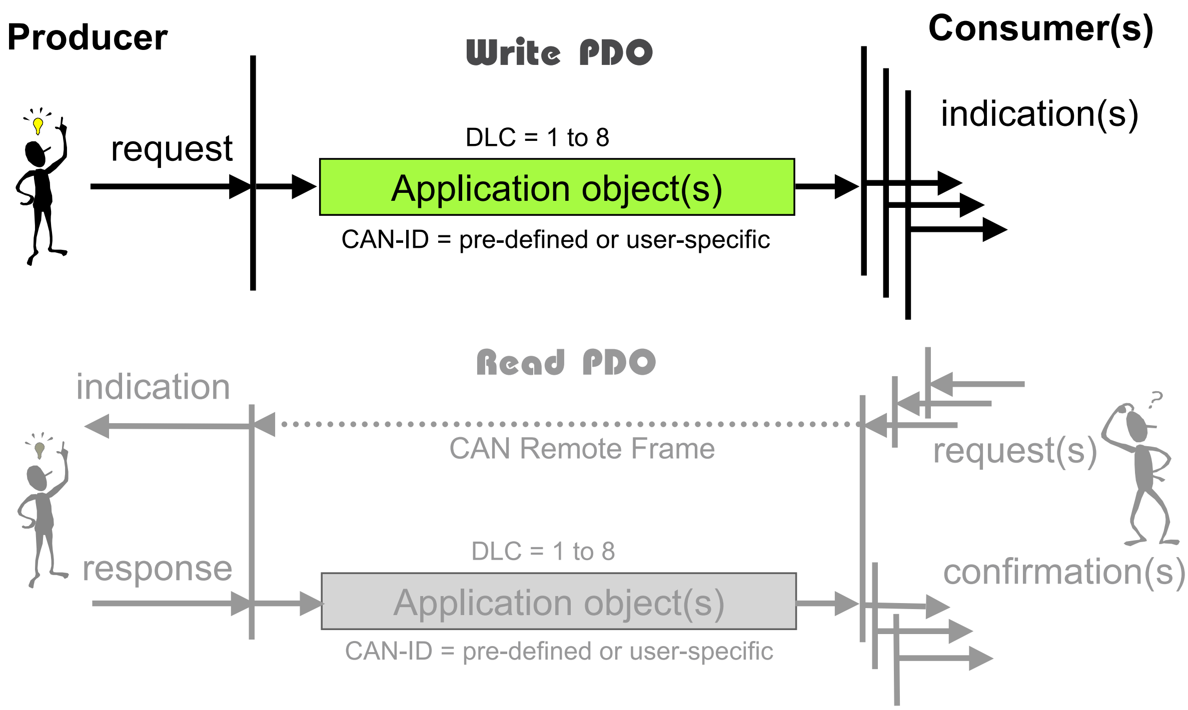
22_h = parameter record for Server SDO or Client SDO

VALUE DEFINITION of COB-IDs



31: SDO exists (0), does not exist (1)
30: Pre-defined CAN-ID (0), temporary CAN-ID (1)
29: base frame format (0), extended frame format (1)

PDO protocol



PDO parameter sets

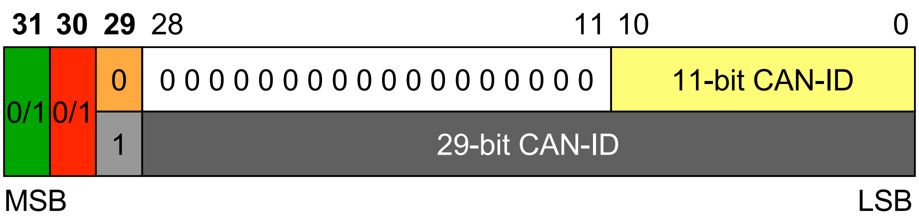
Receive PDO Communication Parameter					
1400	RECORD	1st receive PDO parameter	PDOCommPar	rw	M/O**
1401	RECORD	2nd receive PDO parameter	PDOCommPar	rw	M/O**
:::::	:::::	:::::	:::::	:::::	:::::
15FF	RECORD	512th receive PDO parameter	PDOCommPar	rw	M/O**
Receive PDO Mapping Parameter					
1600	ARRAY	1st receive PDO mapping	PDOMapping	rw	M/O**
1601	ARRAY	2nd receive PDO mapping	PDOMapping	rw	M/O**
:::::	:::::	:::::	:::::	:::::	:::::
17FF	ARRAY	512th receive PDO mapping	PDOMapping	rw	M/O**
Transmit PDO Communication Parameter					
1800	RECORD	1st transmit PDO parameter	PDOCommPar	rw	M/O**
1801	RECORD	2nd transmit PDO parameter	PDOCommPar	rw	M/O**
:::::	:::::	:::::	:::::	:::::	:::::
19FF	RECORD	512th transmit PDO parameter	PDOCommPar	rw	M/O**
Transmit PDO Mapping Parameter					
1A00	ARRAY	1st transmit PDO mapping	PDOMapping	rw	M/O**
1A01	ARRAY	2nd transmit PDO mapping	PDOMapping	rw	M/O**
:::::	:::::	:::::	:::::	:::::	:::::
1BFF	ARRAY	512th transmit PDO mapping	PDOMapping	rw	M/O**

** If a device supports PDOs, the according PDO communication parameter and PDO mapping entries in the object dictionary are mandatory. These may be read_only

Communication parameter

Index	Sub-Index	Description	Data type
1400_h to $15FF_h$ 1800_h to $19FF_h$	00_h	Number of entries	Unsigned8
	01_h	COB-ID	Unsigned32
	02_h	Transmission type	Unsigned8
	03_h	Inhibit time	Unsigned16
	04_h	Reserved	Unsigned8
	05_h	Event timer	Unsigned16
	06_h	SYNC start value	Unsigned8

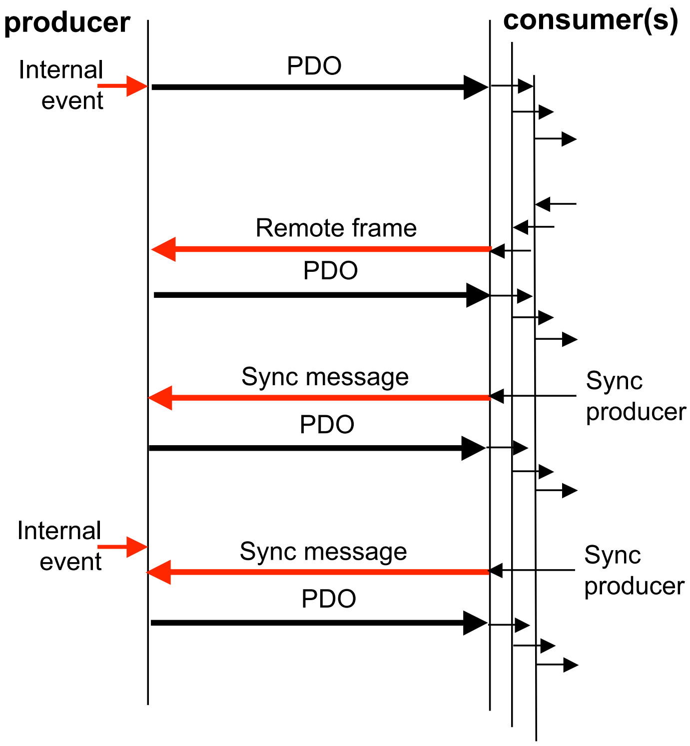
COB-ID VALUE DEFINITION



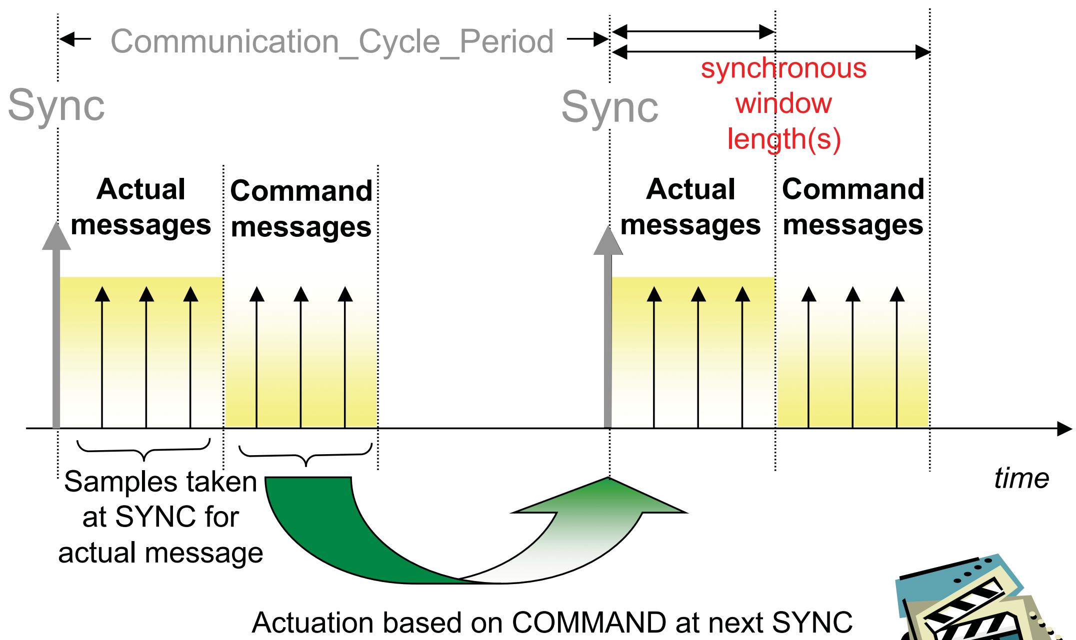
31: PDO exists (0), does not exist (1)
30: RTR allowed (0), not allowed (1)
29: base frame format (0), extended frame format (1)

PDO scheduling modes

1. **Event (change of state) or event-timer driven**
2. **Remote requested**
3. **Synchronous transmission (cyclic)**
4. **Synchronous transmission (acyclic)**



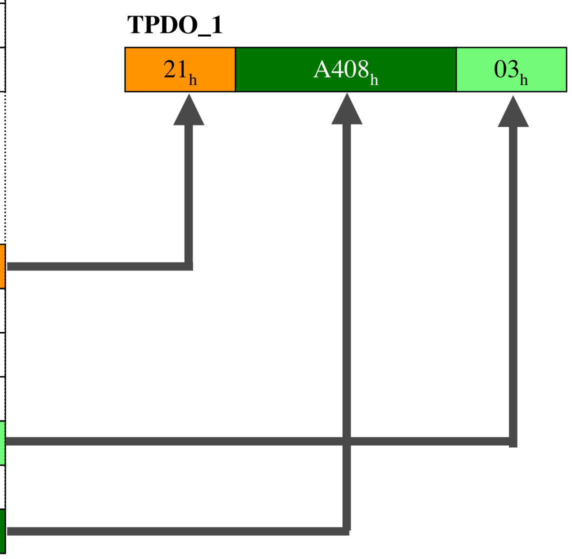
Synchronous operations



PDO mapping

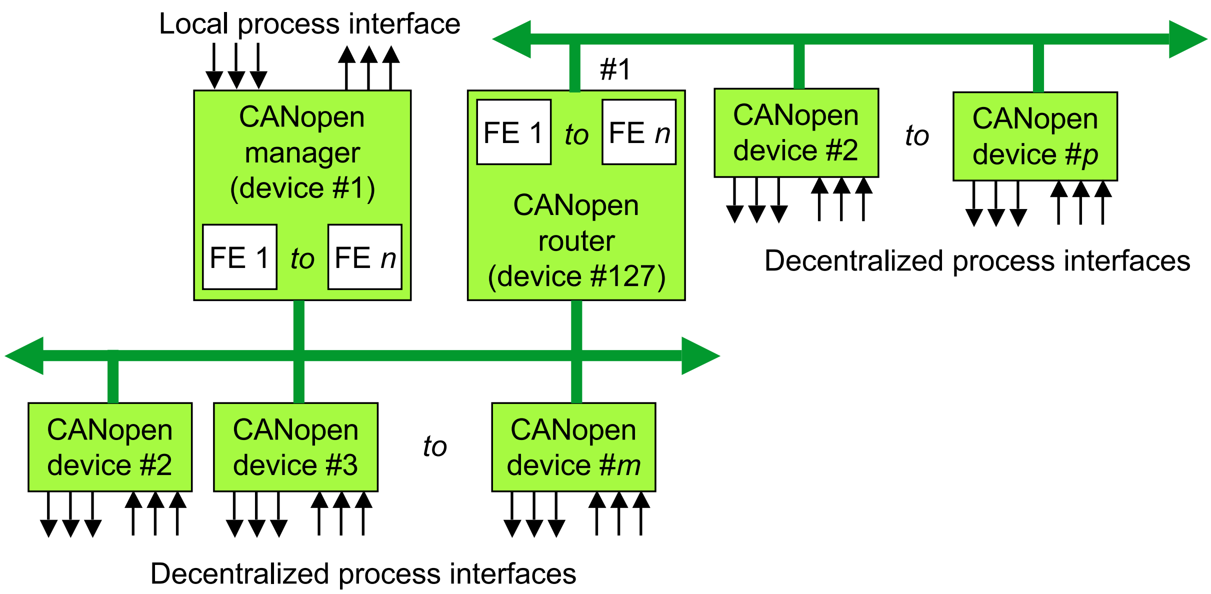
Object Dictionary

Index	Sub	Object contents	
$1A00_h$	01_h	2000_h 01_h	8_h
$1A00_h$	02_h	2003h 03_h	10_h
$1A00_h$	03_h	2003_h 01_h	8_h
2000_h	01_h	21_h (Temperature 1 in °C)	
2000_h	02_h	Temperature 2 in °C	
2001_h	00_h	Pressure 1 in Pa	
2002_h	00_h	Pressure 2 in Pa	
2003_h	01_h	03_h (Height in mm)	
2003_h	02_h	Length in mm	
2003_h	03_h	$A408_h$ (Depth in mm)	



© CiA

Device profile approach



FE = functional element (not standardized)

© CiA

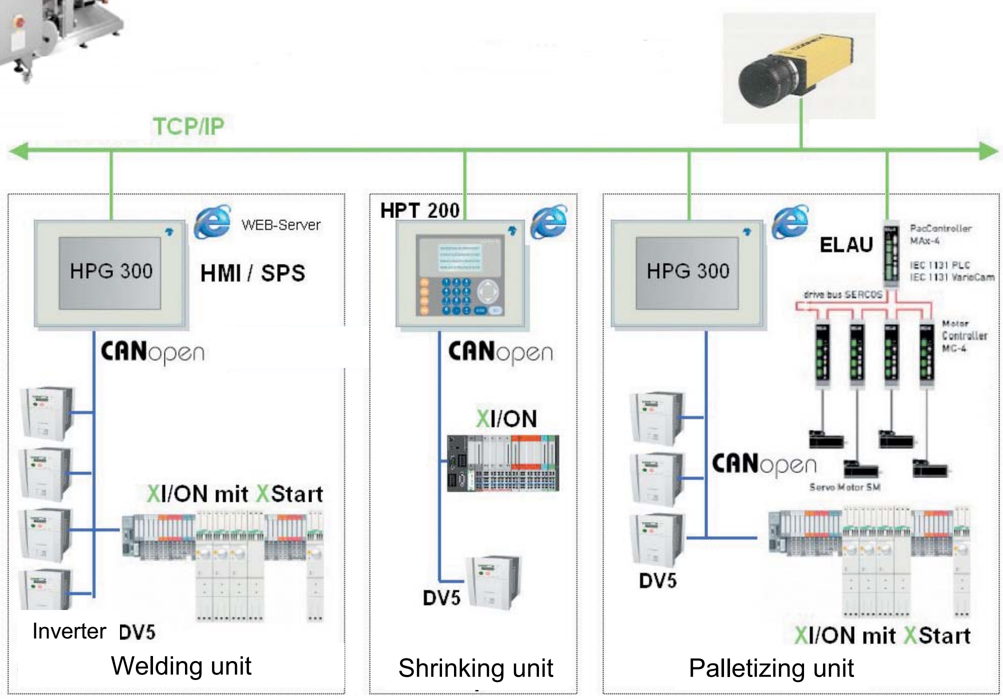
Embedded machine control

CANopen is dedicated to embedded machine control applications. It has been selected and used by market leading machine builders in textile, printing, wood-processing, injection molding, extruder, packaging, and many other types of machines.

CiA 401: CANopen profile for generic I/O modules
CiA 402: CANopen profile for drives and motion controllers
CiA 404: CANopen profile for measuring devices and closed-loop
CiA 405: CANopen profile for IEC 61131-3 programmable devices
CiA 406: CANopen profile for rotary and linear encoders

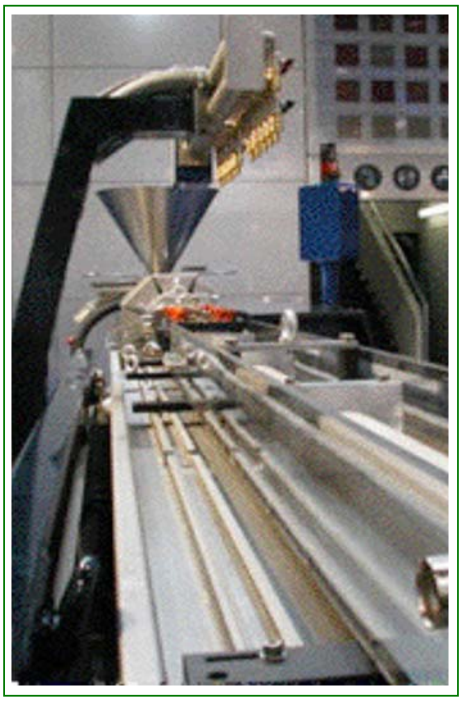
If others can't, we CAN!

Packaging machine



Factory automation

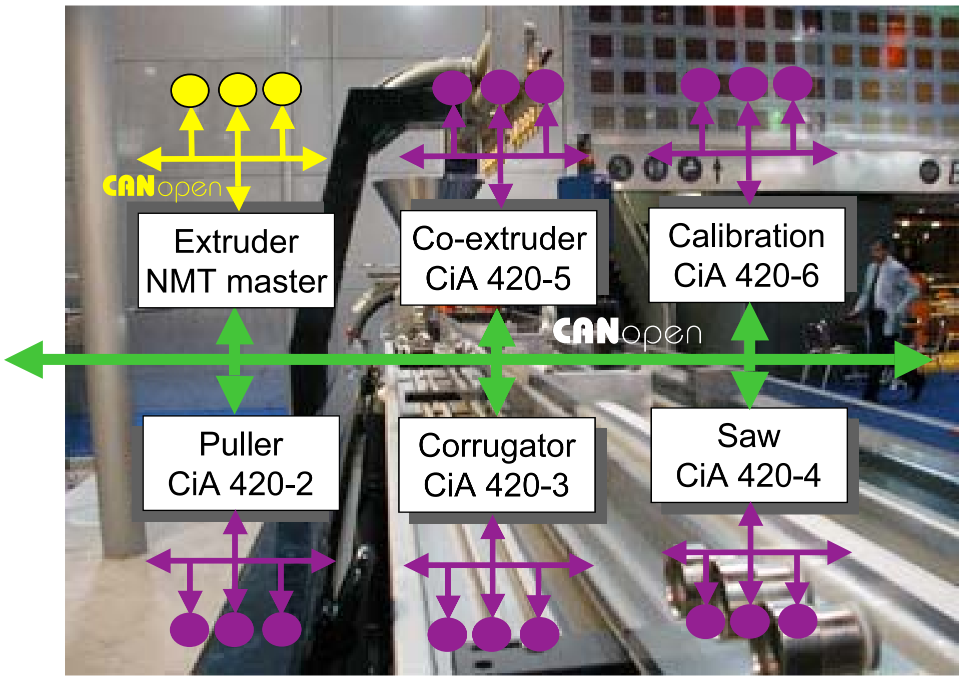
CANopen networks are also installed to interconnect machines or part of machines. Of course, the network length limitation at a given transmission speed has to be considered.



CiA 414: CANopen profiles for weaving machines
CiA 420: CANopen profiles for extruder downstream devices

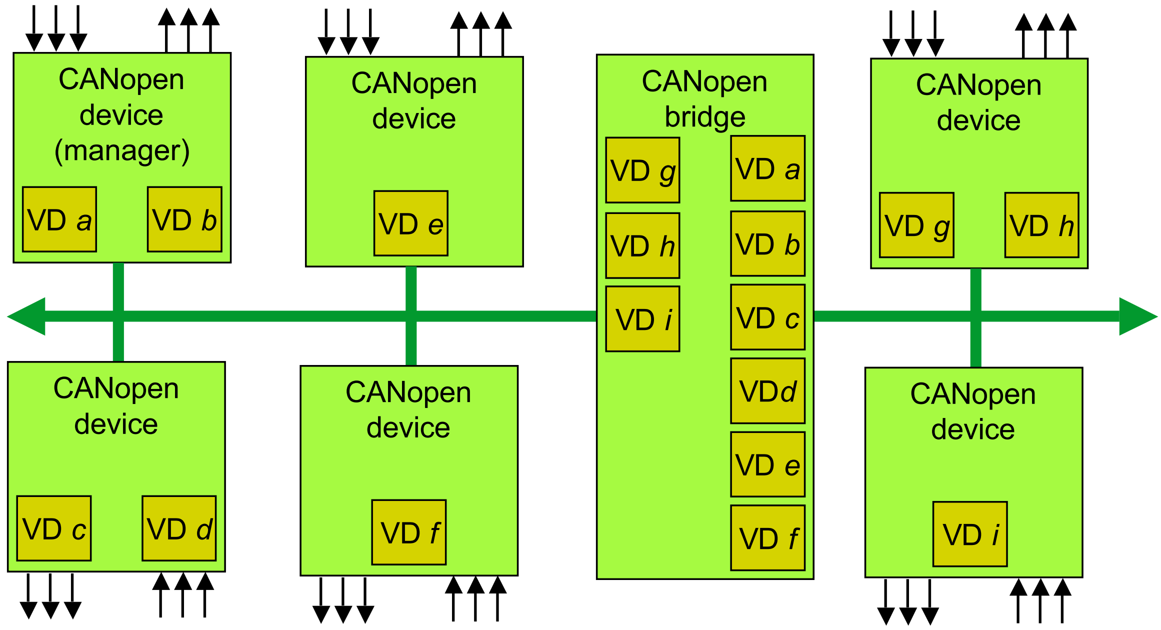
If others can't, we CAN!

Extruder downstream devices



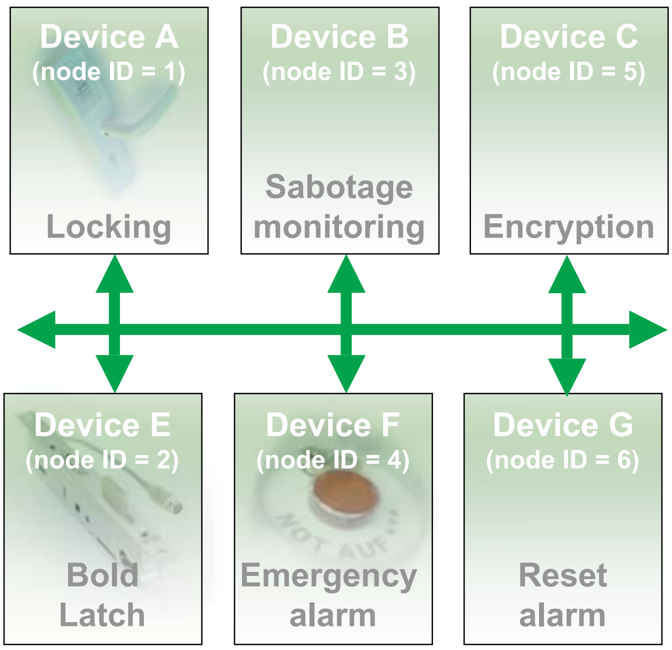
Joint developed of CiA and Euromap non-for-profit organizations (joint specifications are published as CiA 420 and Euromap 27)

Application profile approach

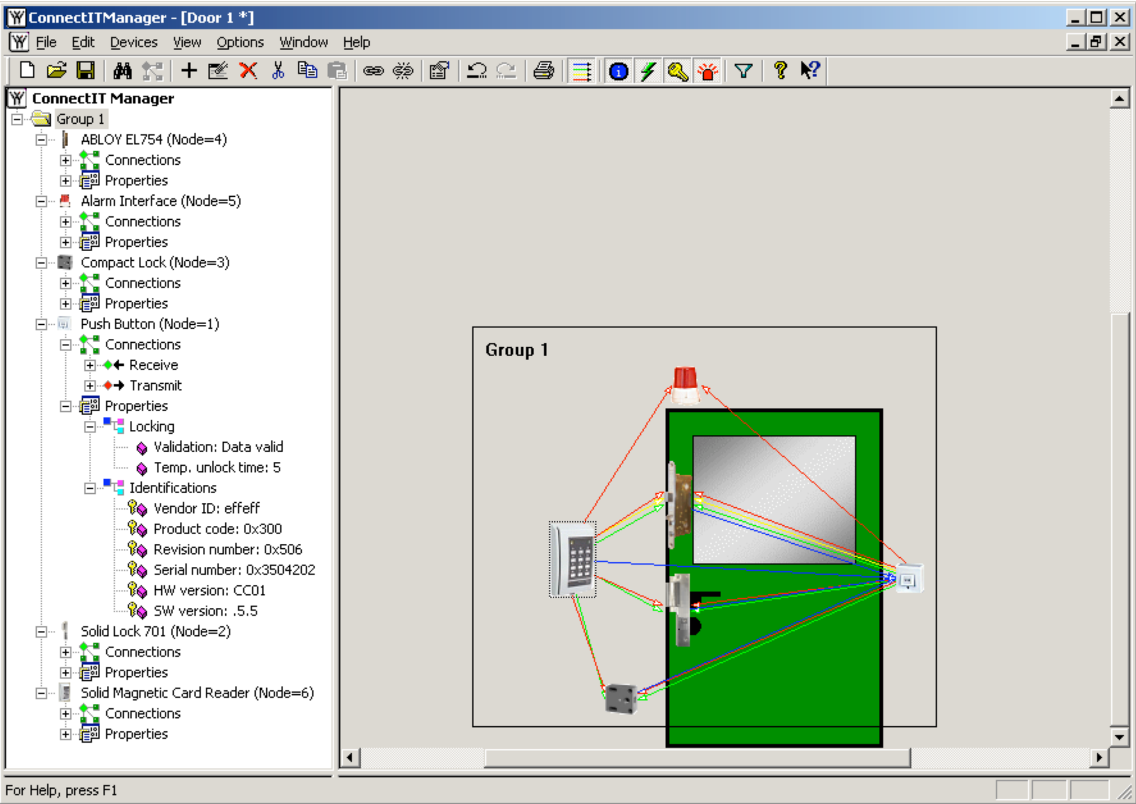


VD = virtual device (standardized FE)

Virtual door devices



Door configuration



We CANopen markets!

System designers view

- Interoperable devices from different manufacturers
- Reasonable devices prices due to competition
- Conformance certified devices reduces integration effort
- Simplified diagnostic due to standardized communication functions
- Support by complete range of tools from different manufacturers
- Flying master, bus redundancy, and safety-related communication available

Device manufacturers view

- CAN semiconductor long-term availability from different manufacturers
- CAN semiconductors on very reasonable prices available
- Reduction of development cost due to CANopen software and tools
- Conformance testing on communication hard- and software
- Reduction of production cost due to higher sales volume

AnyRobot Studio

Samsung Network Robot SW Platform

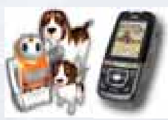
2007.06.27

Hyun-Sik Shim

Telecommunication R&D Center
SAMSUNG ELECTRONICS CO., LTD

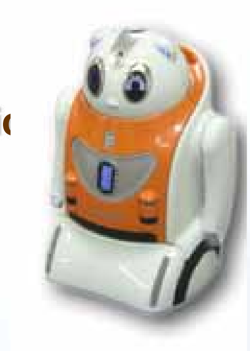
Contents

- **URC**
- **RUPI**
- **AnyRobot Studio**



URC

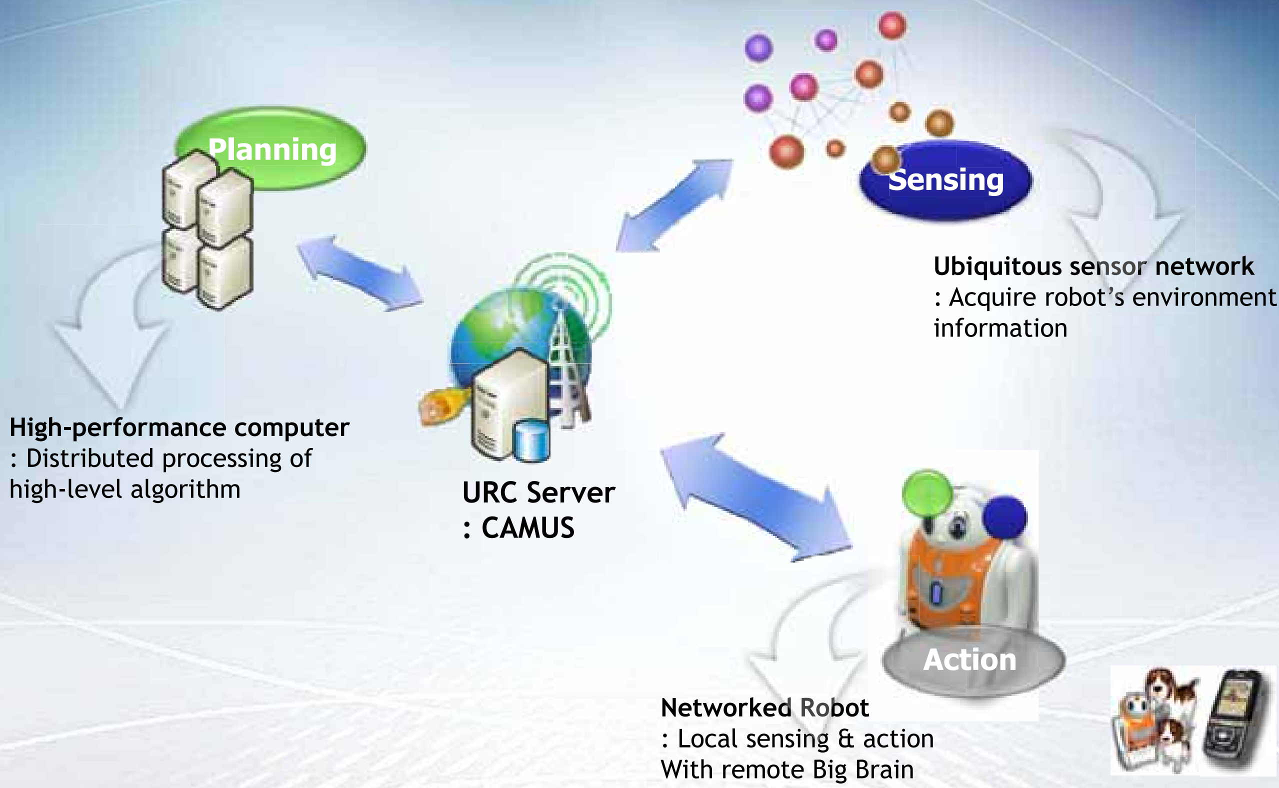
(Ubiquitous Robotic Companio



Stand Alone Robot

Stand Alone Robot

Network-based Robot



URC (Ubiquitous Robotic Companion)

"A Network-based Robot System providing necessary services to me in anywhere at anytime"

Sensing Capability → Through the network, a robot can recognize environment & user's circumstance

Processing Capability → Robot's functional capability & Intelligence can be enhanced with remote Big Brain (Network Server)

Network Connectivity → Robot Services can be available in anywhere, at anytime through the network communication

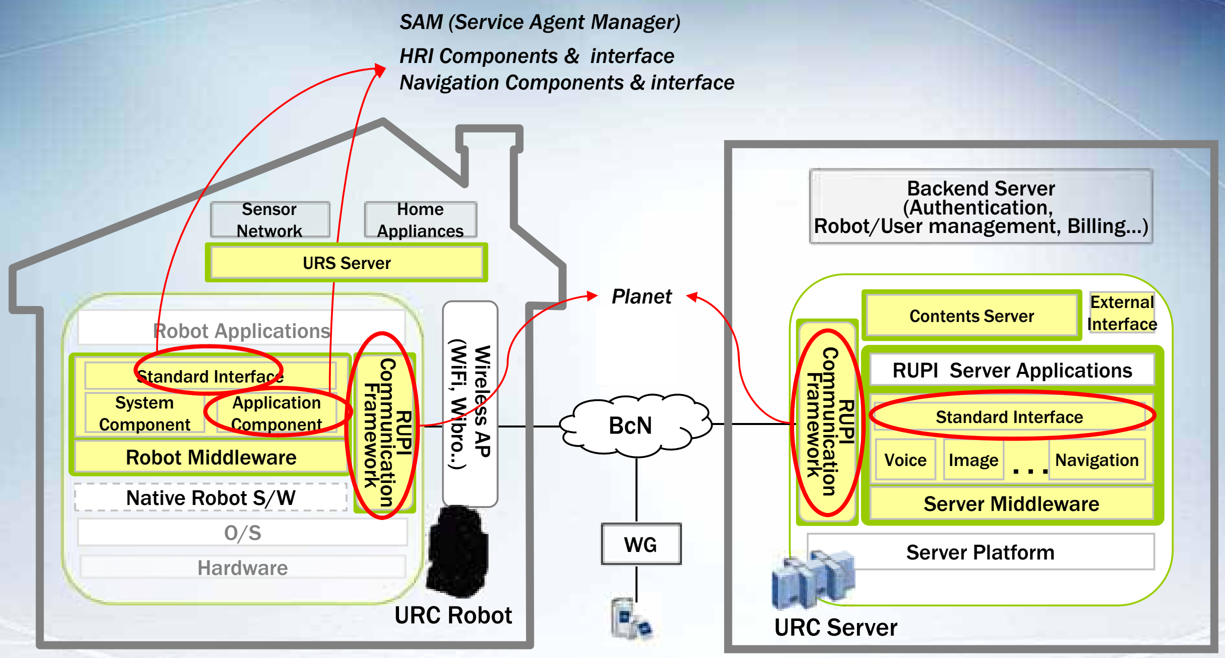
RUPI

(Robot Unified Platform Initiat

RUPI

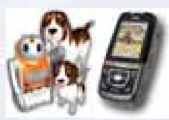
- RUPI is an open standard for network-based robots (URC)
- Standardization of Robot S/W
  - enhancement of S/W reliability and reusability
  - Providing inter-operability and inter-connectivity
- Developing S/W Framework for network-based robot system
  - for reducing investment and risk of robot developers when they build network-based robot system
  - for reducing resources & time efforts to develop robot systems

RUPI Framework



1. Communication Protocols & Interfaces between URC Server and Robot
2. Interfaces for Robot S/W Components (HRI, Navigation, etc)

AnyRobot Studio



AnyRobot Studio

AnyRobot Studio

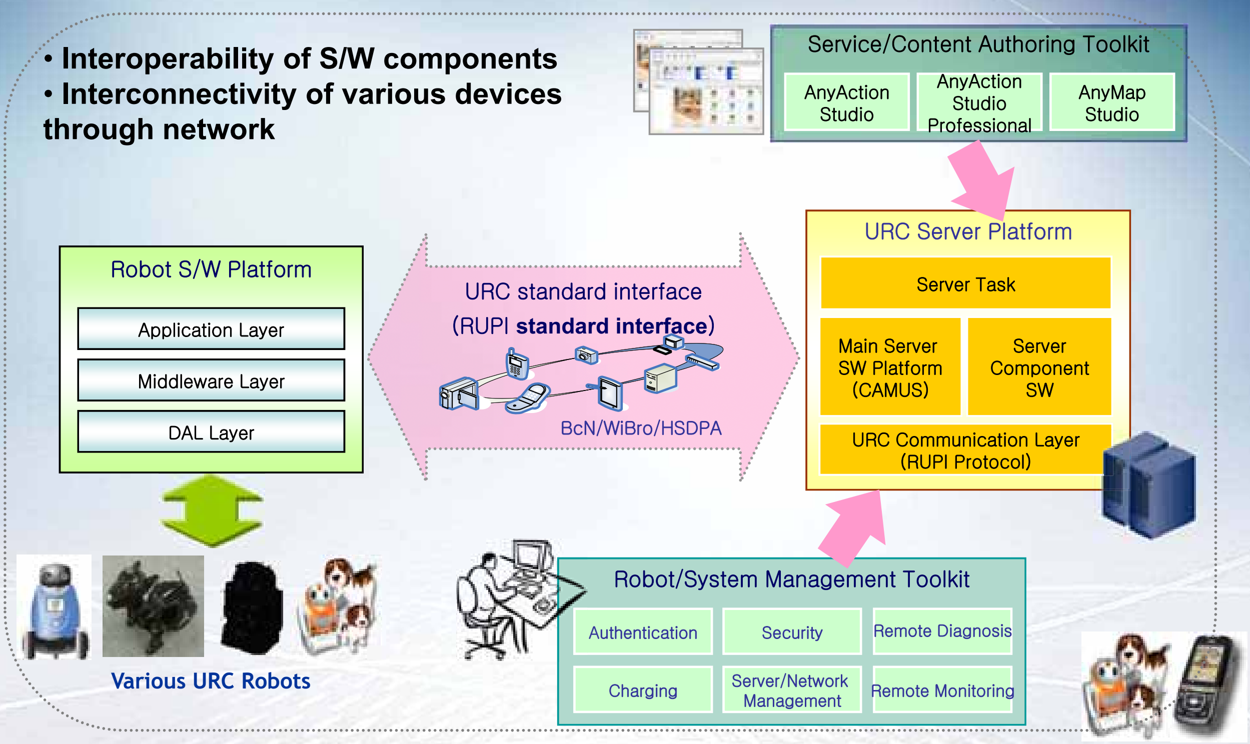
- Robot S/W Package for Network-based Robot System, URC (Ubiquitous Robotics Companion)
  - Supports various robot platforms
  - Provides development environment & tools for building various robot services through the network server
  - Compliance with RUPI standard

It consists of

- Server Platform (Middleware, Protocol) : CAMUS, SAM, PLANET
- Robot S/W Platform (GRIS)
- Robot Simulator
- Remote Management Tools
- Contents Authoring Tools

* AnyRobot Studio : Samsung Robot S/W Package for URC system

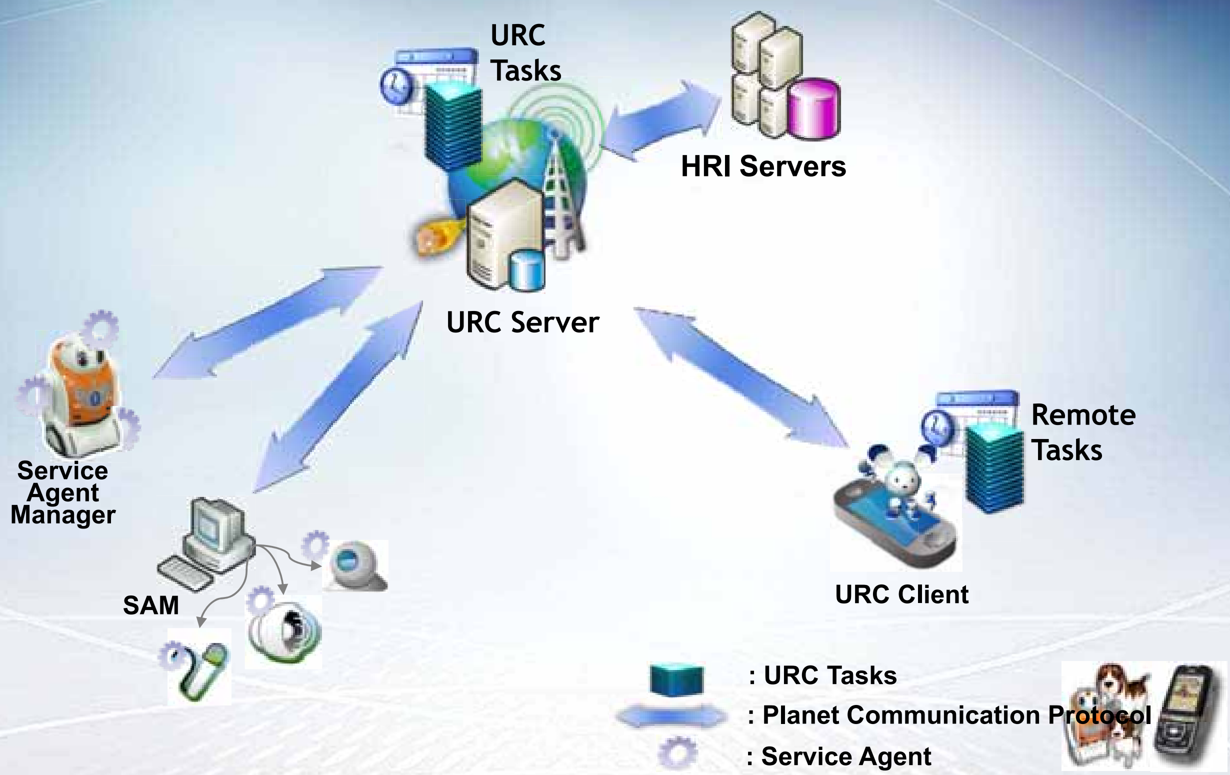
AnyRobot Studio



CAMUS

- **Context-Aware Middleware for URC Services**
- **A gateway between robots and IT world**
- **A context-aware URC application development framework**
  - **acquire information from various sensors**
  - **understand the contextual situation**
  - **perform the appropriate task**

CAMUS : Deployment

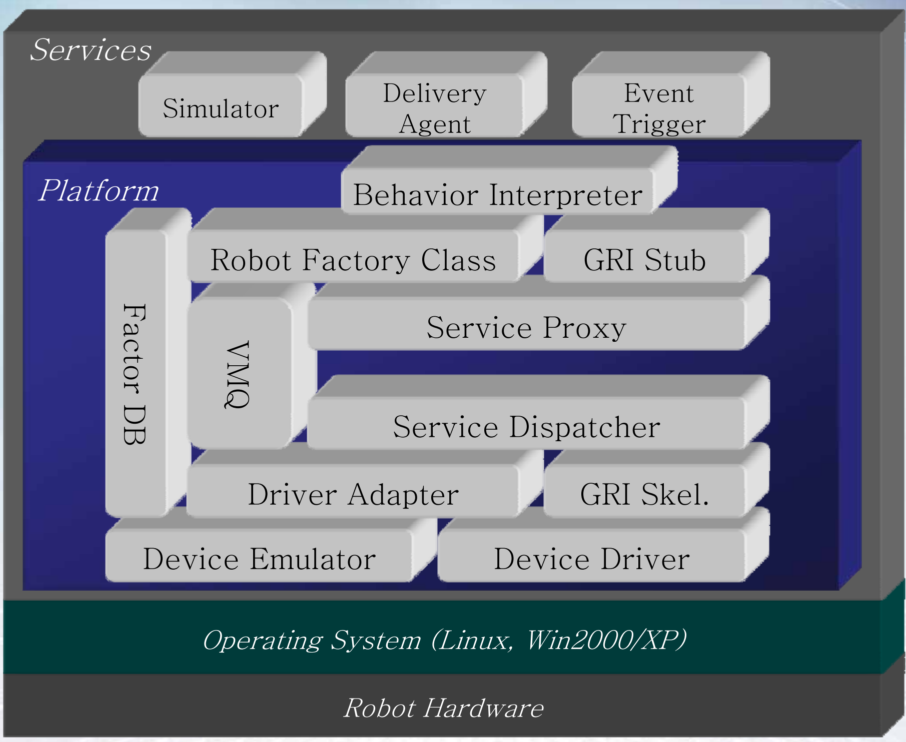


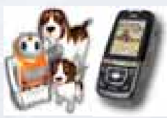
GRIS (General Robot Infra Structure)

- **Samsung Robot S/W Platform**
- **Design requirements**
  - **Rapid development of Robot Application**
  - **Various Robot H/W platforms**
  - **Easy porting to other platform**

  - **Common robot interface (Robot APIs)**
  - **H/W independency (Middleware)**
  - **Multi OS platform (Linux, Windows)**
- **It consists of**
  - ***VMQ (Virtual Message Queue)***
  - ***RFC (Robot Factory Class), GDA (GRIS Device Adapter)***
  - ***GRI (GRIS Remote Interface)***
  - **BI (Behavior Interpreter)**
  - **Multi-OS Wrapper**

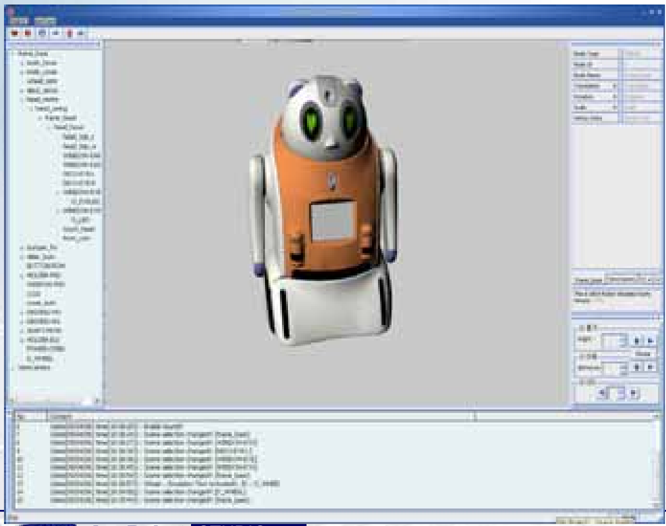
GRIS Architecture





AnyRobot Simulator

- Tools for testing real robot program without real robot platform
  - Simulates robot motion control, sensor data
  - Supports Behavior scripts for testing simple motion, composite motion
  - Provides virtual device driver interface
    - Virtual camera, distance sensors, touch sensors, PIR sensor, sound, actuator etc.
  - Simulation can be executed by real robot program
    - Virtual Device Driver has implemented in the way of real device driver interface of GDA



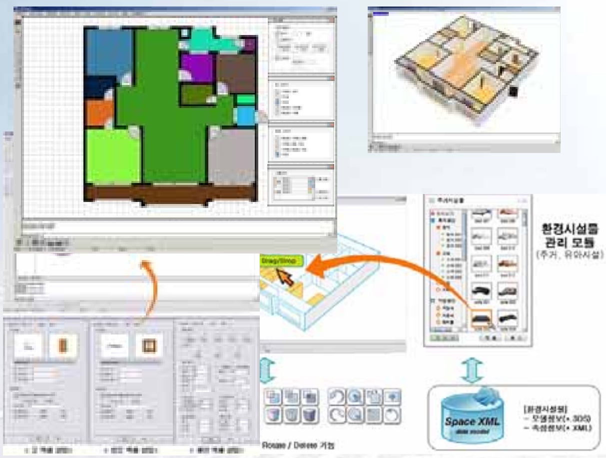
- Environment Configuration
  - Obstacle
  - Environment structures
- Components Modeling
  - Actuator
  - Camera
  - Sensors : PIR,PSD,Touch, …
  - Robot appearance
- Simulation
- Result

AnyMap Studio

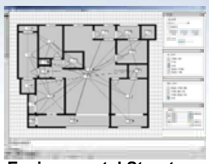
Robot Environment Modeling

- Building CAD Model of Robot Work Environment
- Used for building Robot's Navigation map
- Used for Robot simulation

Conversion 2D Drawing to 3D Environment Model



Generating Robot Navigation Map



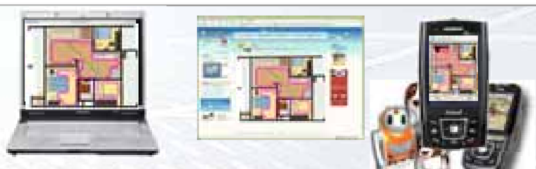
Environmental Structures & Path Planning information

Robot Movement Information

AnyRobot Simulation Environment

- Robot motions
- Sequential Tasks
- Service Verification

Various Environment Map Viewer with standard DB



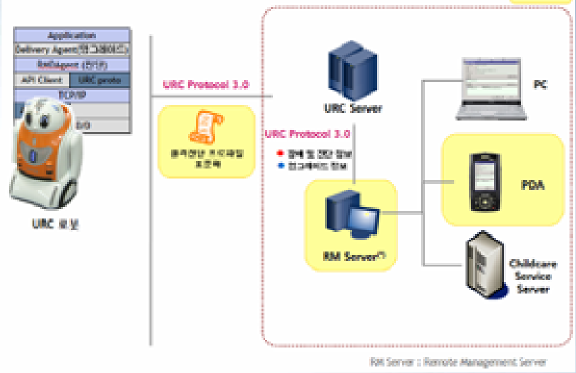
C/S Viewer Web Viewer Mobile Viewer

Remote Diagnosis & Upgrade System

Remote Management System

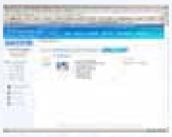
- Reliable remote robot diagnosis & upgrade
- Standard profile for remote management
- Remote management using portable devices

Remote Diagnosis & Upgrade Architecture



Web Service for remote management

Web-based remote management



Inquire diagnosis list & request

Diagnosis result & monitoring

Portable service of remote management

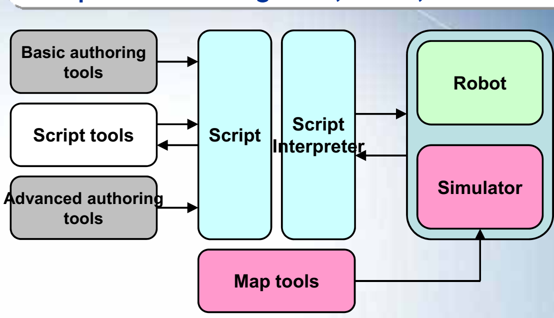
(PDA, SPH-M4500)
Remote management using PDA

AnyAction Studio

Authoring tools & Script

- Time-line based authoring tools
- Event-driven based authoring tools
- Service/Content script for authoring tools

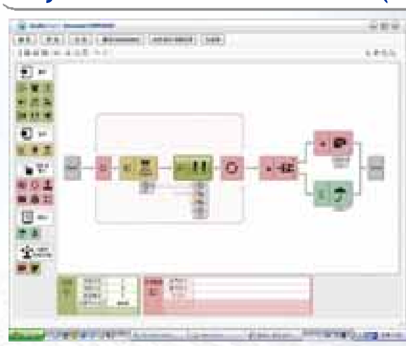
Script for authoring tools, robot, and simulator



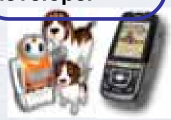
AnyAction Studio (Time-line based)

Basic robot movement & messaging can be edited by the end-users

AnyAction Studio Professional (Event-driven based)



Advanced robot application authoring tools for expert robot S/W developers & Service/Content developer

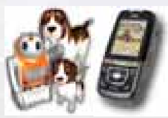


Discussion

- **Brief introduction of AnyRobot Studio**
  - **I t covers all the parts of Network-based robot system, especially for URC system**
- **2007. 4Q, AnyRobot Studio version 1.0 will be available**
  - **Will be used for several robots made by Samsung**
  - **Will be compliant with RUPI standards**

- **It is possible to make standards with some items from our implementations with related to the Network-based Robot System**
  - **Communication Protocols & Interfaces between URC Server and Robot**
  - **Interfaces for Robot S/W Components (HRI, Navigation, etc)**
  - **Abstracted Robot API for robot programming (Robot Factory Class)**
  - **3D Robot Work Environment Map DB**
  - **Robot behavior script**
  - **Remote diagnosis & upgrade system API, DB Schema, diagnosis items, and so on.**

Thank You!



Liaison Report of ISO/SC184/SC2

June 27, 2007

Yun Koo Chung(ETRI), Mitzukawa(SIT)

ISO/TC184/SC2 Report

1. Washington DC Meeting (2007.6.4~8, Gaithersburg, NIST)
2. Participants: 14 experts (Korea, Japan, UK, France, Sweden, US) in AG1(Service Robot) & PT2(Personal Care Robot)

3. Issues

. Safety Issue for Personal Care Robot in PT2

- It is the most important issue and investigated broadly in Project Team 2.
- Advisory Group 1 feels that the safety standard developed in PT2 will be more widely applicable in particular to service robots.

. Vocabulary definition newly starts in PT3 (leader: R. Gelin (France))

- Newly defined Title of SC2 is “Robots and Robot Devices”
- ISO/TC 184/SC 2 asks PT 3 to develop an appropriate deliverable to revise and replace ISO 8373:1994 for robots and robotic devices and report its progress to the next SC 2 meeting .

ISO/TC184/SC2 Report

– ISO/TC 184/SC 2 recognizes the discussions held on definitions and scope for PT 1 and PT 2, and requests AG 1 to present a clarifying proposal by the end of January 2008. AG 1 is also requested to coordinate with PT 1 and PT 2 so that progress can be reached before the next SC2 meeting.

4. Report of WG Activities
- WG3: "Robotic Software Architecture" by Hun Kim(ETRI)
- WG4: "Technical Tasks", "Black box", "Environments", and "Modularity" are identified as important areas of interest for future standardization.

5. Personal Care Robot Types: scope of PT2
- Surgery and medical robots (invasive and non-invasive)
- Mobile manipulator robots: including the provision of a "zero level PC service",
- Physical assistance robots (including rehabilitation), supplementation capabilities,
- People carrier robots (allowing for augmentation capabilities)

ISO/TC184/SC2 Report

6. Roadmap Safety standardization in PT2
. Part 1: Non-invasive personal care robots (including healthcare)
. NWIP: 2008 SC2 plenary meeting together with a CD of Part 1
. A draft standard should be ready for distribution in 2009 and
. FDIS by 2010 SC2 Plenary meeting
. The new standard is expected to be formally offered for Voting and acceptance by the ISO members in 2011

7. OMG Liaison to SC2
. ISO/TC 184/SC 2 asked its secretariat to formalize the OMG liaison with Y.K. Chung as liaison observer.
.Y.K. Chung reported OMG activities to SC2.

8. RAPI (Robot communication framework and APIs)
. The new work item "RAPI" was approved by a majority but did not get participation enough. SC 2 forwarded the RAPI to SC5 for further discussion and process as NWIP.

robotics/2007-06-21

KIRSF – Contact Report

Robotics DTF (Brussels Meeting)
Date: June 27, 2007
Reporter: Yun Koo Chung(ETRI), GuYoung Oh (TTA)

ETRI

1. Korean Standardization Activities

- Many WG meetings held as in the table.

Meeting Group Name		Meeting count	Meeting Date	Issue
KIRSF Service Robot TF		1	May 16	Discuss Management of WGs
TTA Robotics PG		1	April 16	Project approve
WG	Performance /Safety			Planning Workshop
	Robot Service Modeling	3	April 2, May 4 & 21	Drafting Specification
	Robot Middleware	3	April 6, May 1 & 23	Drafting Specification
	HRI	2	April 9, May 4	Drafting Specification
	Navigation	2	May 3, June 7	Drafting Specification

※ KIRSF: Korean Intelligent Robot Standardization Forum

Robotics/2007-6-XX

KIRSF – Contact Report

Robotics DTF (Brussels Meeting)
Date: June 27, 2007
Reporter: Yun Koo Chung(ETRI), GuYoung Oh (TTA)

ETRI

2. Reviewing activities of other area with Robot standardization

- International Standardization Activities of Robotics are too slow
- ISO/TC184/SC2: Beginning stage – Drafting projects for vacabulary, safety.
- OMG: SDO, RTC adopted, 1 active RFP for Localization, 3 areas are slow
- Not so helpful for leading Robot industry
- Korean Standardization activities for Information and Communication Tech.
  - 2006: 4457 domestic standards approved
    (2,294 TTAT, 2,863 TTAS, 480 KICS)
  - Statistics of Korean Standards in IT and Communications

KIRSF – Contact Report

Robotics DTF (Brussels Meeting)
Date: June 27, 2007
Reporter: Yun Koo Chung(ETRI), GuYoung Oh (TTA)

Statistics of Korean Standards in IT and Communications

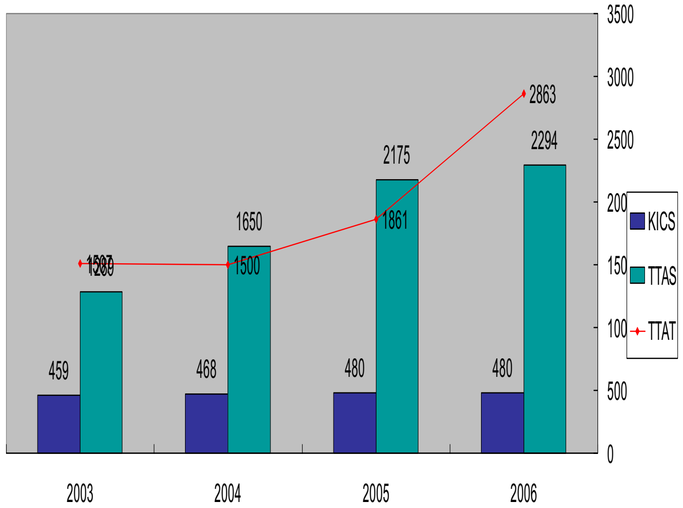


Table 1. Standards statistics adopted during 2003 ~ 2006 in IT & Communications, Korea

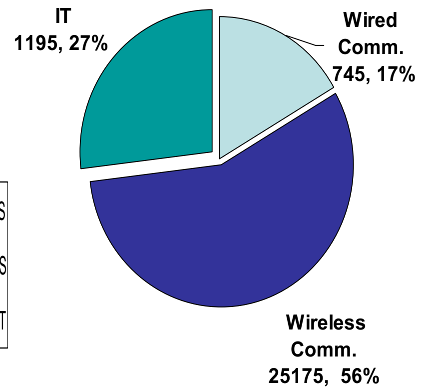


Table 2. Classification of Standards in 2006 (4,457 standards)

Robotics/2007-6-XX

KIRSF – Contact Report

Robotics DTF (Brussels Meeting)
Date: June 27, 2007
Reporter: Yun Koo Chung(ETRI), GuYoung Oh (TTA)

3. The 2nd year "Kukmin Robot Pilot Business" Project for Intelligent Robot
   - Participated corporations will be selected at the end of June, 2007.
   - Issue: Test & Evaluation Specification for Quality Assurance of Robot Products
   - URC

4. "GukMin Robot Business" (URC Robot Business)
   - 29 corporations had kick-off meeting on May mid for good start, including Samsung, Yujin, Hanwul,..
   - The products will use URC middleware and communication frameworks.
   - RUPI standards (Unified URC Standard specifications) will be used.

Contact Report

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

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.

New Offer (24th, June)

- ISO/TC 184/SC 5
  - Architecture, communications and integration frameworks, has drawn our attention to possible overlaps with their work item ISO 20242, Industrial atuomation systems and integration - Service interface for testing applications, and potentially other SC 5 projects. Also the former robot companion standard ISO 9606 may be relevant to the RAPI proposal.

ISO/TC 184/SC 5/WG 6

- The next meeting of the working group, responsible for the ISO 20242 standard, will meet in Frankfurt on 1 and 2 October, 2007

ISO 20242

Related standard ISO 15745

ISO Standards

Browse by

ICS fields

Technical committees

TC 184
Industrial automation systems and integration

TC 184/SC 5
Architecture, communications and integration frameworks

▶ **ISO 20242-1:2005**

Items to show

▶ **Published standards**

Standards under development

Both

View shopping basket

Search options

Text

ISO number

Type in search string

Start search

Extended search

Predefined searches

Search for information

ISO 20242-1:2005

Industrial automation systems and integration -- Service interface for testing applications -- Part 1: Overview

(available in English only)

Edition:	1 (Monolingual)
Number of pages:	11
Technical committee / subcommittee:	TC 184/SC 5; ISO Standards
ICS:	25.040.40
Status:	Published standard
Current stage:	60.60
Stage date:	2005-10-27
Revision information:	None

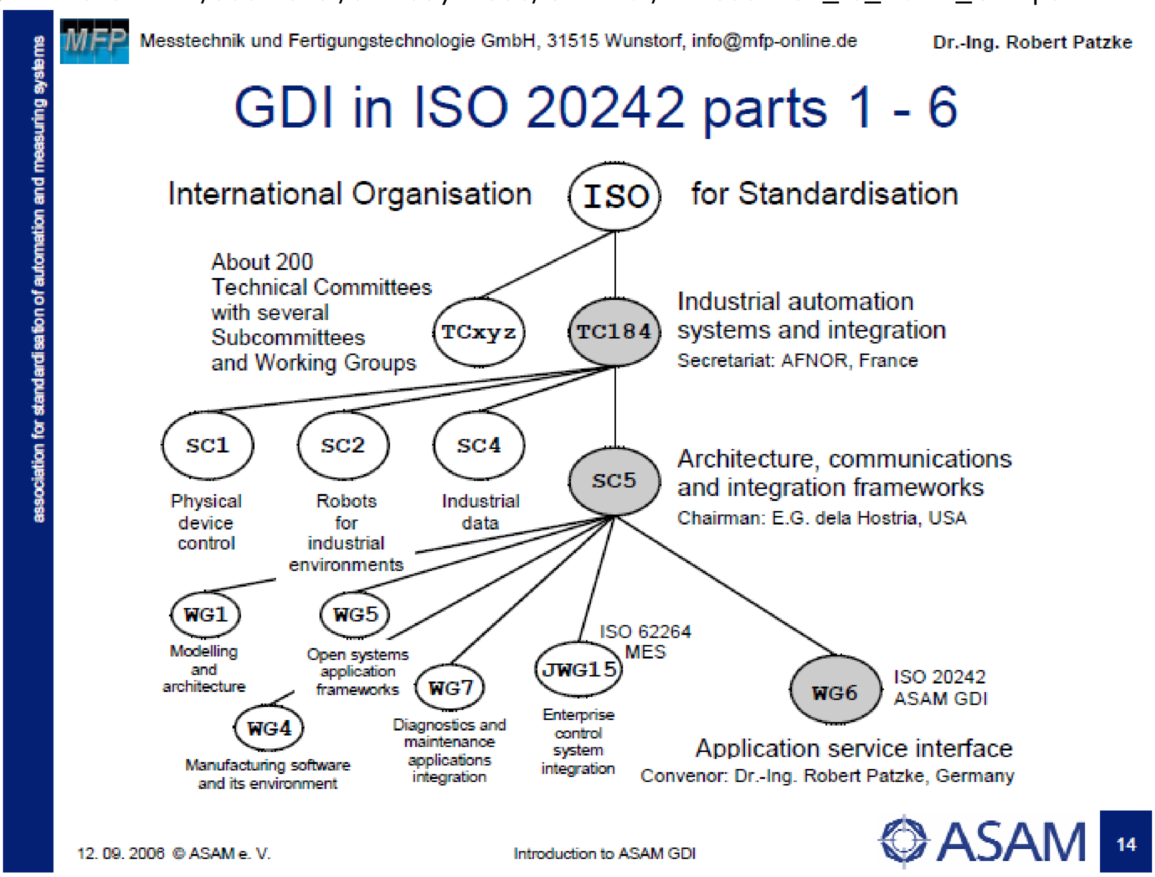
Add to shopping basket	Size	Price
ISO 20242-1:2005 PDF version (en)	392 KB	CHF 72,00
ISO 20242-1:2005 paper version (en)		CHF 72,00

Abstract

ISO 20242-1:2005 provides an overview of the particularities of International Standard ISO 20242 and its use in the computer-aided testing environment, the main aim of ISO 20242 being to provide users with:

- independence from the computer operating system;
- independence from the device connection technology (device interface/network);
- independence from device suppliers;
- the ability to certify device drivers with connected devices and their behaviour in the context of a given computer platform;
- independence from the technological device development in the future.

http://www.asam.net/additional/userdays2006/GDI-ACI/Introduction_to_ASAM_GDI.pdf



Main Goal of GDI

(ISO 20242 Introduction)

Provide users with

- independence from the computer operating system
- independence from the device connection technology (device interface/network)
- independence from device suppliers
- the ability to certify device drivers with connected devices and their behaviour in the context of a given computer platform
- independence from the technological device development in the future

http://www.asam.net/additional/userdays2006/GDI-ACI/Introduction_to_ASAM_GDI.pdf

MFP Messtechnik und Fertigungstechnologie GmbH, 31515 Wunstorf, info@mfp-online.de Dr.-Ing. Robert Patzke

association for standardisation of automation and measuring systems

Claims of GDI

(ISO 20242 Introduction)

GDI will not involve the development of new device families or the use of special interface technologies (networks).

GDI encapsulates a device and its communication interface to make it compatible with other devices of that kind for a given application.

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

Robotics-DTF/SDO-DSIG

Joint Meeting
Closing Session

June 27, 2007

Brussels, Belgium

Crowne Plaza Brussels City Centre

Document Number

- robotics/2007-06-02 Final Agenda (Tetsuo Kotoku)
- robotics/2007-06-03 San Diego Meeting Minutes [approved]
- robotics/2007-06-04 Revised Localization Service DRAFT RFP (Kyuseo Han)
- robotics/2007-06-05 Steering Committee Presentation (Tetsuo Kotoku)
- robotics/2007-06-06 Roadmap for Robotics Activities (Tetsuo Kotoku)
- robotics/2007-06-07 Robotics Seminar: Why Do We Need Standardization of Robot Technology? (Masayoshi Yokomachi)
- robotics/2007-06-08 Robotics Seminar Keynote: A Comparative Evaluation of Robotic Software Systems: A Case Study (Azamat Shakhimardanov and Erwin Prassler)
- robotics/2007-06-09 Robotics Seminar: Introduction to the Robotics Domain Task Force and the Robotic Technology Component (RTC) Specification (Rick Warren)
- robotics/2007-06-10 Robotics Seminar: OpenRTM-aist: A reference Implementation of the Robotic Technology Component Specification (Tetsuo Kotoku)
- robotics/2007-06-11 Robotics Seminar: Keynote: Korean Thrust for Intelligent Service Robot Standards (Sukhan Lee)
- robotics/2007-06-12 Robotics Seminar: Implementation and application of URC and its Standardization (Hyun Kim)
- robotics/2007-06-13 Robotic Localization Service RFP [C4I joint session presentation] (Kyuseo Han)
-

Document Number

- robotics/2007-06-14 Face Recognition Service Component API for Intelligent Robots (Su-Young Chi)
- robotics/2007-06-15 Localization Service DRAFT RFP 3rd revision (Kyuseo Han and Shunichi Nishio)
- robotics/2007-06-16 Robotic Functional Services WG Meeting Report (Su-Young Chi)
- robotics/2007-06-17 Robotic Data Structure and Profiles WG Progress Report (Seung-Ik Lee)
- robotics/2007-06-18 Special Talk: Introduction to CANopen (Holger Zeltwanger)
- robotics/2007-06-19 Special Talk: Anybot studio - Samsung Network Robot SW Platform (Hyun-Sik Shim and Soon-Hyuk Hong)
- robotics/2007-06-20 Contact report: ISO/TC184/SC2 Report (Yun-Koo Chung)
- robotics/2007-06-21 Contact report: KRISF Report (Yun-Koo Chung)
- robotics/2007-06-22 Contact Report: ORiN and RAPI (Makoto Mizukawa)
- robotics/2007-06-23 Closing Presentation (Tetsuo Kotoku)
- robotics/2007-06-24 Next Meeting Preliminary Agenda - DRAFT (Tetsuo Kotoku)
- robotics/2007-06-25 Localization Service DRAFT RFP final revision (Kyuseo Han and Shunichi Nishio)
- robotics/2007-06-26 DTC Report Presentation (Yun-Koo Chung)
- robotics/2007-06-27 Brussels Meeting Minutes - DRAFT (Fumio Ozaki and Yun-Koo Chung)

Next Meeting Agenda

Sep. 24-28 (Jacksonville, FL, USA)

Monday-Tuesday:

Steering Committee (morning)
WG activity [Parallel WG Session]

Wednesday :

Robotics-DTF Plenary Meeting
•Guest and Member Presentation
•Contact reports

Robotics Domain Task Force Preliminary Agenda -DRAFT- ver0.0.2 robotics/2007-06-24

OMG Technical Meeting - **Jacksonville, FL, USA** -- Sep. 24-28 , 2007

http://robotics.omg.org/

		TF/SIG				
		Host	**Joint (Invited)**	**Agenda Item**	**Purpose**	**Room**
Monday WG activity						
9:00	10:00	Robotics	(SDO)	Robotics Steering Committee	Arrangement	
10:00	12:00	Robotics		Services WG(2h): Robotic Localization Services Submitter's Meeting - Kyenseo Han and Shuichi Nishio	discussion	
				Services WG(2h): Human Robot Interaction RFP draft Meeting - Su-Young Chi	discussion	
12:00	13:00	**LUNCH**				
13:00	18:00			Architecture Board Plenary		
13:00	17:00	Robotics		Services WG(4h): Robotic Localization Services Submitter's Meeting - Kyenseo Han and Shuichi Nishio	discussion	
				Services WG(4h): Human Robot Interaction RFP draft Meeting - Su-Young Chi	discussion	
Tuesday WG activities						
9:00	12:00	Robotics		Profile WG(3h): - Seung-Ik Lee, Bruce Boyes	discussion	
				Services WG(3h): Robotic Localization Services Submitter's Meeting - Kyenseo Han and Shuichi Nishio	discussion	
				Services WG(3h): Human Robot Interaction RFP draft Meeting - Su-Young Chi	discussion	
12:00	13:00	**LUNCH**				
13:00	17:00	Robotics		Profile WG(4h): Discussion on profile standardization - Seung-Ik Lee, Bruce Boyes	discussion	
				Services WG(4h): Robotic Localization Services Submitter's Meeting - Kyenseo Han and Shuichi Nishio	discussion	
				Services WG(4h): Human Robot Interaction RFP draft Meeting - Su-Young Chi	discussion	
Wednesday Robotics Plenary						
9:00	10:00	Robotics	(SDO)	WG Reports and Roadmap Discussion (Service WG, Profile WG)	reporting and discussion	
10:00	11:00	Robotics	(SDO)	**Special Talk:** **- TBA**	presentation and discussion	
11:00	12:00	Robotics	(SDO)	**Special Talk:** **- TBA**	presentation and discussion	
12:00	14:00	**LUNCH and OMG Plenary**				
14:00	15:00	Robotics	(SDO)	**Special Talk:** **- TBA**	demonstration and discussion	
				Break (30min)		
15:30	16:30	Robotics	(SDO)	Contact Reports: - Makoto Mizukawa(Shibaura-IT), and Yun-Koo Chung(ETRI)	Information Exchange	
16:30	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						
12:00	13:00	**LUNCH**				
13:00	18:00			Architecture Board Plenary		
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

Object Management Group

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Telephone: +1-781-444-0404
Facsimile: +1-781-444-0320

Request For Proposal

Robotic Localization Service

OMG Document: robotics/2007-06-25

Letters of Intent due: September 15, 2007
Submissions due: November 12, 2007

Objective of this RFP

This RFP solicits proposals for a Platform Independent Model (PIM) and at least one CORBA Platform Specific Model (PSM) or C++ PSM of Localization Service that specify

- common interfaces for Localization Service to transfer data and commands
- a set of common information to represent location

In the context of this RFP the word "localization" means "to find the location of some physical entities through analysis of sensor data", consistent with the common use of this term in Robotics.

For further details see Chapter 6 of this document.

1.0 Introduction

1.1 Goals of OMG

The Object Management Group (OMG) is the world's largest software consortium with an international membership of vendors, developers, and end users. Established in 1989, its mission is to help computer users solve enterprise integration problems by supplying open, vendor-neutral portability, interoperability and reusability specifications based on Model Driven Architecture (MDA). MDA defines an approach to IT system specification that separates the specification of system functionality from the specification of the implementation of that functionality on a specific technology platform, and provides a set of guidelines for structuring specifications expressed as models. OMG has established numerous widely used standards such as OMG IDL[IDL], CORBA[CORBA], Realtime CORBA [CORBA], GIOP/IIOP[CORBA], UML[UML], MOF[MOF], XMI[XMI] and CWM[CWM] to name a few significant ones.

1.2 Organization of this document

The remainder of this document is organized as follows:

Chapter 2 - *Architectural Context* - background information on OMG's Model Driven Architecture.

Chapter 3 - *Adoption Process* - background information on the OMG specification adoption process.

Chapter 4 - *Instructions for Submitters* - explanation of how to make a submission to this RFP.

Chapter 5 - *General Requirements on Proposals* - requirements and evaluation criteria that apply to all proposals submitted to OMG.

Chapter 6 - *Specific Requirements on Proposals* - problem statement, scope of proposals sought, requirements and optional features, issues to be discussed, evaluation criteria, and timetable that apply specifically to this RFP.

Appendix A – *References and Glossary Specific to this RFP*

Appendix B – General References and Glossary

1.3 Conventions

The key words "**must**", "**must not**", "**required**", "**shall**", "**shall not**", "**should**", "**should not**", "**recommended**", "**may**", and "**optional**" in this document are to be interpreted as described in RFC 2119 [RFC2119].

1.4 Contact Information

Questions related to the OMG's technology adoption process may be directed to *omg-process@omg.org*. General questions about this RFP may be sent to *responses@omg.org*.

OMG documents (and information about the OMG in general) can be obtained from the OMG's web site *(http://www.omg.org/*). OMG documents may also be obtained by contacting OMG at *documents@omg.org*. Templates for RFPs (this document) and other standard OMG documents can be found at the OMG *Template Downloads Page* at *http://www.omg.org/technology/template_download.htm*

2.0 Architectural Context

MDA provides a set of guidelines for structuring specifications expressed as models and the mappings between those models. The MDA initiative and the standards that support it allow the same model specifying business system or application functionality and behavior to be realized on multiple platforms. MDA enables different applications to be integrated by explicitly relating their models; this facilitates integration and interoperability and supports system evolution (deployment choices) as platform technologies change. The three primary goals of MDA are portability, interoperability and reusability.

Portability of any subsystem is relative to the subsystems on which it depends. The collection of subsystems that a given subsystem depends upon is often loosely called the *platform,* which supports that subsystem. Portability – and reusability - of such a subsystem is enabled if all the subsystems that it depends upon use standardized interfaces (APIs) and usage patterns.

MDA provides a pattern comprising a portable subsystem that is able to use any one of multiple specific implementations of a platform. This pattern is repeatedly usable in the specification of systems. The five important concepts related to this pattern are:

1. *Model* - A model is a representation of a part of the function, structure and/or behavior of an application or system. A *representation* is said to be *formal* when it is based on a language that has a well-defined form

("syntax"), meaning ("semantics"), and possibly rules of analysis, inference, or proof for its constructs. The syntax may be graphical or textual. The semantics might be defined, more or less formally, in terms of things observed in the world being described (e.g. message sends and replies, object states and state changes, etc.), or by translating higher-level language constructs into other constructs that have a well-defined meaning. The optional rules of inference define what unstated properties you can deduce from the explicit statements in the model. In MDA, a *representation* that is not *formal* in this sense is not a model. Thus, a diagram with boxes and lines and arrows that is not supported by a definition of the meaning of a box, and the meaning of a line and of an arrow is not a model—it is just an informal diagram.

2. *Platform* – A set of subsystems/technologies that provide a coherent set of functionality through interfaces and specified usage patterns that any subsystem that depends on the platform can use without concern for the details of how the functionality provided by the platform is implemented.

3. *Platform Independent Model (PIM)* – A model of a subsystem that contains no information specific to the platform, or the technology that is used to realize it.

4. *Platform Specific Model (PSM)* – A model of a subsystem that includes information about the specific technology that is used in the realization of that subsystem on a specific platform, and hence possibly contains elements that are specific to the platform.

5. *Mapping* – Specification of a mechanism for transforming the elements of a model conforming to a particular metamodel into elements of another model that conforms to another (possibly the same) metamodel. A mapping may be expressed as associations, constraints, rules, templates with parameters that must be assigned during the mapping, or other forms yet to be determined.

For example, in case of CORBA the platform is specified by a set of interfaces and usage patterns that constitute the CORBA Core Specification [CORBA]. The CORBA platform is independent of operating systems and programming languages. The OMG Trading Object Service specification [TOS] (consisting of interface specifications in OMG Interface Definition Language (OMG IDL)) can be considered to be a PIM from the viewpoint of CORBA, because it is independent of operating systems and programming languages. When the IDL to C++ Language Mapping specification is applied to the Trading Service PIM, the C++-specific result can be considered to be a PSM for the Trading Service, where the platform is the C++ language and the C++ ORB implementation. Thus the IDL to C++ Language Mapping specification [IDLC++] determines the mapping from the Trading Service PIM to the Trading Service PSM.

Note that the Trading Service model expressed in IDL is a PSM relative to the CORBA platform too. This highlights the fact that platform-independence and platform-specificity are relative concepts.

The UML Profile for EDOC specification [EDOC] is another example of the application of various aspects of MDA. It defines a set of modeling constructs that are independent of middleware platforms such as EJB [EJB], CCM [CCM], MQSeries [MQS], etc. A PIM based on the EDOC profile uses the middleware-independent constructs defined by the profile and thus is middleware-independent. In addition, the specification defines formal metamodels for some specific middleware platforms such as EJB, supplementing the already-existing OMG metamodel of CCM (CORBA Component Model). The specification also defines mappings from the EDOC profile to the middleware metamodels. For example, it defines a mapping from the EDOC profile to EJB. The mapping specifications facilitate the transformation of any EDOC-based PIM into a corresponding PSM for any of the specific platforms for which a mapping is specified.

Continuing with this example, one of the PSMs corresponding to the EDOC PIM could be for the CORBA platform. This PSM then potentially constitutes a PIM, corresponding to which there would be implementation language specific PSMs derived via the CORBA language mappings, thus illustrating recursive use of the Platform-PIM-PSM-Mapping pattern.

Note that the EDOC profile can also be considered to be a platform in its own right. Thus, a model expressed via the profile is a PSM relative to the EDOC platform.

An analogous set of concepts apply to Interoperability Protocols wherein there is a PIM of the payload data and a PIM of the interactions that cause the data to find its way from one place to another. These then are realized in specific ways for specific platforms in the corresponding PSMs.

Analogously, in case of databases there could be a PIM of the data (say using the Relational Data Model), and corresponding PSMs specifying how the data is actually represented on a storage medium based on some particular data storage paradigm etc., and a mapping from the PIM to each PSM.

OMG adopts standard specifications of models that exploit the MDA pattern to facilitate portability, interoperability and reusability, either through ab initio development of standards or by reference to existing standards. Some examples of OMG adopted specifications are:

1. *Languages* – e.g. IDL for interface specification, UML for model specification, OCL for constraint specification, etc.

2. *Mappings* – e.g. Mapping of OMG IDL to specific implementation languages (CORBA PIM to Implementation Language PSMs), UML Profile for EDOC (PIM) to CCM (CORBA PSM) and EJB (Java PSM), CORBA (PSM) to COM (PSM) etc.

3. *Services* – e.g. Naming Service [NS], Transaction Service [OTS], Security Service [SEC], Trading Object Service [TOS] etc.

4. *Platforms* – e.g. CORBA [CORBA].

5. *Protocols* – e.g. GIOP/IIOP [CORBA] (both structure and exchange protocol), [XMI] (structure specification usable as payload on multiple exchange protocols).

6. *Domain Specific Standards* – e.g. Data Acquisition from Industrial Systems (Manufacturing) [DAIS], General Ledger Specification (Finance) [GLS], Air Traffic Control (Transportation) [ATC], Gene Expression (Life Science Research) [GE], Personal Identification Service (Healthcare) [PIDS], etc.

For an introduction to MDA, see [MDAa]. For a discourse on the details of MDA please refer to [MDAc]. To see an example of the application of MDA see [MDAb]. For general information on MDA, see [MDAd].

Object Management Architecture (OMA) is a distributed object computing platform architecture within MDA that is related to ISO's Reference Model of Open Distributed Processing RM-ODP[RM-ODP]. CORBA and any extensions to it are based on OMA. For information on OMA see [OMA].

3.0 Adoption Process

3.1 Introduction

OMG adopts specifications by explicit vote on a technology-by-technology basis. The specifications selected each satisfy the architectural vision of MDA. OMG bases its decisions on both business and technical considerations. Once a specification adoption is finalized by OMG, it is made available for use by both OMG members and non-members alike.

Request for Proposals (RFP) are issued by a *Technology Committee* (TC), typically upon the recommendation of a *Task Force* (TF) and duly endorsed by the *Architecture Board* (AB).

Submissions to RFPs are evaluated by the TF that initiated the RFP. Selected specifications are *recommended* to the parent TC after being *reviewed* for technical merit and consistency with MDA and other adopted specifications and *endorsed* by the AB. The parent TC of the initiating TF then votes to *recommend adoption* to the OMG Board of Directors (BoD). The BoD acts on the recommendation to complete the adoption process.

For more detailed information on the adoption process see the *Policies and Procedures of the OMG Technical Process* [P&P] and the *OMG Hitchhiker's Guide* [Guide]. In case of any inconsistency between this document and the [P&P] in all cases the [P&P] shall prevail.

3.2 Steps in the Adoption Process

A TF, its parent TC, the AB and the Board of Directors participate in a collaborative process, which typically takes the following form:

- *Development and Issuance of RFP*

  RFPs are drafted by one or more OMG members who are interested in the adoption of a standard in some specific area. The draft RFP is presented to an appropriate TF, based on its subject area, for approval and recommendation to issue. The TF and the AB provide guidance to the drafters of the RFP. When the TF and the AB are satisfied that the RFP is appropriate and ready for issuance, the TF recommends issuance to its parent TC, and the AB endorses the recommendation. The TC then acts on the recommendation and issues the RFP.

- *Letter of Intent (LOI)*

  A Letter of Intent (LOI) must be submitted to the OMG signed by an officer of the member organization, which intends to respond to the RFP, confirming the organization's willingness to comply with OMG's terms and conditions, and commercial availability requirements. (See section 4.3 for more information.). In order to respond to an RFP the respondent must be a member of the TC that issued the RFP.

- *Voter Registration*

  Interested OMG members, other than Trial, Press and Analyst members may participate in specification selection votes in the TF for an RFP. They may need to register to do so, if so stated in the RFP. Registration ends on a specified date, 6 or more weeks after the announcement of the registration period. The registration closure date is typically around the time of initial submissions. Member organizations that have submitted an LOI are automatically registered to vote.

- *Initial Submissions*

  Initial Submissions are due by a specified deadline. Submitters normally present their proposals at the first meeting of the TF after the deadline. Initial Submissions are expected to be complete enough to provide insight on the technical directions and content of the proposals.

- *Revision Phase*

  During this time submitters have the opportunity to revise their Submissions, if they so choose.

- *Revised Submissions*

  Revised Submissions are due by a specified deadline. Submitters again normally present their proposals at the next meeting of the TF after the deadline. (Note that there may be more than one Revised Submission deadline. The decision to extend this deadline is made by the registered voters for that RFP.)

- *Selection Votes*

  When the registered voters for the RFP believe that they sufficiently understand the relative merits of the Revised Submissions, a selection vote is taken. The result of this selection vote is a recommendation for adoption to the TC. The AB reviews the proposal for MDA compliance and technical merit. An endorsement from the AB moves the voting process into the issuing Technology Committee. An eight-week voting period ensues in which the TC votes to recommend adoption to the OMG Board of Directors (BoD). The final vote, the vote to adopt, is taken by the BoD and is based on technical merit as well as business qualifications. The resulting draft standard is called the *Adopted Specification*.

- *Business Committee Questionnaire*

  The submitting members whose proposal is recommended for adoption need to submit their response to the BoD Business Committee Questionnaire [BCQ] detailing how they plan to make use of and/or make the resulting standard available in products. If no organization commits to make use of the standard, then the BoD will typically not act on the recommendation to adopt the standard. So it is very important to fulfill this requirement.

- *Finalization*

  A Finalization Task Force (FTF) is chartered by the TC that issued the RFP, to prepare an *adopted* submission for publishing as a formal, publicly available specification. Its responsibility includes production of one or more prototype implementations and fixing any problems that are discovered in the process. This ensures that the final available standard is actually implementable and has no show-stopping bugs. Upon completion of its activity the FTF recommends adoption of the resulting draft standard called the *Available Specification*. The FTF must also provide evidence of the existence of one or more prototype implementations. The parent TC acts on the recommendation and recommends adoption to the BoD. OMG Technical Editors produce the *Formal Published Specification* document based on this *Available Specification*.

- *Revision*

  A Revision Task Force (RTF) is normally chartered by a TC, after the FTF completes its work, to manage issues filed against the *Available Specification* by implementers and users. The output of the RTF is a revised specification reflecting minor technical changes.

3.3 Goals of the evaluation

The primary goals of the TF evaluation are to:

- Provide a fair and open process
- Facilitate critical review of the submissions by members of OMG
- Provide feedback to submitters enabling them to address concerns in their revised submissions
- Build consensus on acceptable solutions
- Enable voting members to make an informed selection decision

Submitters are expected to actively contribute to the evaluation process.

4.0 Instructions for Submitters

4.1 OMG Membership

To submit to an RFP issued by the Platform Technology Committee the submitter or submitters must be either Platform or Contributing members on the date of the submission deadline, while for Domain Technology RFPs the submitter or submitters must be either Contributing or Domain members. Submitters sometimes choose to name other organizations that support a submission in some way; however, this has no formal status within the OMG process, and for OMG's purposes confers neither duties nor privileges on the organizations thus named.

4.2 Submission Effort

An RFP submission may require significant effort in terms of document preparation, presentations to the issuing TF, and participation in the TF evaluation process. Several staff months of effort might be necessary. OMG is unable to reimburse submitters for any costs in conjunction with their submissions to this RFP.

4.3 Letter of Intent

A Letter of Intent (LOI) must be submitted to the OMG Business Committee signed by an officer of the submitting organization signifying its intent to respond to the RFP and confirming the organization's willingness to comply with OMG's terms and conditions, and commercial availability requirements. These terms, conditions, and requirements are defined in the *Business Committee RFP Attachment* and are reproduced verbatim in section 4.4 below.

The LOI should designate a single contact point within the submitting organization for receipt of all subsequent information regarding this RFP and the submission. The name of this contact will be made available to all OMG members. The LOI is typically due 60 days before the deadline for initial submissions. LOIs must be sent by fax or paper mail to the "RFP Submissions Desk" at the main OMG address shown on the first page of this RFP.

Here is a suggested template for the Letter of Intent:

This letter confirms the intent of <___organization required___> (the organization) to submit a response to the OMG <___RFP name required___> RFP. We will grant OMG and its members the right to copy our response for review purposes as specified in section 4.7 of the RFP. Should our response be adopted by OMG we will comply with the OMG Business Committee terms set out in section 4.4 of the RFP and in document omg/06-03-02.

<____contact name and details required____> will be responsible for liaison with OMG regarding this RFP response.

The signatory below is an officer of the organization and has the approval and authority to make this commitment on behalf of the organization.

<___signature required____>

4.4 Business Committee RFP Attachment

This section contains the text of the Business Committee RFP attachment concerning commercial availability requirements placed on submissions. This attachment is available separately as an OMG document omg/06-03-02.

Commercial considerations in OMG technology adoption

A1 Introduction

OMG wishes to encourage rapid commercial adoption of the specifications it publishes. To this end, there must be neither technical, legal nor commercial obstacles to their implementation. Freedom from the first is largely judged through technical review by the relevant OMG Technology Committees; the second two are the responsibility of the OMG Business Committee. The BC also looks for evidence of a commitment by a submitter to the commercial success of products based on the submission.

A2 Business Committee evaluation criteria

A2.1 Viable to implement across platforms

While it is understood that final candidate OMG submissions often combine technologies before they have all been implemented in one system, the Business Committee nevertheless wishes to see evidence that each major feature has been implemented, preferably more than once, and by separate organisations. Pre-product implementations are acceptable. Since use of OMG specifications should not be dependant on any one platform, cross-platform availability and interoperability of implementations should be also be demonstrated.

A2.2 Commercial availability

In addition to demonstrating the existence of implementations of the specification, the submitter must also show that products based on the specification are commercially available, or will be within 12 months of the date when the specification was recommended for adoption by the appropriate Task Force. Proof of intent to ship product within 12 months might include:

- *A public product announcement with a shipping date within the time limit.*
- *Demonstration of a prototype implementation and accompanying draft user documentation.*

Alternatively, and at the Business Committee's discretion, submissions may be adopted where the submitter is not a commercial software provider, and therefore will not make implementations commercially available. However, in this case the BC will require concrete evidence of two or more independent implementations of the specification being used by end- user organisations as part of their businesses. Regardless of which requirement is in use, the submitter must inform the OMG of completion of the implementations when commercially available.

A2.3 Access to Intellectual Property Rights

OMG will not adopt a specification if OMG is aware of any submitter, member or third party which holds a patent, copyright or other intellectual property right (collectively referred to in this policy statement as "IPR") which might be infringed by implementation or recommendation of such specification, unless OMG believes that such IPR owner will grant a license to organisations (whether OMG members or not) on non-discriminatory and commercially reasonable terms which wish to make use of the specification. Accordingly, the submitter must certify that it is not aware of any claim that the specification infringes any IPR of a third party or that it is aware and believes that an appropriate non-discriminatory license is available from that third party. Except for this certification, the submitter will not be required to make any other warranty, and specifications will be offered by OMG for use "as is". If the submitter owns IPR to which an use of a specification based upon its submission would necessarily be subject, it must certify to the Business Committee that it will make a suitable license available to any user on non- discriminatory and commercially reasonable terms, to permit development and commercialisation of an implementation that includes such IPR.

It is the goal of the OMG to make all of its technology available with as few impediments and disincentives to adoption as possible, and therefore OMG strongly encourages the submission of technology as to which royalty-free licenses will be available. However, in all events, the submitter shall also certify that any necessary licence will be made available on commercially reasonable, non-discriminatory terms. The submitter is responsible for disclosing in detail all known restrictions, placed either by the submitter or, if known, others, on technology necessary for any use of the specification.

A2.4 Publication of the specification

Should the submission be adopted, the submitter must grant OMG (and its sublicensees) a world- wide, royalty-free licence to edit, store, duplicate and distribute both the specification and works derived from it (such as revisions and teaching materials). This requirement applies only to the written specification, not to any implementation of it.

A2.5 Continuing support

The submitter must show a commitment to continue supporting the technology underlying the specification after OMG adoption, for instance by showing the BC development plans for future revisions, enhancement or maintenance.

4.5 Responding to RFP items

4.5.1 Complete proposals

A submission must propose full specifications for all of the relevant requirements detailed in Chapter 6 of this RFP. Submissions that do not present complete proposals may be at a disadvantage.

Submitters are highly encouraged to propose solutions to any optional requirements enumerated in Chapter 6.

4.5.2 Additional specifications

Submissions may include additional specifications for items not covered by the RFP that they believe to be necessary and integral to their proposal. Information on these additional items should be clearly distinguished.

Submitters must give a detailed rationale as to why these specifications should also be considered for adoption. However submitters should note that a TF is unlikely to consider additional items that are already on the roadmap of an OMG TF, since this would pre-empt the normal adoption process.

4.5.3 Alternative approaches

Submitters may provide alternative RFP item definitions, categorizations, and groupings so long as the rationale for doing so is clearly stated. Equally, submitters may provide alternative models for how items are provided if there are compelling technological reasons for a different approach.

4.6 Confidential and Proprietary Information

The OMG specification adoption process is an open process. Responses to this RFP become public documents of the OMG and are available to members and non-members alike for perusal. No confidential or proprietary information of any kind will be accepted in a submission to this RFP.

4.7 Copyright Waiver

Every submission document must contain: (i) a waiver of copyright for unlimited duplication by the OMG, and (ii) a limited waiver of copyright that allows each OMG member to make up to fifty (50) copies of the document forreview purposes only. See Section 4.9.2 for recommended language.

4.8 Proof of Concept

Submissions must include a "proof of concept" statement, explaining how the submitted specifications have been demonstrated to be technically viable. The technical viability has to do with the state of development and maturity of the technology on which a submission is based. This is not the same as commercial availability. Proof of concept statements can contain any information deemed relevant by the submitter; for example:

> "This specification has completed the design phase and is in the process of being prototyped."
>
> "An implementation of this specification has been in beta-test for 4 months."
>
> "A named product (with a specified customer base) is a realization of this specification."

It is incumbent upon submitters to demonstrate to the satisfaction of the TF managing the evaluation process, the technical viability of their proposal. OMG will favor proposals based on technology for which sufficient relevant experience has been gained.

4.9 Format of RFP Submissions

This section presents the structure of a submission in response to an RFP. *All submissions* must contain the elements itemized in section 4.9.2 below before they can be accepted as a valid response for evaluation or a vote can be taken to recommend for adoption.

4.9.1 General

- Submissions that are concise and easy to read will inevitably receive more consideration.
- Submitted documentation should be confined to that directly relevant to the items requested in the RFP. If this is not practical, submitters must make clear what portion of the documentation pertains directly to the RFP and what portion does not.
- The key words "**must**", "**must not**", "**required**", "**shall**", "**shall not**", "**should**", "**should not**", "**recommended**", "**may**", and "**optional**" shall be used in the submissions with the meanings as described in RFC 2119 [RFC2119].

4.9.2 Required Outline

A three-part structure for submissions is required. Parts I is non-normative, providing information relevant to the evaluation of the proposed specification. Part II is normative, representing the proposed specification. Specific sections like Appendices may be explicitly identified as non-normative in Part II. Part III is normative specifying changes that must be made to previously adopted specifications in order to be able to implement the specification proposed in Part II.

PART I

- The name of the RFP that the submission is responding to.
- List of OMG members making the submission (see 4.1) listing exactly which members are making the submission, so that submitters can be matched with LOI responders and their current eligibility can be verified.
- Copyright waiver (see 4.7), in a form acceptable to the OMG.

  One acceptable form is:

  "Each of the entities listed above: (i) grants to the Object Management Group, Inc. (OMG) a nonexclusive, royalty-free, paid up, worldwide license to copy and distribute this document and to modify this document and distribute copies of the modified version, and (ii) grants to each member of the OMG a nonexclusive, royalty-free, paid up, worldwide license to make up to fifty (50) copies of this document for internal review purposes only and not for distribution, and (iii) has agreed that no person shall be deemed to have infringed the copyright in the included material of any such copyright holder by reason of having used any OMG specification that may be based hereon or having conformed any computer software to such specification."

  If you wish to use some other form you must get it approved by the OMG legal counsel before using it in a submission.

- For each member making the submission, an individual contact point who is authorized by the member to officially state the member's position relative to the submission, including matters related to copyright ownership, etc. (see 4.3)
- Overview or guide to the material in the submission
- Overall design rationale (if appropriate)
- Statement of proof of concept (see 4.8)
- Resolution of RFP requirements and requests

Explain how the proposal satisfies the specific requirements and (if applicable) requests stated in Chapter 6. References to supporting material in Part II should be given.

In addition, if the proposal does not satisfy any of the general requirements stated in Chapter 5, provide a detailed rationale.

- Responses to RFP issues to be discussed

Discuss each of the "Issues To Be Discussed" identified in Chapter 6.

PART II

The contents of this part should be structured based on the template found in [FORMS] and should contain the following elements as per the instructions in the template document cited above:

- Scope of the proposed specification
- Proposed conformance criteria

Submissions should propose appropriate conformance criteria for implementations.

- Proposed normative references

Submissions should provide a list of the normative references that are used by the proposed specification

- Proposed list of terms and definitions

Submissions should provide a list of terms that are used in the proposed specification with their definitions.

- Proposed list of symbols

Submissions should provide a list of special symbols that are used in the proposed specification together with their significance

- Proposed specification.

PART III

- Changes or extensions required to adopted OMG specifications

Submissions must include a full specification of any changes or extensions required to existing OMG specifications. This should be in a form that enables "mechanical" section-by-section revision of the existing specification.

4.10 How to Submit

Submitters should send an electronic version of their submission to the *RFP Submissions Desk* (omg-documents@omg.org) at OMG Headquarters by 5:00 PM U.S. Eastern Standard Time (22:00 GMT) on the day of the Initial and Revised Submission deadlines. Acceptable formats are Postscript, ASCII, PDF, Adobe FrameMaker, Microsoft Word, and WordPerfect. However, it should be noted that a successful (adopted) submission must be supplied to OMG's technical editors in FrameMaker source format, using the most recent available OMG submission template (see [FORMS]). The AB will not endorse adoption of any submission for which appropriately formatted FrameMaker sources are not submitted to OMG; it may therefore be convenient to prepare all stages of a submission using this template.

Submitters should make sure they receive electronic or voice confirmation of the successful receipt of their submission. Submitters should be prepared to send a single hardcopy version of their submission, if requested by OMG staff, to the attention of the "RFP Submissions Desk" at the main OMG address shown on the first page of this RFP.

5.0 General Requirements on Proposals

5.1 Requirements

5.1.1 Submitters are encouraged to express models using OMG modeling languages such as UML, MOF, CWM and SPEM (subject to any further constraints on the types of the models and modeling technologies specified in Chapter 6 of this RFP). Submissions containing models expressed via OMG modeling languages shall be accompanied by an OMG XMI [XMI] representation of the models (including a machine-readable copy). A best effort should be made to provide an OMG XMI representation even in those cases where models are expressed via non-OMG modeling languages.

5.1.2 Chapter 6 of this RFP specifies whether PIM(s), PSM(s), or both are being solicited. If proposals specify a PIM and corresponding PSM(s), then the rules specifying the mapping(s) between the PIM and PSM(s) shall either be identified by reference to a standard mapping or specified in the proposal. In order to allow possible inconsistencies in a proposal to be resolved later, proposals shall identify whether the mapping technique or the resulting PSM(s) are to be considered normative.

5.1.3 Proposals shall be *precise* and *functionally complete*. All relevant assumptions and context required for implementing the specification shall be provided.

5.1.4 Proposals shall specify *conformance criteria* that clearly state what features all implementations must support and which features (if any) may *optionally* be supported.

5.1.5 Proposals shall *reuse* existing OMG and other standard specifications in preference to defining new models to specify similar functionality.

5.1.6 Proposals shall justify and fully specify any *changes or extensions* required to existing OMG specifications. In general, OMG favors proposals that are *upwards compatible* with existing standards and that minimize changes and extensions to existing specifications.

5.1.7 Proposals shall factor out functionality that could be used in different contexts and specify their models, interfaces, etc. separately. Such *minimalism* fosters re-use and avoids functional duplication.

5.1.8 Proposals shall use or depend on other specifications only where it is actually necessary. While re-use of existing specifications to avoid duplication will be encouraged, proposals should avoid gratuitous use.

5.1.9 Proposals shall be *compatible* with and *usable* with existing specifications from OMG and other standards bodies, as appropriate. Separate specifications offering distinct functionality should be usable together where it makes sense to do so.

5.1.10 Proposals shall preserve maximum *implementation flexibility*. Implementation descriptions should not be included and proposals shall not constrain implementations any more than is necessary to promote interoperability.

5.1.11 Proposals shall allow *independent implementations* that are *substitutable* and *interoperable*. An implementation should be replaceable by an alternative implementation without requiring changes to any client.

5.1.12 Proposals shall be compatible with the architecture for system distribution defined in ISO's Reference Model of Open Distributed Processing [RM-ODP]. Where such compatibility is not achieved, or is not appropriate, the response to the RFP must include reasons why compatibility is not appropriate and an outline of any plans to achieve such compatibility in the future.

5.1.13 In order to demonstrate that the specification proposed in response to this RFP can be made secure in environments requiring security, answers to the following questions shall be provided:

- What, if any, are the security sensitive elements that are introduced by the proposal?
- Which accesses to security-sensitive elements must be subject to security policy control?
- Does the proposed service or facility need to be security aware?
- What default policies (e.g., for authentication, audit, authorization, message protection etc.) should be applied to the security sensitive elements introduced by the proposal? Of what security considerations must the implementers of your proposal be aware?

The OMG has adopted several specifications, which cover different aspects of security and provide useful resources in formulating responses. [CSIV2] [SEC] [RAD].

5.1.14 Proposals shall specify the degree of internationalization support that they provide. The degrees of support are as follows:

a) Uncategorized: Internationalization has not been considered.

b) Specific to <region name>: The proposal supports the customs of the specified region only, and is not guaranteed to support the customs of any other region. Any fault or error caused by requesting the services outside of a context in which the customs of the specified region are being consistently followed is the responsibility of the requester.

c) Specific to <multiple region names>: The proposal supports the customs of the specified regions only, and is not guaranteed to support the customs of any other regions. Any fault or error caused by requesting the services outside of a context in which the customs of at least one of the specified regions are being consistently followed is the responsibility of the requester.

d) Explicitly not specific to <region(s) name>: The proposal does not support the customs of the specified region(s). Any fault or error caused by requesting the services in a context in which the customs of the specified region(s) are being followed is the responsibility of the requester.

5.2 Evaluation criteria

Although the OMG adopts model-based specifications and not implementations of those specifications, the technical viability of implementations will be taken into account during the evaluation process. The following criteria will be used:

5.2.1 Performance

Potential implementation trade-offs for performance will be considered.

5.2.2 Portability

The ease of implementation on a variety of systems and software platforms will be considered.

5.2.3 Securability

The answer to questions in section 5.1.13 shall be taken into consideration to ascertain that an implementation of the proposal is securable in an environment requiring security.

5.2.4 Conformance: Inspectability and Testability

The adequacy of proposed specifications for the purposes of conformance inspection and testing will be considered. Specifications should provide sufficient constraints on interfaces and implementation characteristics to ensure that conformance can be unambiguously assessed through both manual inspection and automated testing.

5.2.5 Standardized Metadata

Where proposals incorporate metadata specifications, usage of OMG standard XMI metadata [XMI] representations must be provided as this allows specifications to be easily interchanged between XMI compliant tools and applications. Since use of XML (including XMI and XML/Value [XML/Value]) is evolving rapidly, the use of industry specific XML vocabularies (which may not be XMI compliant) is acceptable where justified.

6.0 Specific Requirements on Proposals

6.1 Problem Statement

A robotic system is commonly defined as an apparatus equipped with a function of interacting with physical entities in a given environment. Navigation, manipulation and human-robot interaction are typical features including physical interaction of a robot, which make a robotic system distinguished from an information appliance.

A robot requires geometric association between physical entities of interest and the robot itself for implementing a task scenario given to the robot.

There are two important attributes for describing a physical entity in space: shape and location. Of the two attributes, location information plays a far more fundamental role in carrying out various tasks involving a robot.

The following are some typical robotic tasks which employ location information.

- Navigation: a robot moves from its current to goal location. The robot should know the two locations and at the same time, it should know relative locations of obstacles it may meet along a moving path.
- Manipulation: a robotic gripper grabs an entity in a sequence of a task, identifying relative position of the entity with respect to a task in a reference coordinate system.
- Human robot interaction: a robot should be aware of the location of human(s) and itself when a given task involves interaction with a human.
- Communication with environments: a robot should recognize physical events in an environment and react to them by incorporating location information of each individual event.

Besides these examples, the number of location-based robotic tasks is continuously increasing as personal or service robot fields are gradually expanded. Since types of location-based applications are varied along with localization methods, it is necessary to build a unified way of localization to support a wide range of location-based robotic tasks.

In the context of this RFP the word “localization” means “to find the location of some physical entities through analysis of sensor data”, consistent with the common use of this term in Robotics. Here the location to be found may include not only the position in the space, but also heading orientation of the entity, or additional information such as error estimation or timestamp. Also, the word “physical entity” (or “entity” in short) is used to describe the target to be localized, including robots, humans or other objects.

Localization technology may be classified into two categories: relative and absolute localization. Odometry and inertial navigation are typical examples utilizing relative localization, where the current location of a mobile robot is measured with respect to the initial location of the robot. Typical sensors used in relative localization are encoders, gyroscopes, accelerometers, and so on, which are usually installed within the body of a robot.

Absolute localization utilizes beacons or landmarks whose locations are known with respect to a predefined reference frame. Localization of a mobile robot is initiated by recognizing beacons or landmarks. Map matching method also belongs to this category, utilizing range scan data of an environment as a natural landmark. GPS (Global Positioning System) may be the most successful commercial solution for absolute localization in outdoor environment. Recent applications utilizing sensors installed in the environment such as networked cameras, RF tag readers, and floor sensors may also fall into this category.

Localization solutions differ from one another in accordance with employed sensors, working environment and strategic use for a specific application. Since a specific sensor usually measures a physical quantity of a single kind, it is a common practice that developers of a localization solution utilize multiple sensors for compensating one another, which means that an unlimited number of localization solutions can be brought about. A variety of existing software and hardware platforms further increases the complexity and difficulty to develop a localization solution.

Therefore, localization can be referred to as a systematic approach to estimate the current location of physical entities by utilizing uncertain data from sensors installed in the robot or in the environment.

With an ever-increasing need for a location solution applicable to a wide range of robotic tasks, it is necessary to create a much more flexible way to provide location information irrespective of characteristics of employed sensors, algorithms, and so on. Once such a capability is provided to a localization solution, it can be easily adopted to the vast majority of robotic tasks including localization of robots and related entities.

To achieve flexibility and robustness of localization in robotic systems, it is important to standardize functionalities and associated interfaces for localizing robots and entities as a service. We call such a service as “Localization Service (LS)”.

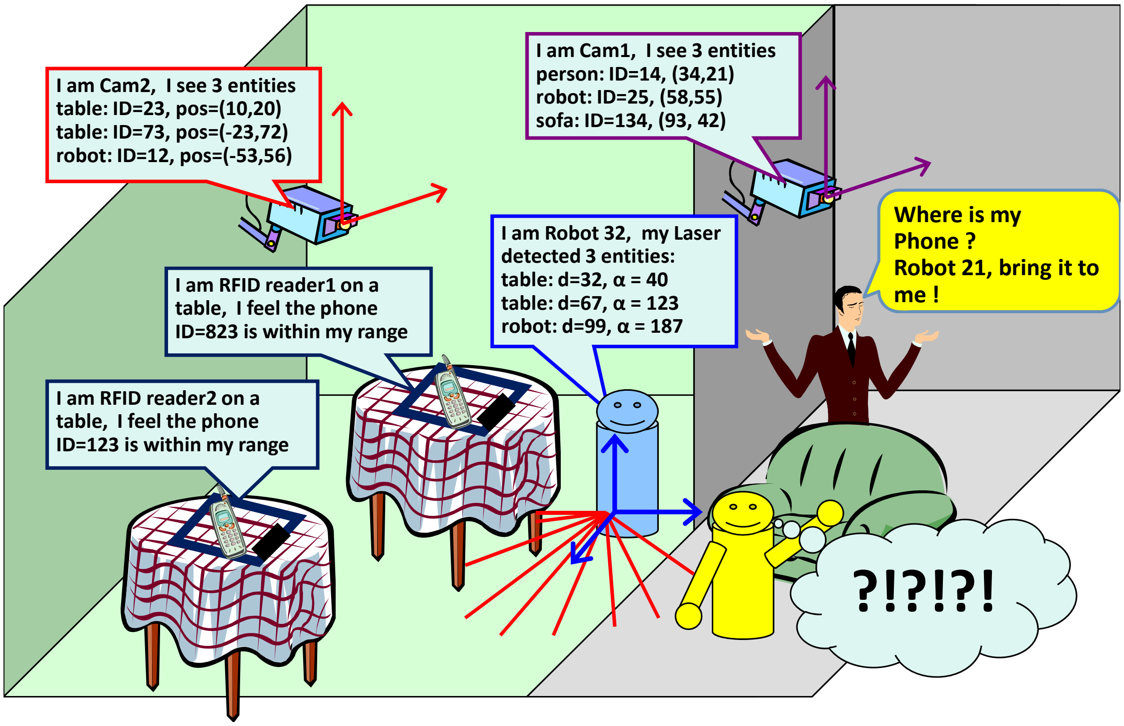

Figure 1 Example of a typical robotic service situation requiring localization of an entity

The LS is a framework of software modules which supports the functionalities for localizing entities in the physical world including robots, regardless of specific sensors and algorithms. Figure 1 illustrates a typical situation in a robot service where localization of an entity is required. Here, a robot in service needs to obtain the location of a cellular phone, utilizing information from various robotic entities in the environment. These robotic entities have the ability to estimate the location of the entities within their sensing range. Thus, the problem here is to aggregate the location estimations from the robotic entities, and to localize the cellular phone in target. Here, three major issues arise.

- The location information provided by the robotic entities may be incomplete information. For example, Cam2 in figure 1 provides only 2D information for the entities within its sensing range. This location information shall be compensated by responses from other robotic entities, in order to make 3D location information required for the robotic service.

- The location information provided by the robotic entities may be based on the local coordinate system of each robotic entity. In order to aggregate these responses, the provided location information needs to be translated into some common coordinate system, such as the global coordinate system or the local coordinate system of the robot in service.

- The ID information in the location information provided by the robotic entities may be based on the local ID system of each robotic entity. In order to aggregate these responses, the provided ID information needs to be translated into some common ID system, such as the global ID system or the local ID system of the robot in service.

The LS shall hold the functionality to provide a solution to the above issues. Figure 2 illustrates an example structure of LS. In this example, the LS is composed of the following three functionalities:

- An interface for accepting requests and for publishing localization results. For example, an application can send a request to the LS asking for the current location of a robot and then the LS responds to the request via a predetermined interface protocol. Also, the LS can publish its localization result to applications even if there were no request from them.

- A *Localizing Object* is an actual localization component which finds locations of physical entities by converting raw data from localization sensor(s) into specific location information. Each individual Localizing Object embodies a specific localization algorithm as well as input and output interfaces to take sensor data and provide a localization result.

- A *Location Aggregator* is a means to aggregate various location data from Localizing Objects to produce an integrated response to applications. Location Aggregator in Figure 2 realizes the process of combining multiple location data from each Localizing Object into a single location in a synergistic manner.

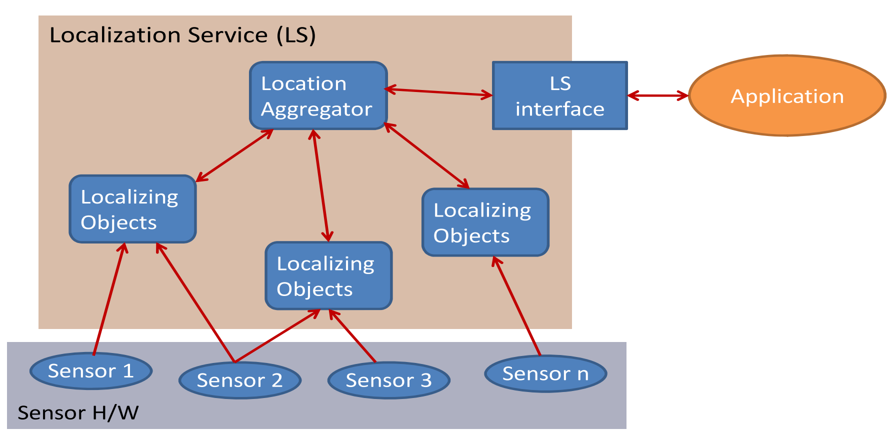

Figure 2 An Example of Localization Service Implementation Structure

6.2 Scope of Proposals Sought

This RFP seeks proposals that specify a localization service, on top of which various robotic applications are developed.

It is necessary to consider the followings in the specification of the localization service (LS).

(1) The LS specification must be general enough to incorporate various localization sensors and algorithms.

(2) The LS specification should provide the data representation for its external application interface as well as its internal functionalities.

- The data representation may include elements for specifying location such as location format, coordinate system, measurement unit, etc.
- The location format may include auxiliary information, such as identification, time stamp, error estimate, etc.

(3) The LS specification should satisfy interoperability and reusability, such by providing common interfaces and common data formats. A LS implemented by one vendor should be able to be replaced with LSs provided by other vendors with little efforts.

(4) The LS specification should provide a minimum set of functionalities to satisfy the following:

- Providing an interface for accepting requests and for publishing localization results.
- Providing means for initialization of the LS and for adjustment of the localization result.
- Providing a mean for specifying the data format, such as the coordinate system for the location data, the identification system for the identification data, or the format for the error data.
- Providing an interface for accepting location information translation requests and publishing the results.

(5) Real-time operations are especially important for the LS. The LS specification should be able to demonstrate its real-time support.

6.3 Relationship to Existing OMG Specifications

Submitters should examine the following OMG specifications for possible benefit:

- Platform Independent Model (PIM) and Platform Specific Model (PSM) for super Distributed Objects (SDO) Specification version 1.0 [formal/2004-11-01]
- Unified Modeling Language: Infrastructure version 2.1.1 [formal/07-02-06]
- Unified Modeling Language: Superstructure version 2.1.1 [formal/07-02-05]
- CORBA Component Model V4.0 [formal/2006-04-01]
- Robotic Technology Component specification version 1.0 [ptc/06-11-07]
- OMG Systems Modeling Language (SysML) specification version 1.0 [ptc/07-02-04]
- Smart Transducers Interface specification version 1.0 [formal/03-01-01]
- Data Distribution Service for Real-time Systems specification version 1.2 [formal/2007-01-01]
- Data Acquisition from Industrial Systems (DAIS) specification version 1.1 [formal/2005-06-01]
- Historical Data Acquisition from Industrial Systems (HDAIS) specification version 1.0 [formal/2005-06-02]
- Distributed Simulation System specification version 2.0 [mfg/2001-10-01]

6.4 Related Activities, Documents and Standards

Proposals may include existing systems, documents, URLS, and standards that are relevant to the problems discussed in this RFP. They can be used as background information for the proposal.

Example:

- IEEE Robotics and Automation Society, Technical Committee on Network Robot
- IEEE Robotics and Automation Society, Technical Committee on Programming Environment in Robotics and Automation
- SAE AS-4 Unmanned Systems Committee or JAUS: Joint Architecture for Unmanned Systems, *http://www.jauswg.org/*
- URC (Ubiquitous Robotic Companion) Project
- URS (Ubiquitous Robotic Space) Project
- NRF (Network Robot Forum), *http://www.scat.or.jp/nrf/*
- OGC (Open Geospatial Consortium): OpenGIS Location Service (OpenLS) Implementation Specification: Core service [IS/05-016]
- ISO/ TC 211 Geographic Information/Geomatics : ISO 19116:2004 Geographic Information – Positioning Service
- ISO/TC 211 Geographic Information/Geomatics : ISO 19111:2004 Geographic information – Spatial referencing by coordinates

6.5 Mandatory Requirements

Proposals shall provide a Platform Independent Model (PIM) and at least one CORBA-specific model of Localization Service (LS) or C++ -specific model of LS. The models shall meet the following requirements.

1. Proposals shall specify a general mechanism for accessing location information of physical entities to be localized.
    - Proposals shall specify a set of data and/or their structures necessary to represent location information of entities.
    - Proposals shall specify a set of methods and/or their parameters to access location information of entities.
2. Proposals shall specify interfaces for modules that perform location calculation.

- Proposals shall specify the interface for accepting localization request.
- Proposals shall specify the interface for publishing the localization result.

3. Proposals shall specify the interface of a facility that provides functionalities related to:

   - Conversion of location information from one coordinate system to another.
   - Aggregation of multiple location information outputs into one final location.

6.6 Optional Requirements

Proposals may specify interfaces for the functionalities listed below.

- Advertising what types of entities can be localized and/or what entities are being localized.
- Advertising what kind of sensor data can be used and/or what sensors are used.
- Incorporating additional information for localization or aggregation, such as for notifying the LS about some entities that moved in/out of its range.
- Managing the different coordinate systems and frames defined in a robotic system, as well as their physical relationship.
- Managing the instances of *Localizing Object* or *Localization Service* present in the robotic system.
- Controlling the internal parameters for the location fusion algorithms used in aggregating locations. With this interface, the algorithm used for location aggregation can be implemented as a module. In this way, developers can easily exchange this algorithm module by modules with other algorithms when necessary.

6.7 Issues to be discussed

These issues will be considered during submission evaluation. They should not be part of the proposed normative specification. (Place them in Part I of the submission.)

- Proposals shall demonstrate its feasibility by using a specific application based on the proposed model.
- Proposals shall demonstrate its applicability to existing technology such as RTLS (Real-Time Location System).
- Proposals shall discuss simplicity of implementation.
- Proposals shall discuss the possibility to apply the proposed model to other existing fields/projects of interest that utilize location information, such as "Sensor Network Project" [SensorNet].
- Proposals shall discuss the possibility of providing standard mechanism to access map data.
- Proposals shall discuss their relation and dependency to existing communication protocols or middleware standards, such as CORBA [CORBA] or DDS [DDS].

6.8 Evaluation Criteria

Proposals will be evaluated in terms of consistency in their specifications, feasibility and versatility across a wide range of different robot applications.

6.9 Other information unique to this RFP

None

6.10 RFP Timetable

The timetable for this RFP is given below. Note that the TF or its parent TC may, in certain circumstances, extend deadlines while the RFP is running, or may elect to have more than one Revised Submission step. The latest timetable can always be found at the OMG *Work In Progress* page at http://www.omg.org/schedules/ under the item identified by the name of this RFP. Note that "<month>" and "<approximate month>" is the name of the month spelled out; e.g., January.

Event or Activity	Actual Date
Preparation of RFP by TF	*June 1, 2007*
RFP placed on OMG document server	*June 4, 2007*
Approval of RFP by Architecture Board *Review by TC*	*June 28, 2007*
TC votes to issue RFP	*June 29, 2007*

LOI to submit to RFP due	*September 15, 2007*
Initial Submissions due and placed on OMG document server ("Four week rule")	*November 12, 2007*
Voter registration closes	*December 3, 2007*
Initial Submission presentations	*December 10, 2007*
Preliminary evaluation by TF	
Revised Submissions due and placed on OMG document server ("Four week rule")	*May 26,2008*
Revised Submission presentations	*June 23, 2008*
Final evaluation and selection by TF *Recommendation to AB and TC*	
Approval by Architecture Board *Review by TC*	
TC votes to recommend specification	*September 26, 2008*
BoD votes to adopt specification	*December, 2008*

Appendix A References and Glossary Specific to this RFP

A.1 References Specific to this RFP

[DDS] Data Distribution Service for Real-time Systems Specification, http://www.omg.org/technology/documents/formal/data_distribution.htm

[IS/05-016] OGC (Open Geospatial Consortium): OpenGIS Location Service (OpenLS) Implementation Specification: Core service, http://www.opengeospatial.org/standards/olscore

[SensorNet] UNS (Ubiquitous Network Society) Sensor Network Project, http://www.ubiquitous-forum.jp/

A.2 Glossary Specific to this RFP

None

Appendix B General Reference and Glossary

B.1 General References

The following documents are referenced in this document:

[ATC] Air Traffic Control Specification, *http://www.omg.org/technology/documents/formal/air_traffic_control.htm*

[BCQ] OMG Board of Directors Business Committee Questionnaire, *http://www.omg.org/cgi-bin/doc?bc/02-02-01*

[CCM] CORBA Core Components Specification, *http://www.omg.org/technology/documents/formal/components.htm*

[CORBA] Common Object Request Broker Architecture (CORBA/IIOP), *http://www.omg.org/technology/documents/formal/corba_iiop.htm*

[CSIV2] [CORBA] Chapter 26

[CWM] Common Warehouse Metamodel Specification, *http://www.omg.org/technology/documents/formal/cwm.htm*

[DAIS] Data Acquisition from Industrial Systems, *http://www.omg.org/technology/documents/formal/dais.htm*

[EDOC] UML Profile for EDOC Specification, *http://www.omg.org/techprocess/meetings/schedule/UML_Profile_for_EDOC_FTF.html*

[EJB] "Enterprise JavaBeans™", *http://java.sun.com/products/ejb/docs.html*

[FORMS] "ISO PAS Compatible Submission Template". *http://www.omg.org/cgi-bin/doc?pas/2003-08-02*

[GE] Gene Expression, *http://www.omg.org/technology/documents/formal/gene_expression.htm*

[GLS] General Ledger Specification , *http://www.omg.org/technology/documents/formal/gen_ledger.htm*

[Guide] The OMG Hitchhiker's Guide,, *http://www.omg.org/cgi-bin/doc?hh*

[IDL] ISO/IEC 14750 also see [CORBA] Chapter 3.

[IDLC++] IDL to C++ Language Mapping, *http://www.omg.org/technology/documents/formal/c++.htm*

[MDAa] OMG Architecture Board, "Model Driven Architecture - A Technical Perspective*", http://www.omg.org/mda/papers.htm*

[MDAb] "Developing in OMG's Model Driven Architecture (MDA)," *http://www.omg.org/docs/omg/01-12-01.pdf*

[MDAc] "MDA Guide" (*http://www.omg.org/docs/omg/03-06-01.pdf*)

[MDAd] "MDA "The Architecture of Choice for a Changing World™"", *http://www.omg.org/mda*

[MOF] Meta Object Facility Specification, *http://www.omg.org/technology/documents/formal/mof.htm*

[MQS] "MQSeries Primer", *http://www.redbooks.ibm.com/redpapers/pdfs/redp0021.pdf*

[NS] Naming Service, *http://www.omg.org/technology/documents/formal/naming_service.htm*

[OMA] "Object Management Architecture™", *http://www.omg.org/oma/*

[OTS] Transaction Service, *http://www.omg.org/technology/documents/formal/transaction_service.htm*

[P&P] Policies and Procedures of the OMG Technical Process*, http://www.omg.org/cgi-bin/doc?pp*

[PIDS] Personal Identification Service, *http://www.omg.org/technology/documents/formal/person_identification_service.htm*

[RAD] Resource Access Decision Facility, *http://www.omg.org/technology/documents/formal/resource_access_decision.htm*

[RFC2119] IETF Best Practices: Key words for use in RFCs to Indicate Requirement Levels, (*http://www.ietf.org/rfc/rfc2119.txt*).

[RM-ODP] ISO/IEC 10746

[SEC] CORBA Security Service, *http://www.omg.org/technology/documents/formal/security_service.htm*

[TOS] Trading Object Service, *http://www.omg.org/technology/documents/formal/trading_object_service.htm*

[UML] Unified Modeling Language Specification, *http://www.omg.org/technology/documents/formal/uml.htm*

[UMLC] UML Profile for CORBA, *http://www.omg.org/technology/documents/formal/profile_corba.htm*

[XMI] XML Metadata Interchange Specification, *http://www.omg.org/technology/documents/formal/xmi.htm*

[XML/Value] XML Value Type Specification, *http://www.omg.org/technology/documents/formal/xmlvalue.htm*

B.2 General Glossary

Architecture Board (AB) - The OMG plenary that is responsible for ensuring the technical merit and MDA-compliance of RFPs and their submissions.

Board of Directors (BoD) - The OMG body that is responsible for adopting technology.

Common Object Request Broker Architecture (CORBA) - An OMG distributed computing platform specification that is independent of implementation languages.

Common Warehouse Metamodel (CWM) - An OMG specification for data repository integration.

CORBA Component Model (CCM) - An OMG specification for an implementation language independent distributed component model.

Interface Definition Language (IDL) - An OMG and ISO standard language for specifying interfaces and associated data structures.

Letter of Intent (LOI) - A letter submitted to the OMG BoD's Business Committee signed by an officer of an organization signifying its intent to respond to the RFP and confirming the organization's willingness to comply with OMG's terms and conditions, and commercial availability requirements.

Mapping - Specification of a mechanism for transforming the elements of a model conforming to a particular metamodel into elements of another model that conforms to another (possibly the same) metamodel.

Metadata - Data that represents models. For example, a UML model; a CORBA object model expressed in IDL; and a relational database schema expressed using CWM.

Metamodel - A model of models.

Meta Object Facility (MOF) - An OMG standard, closely related to UML, that enables metadata management and language definition.

Model - A formal specification of the function, structure and/or behavior of an application or system.

Model Driven Architecture (MDA) - An approach to IT system specification that separates the specification of functionality from the specification of the implementation of that functionality on a specific technology platform.

Normative – Provisions that one must conform to in order to claim compliance with the standard. (as opposed to non-normative or informative which is explanatory material that is included in order to assist in understanding the standard and does not contain any provisions that must be conformed to in order to claim compliance).

Normative Reference – References that contain provisions that one must conform to in order to claim compliance with the standard that contains said normative reference.

Platform - A set of subsystems/technologies that provide a coherent set of functionality through interfaces and specified usage patterns that any subsystem that depends on the platform can use without concern for the details of how the functionality provided by the platform is implemented.

Platform Independent Model (PIM) - A model of a subsystem that contains no information specific to the platform, or the technology that is used to realize it.

Platform Specific Model (PSM) - A model of a subsystem that includes information about the specific technology that is used in the realization of it on a specific platform, and hence possibly contains elements that are specific to the platform.

Request for Information (RFI) - A general request to industry, academia, and any other interested parties to submit information about a particular technology area to one of the OMG's Technology Committee subgroups.

Request for Proposal (RFP) - A document requesting OMG members to submit proposals to the OMG's Technology Committee. Such proposals must be received by a certain deadline and are evaluated by the issuing task force.

Task Force (TF) - The OMG Technology Committee subgroup responsible for issuing a RFP and evaluating submission(s).

Technology Committee (TC) - The body responsible for recommending technologies for adoption to the BoD. There are two TCs in OMG – *Platform TC* (PTC), that focuses on IT and modeling infrastructure related standards; and *Domain TC* (DTC), that focus on domain specific standards.

Unified Modeling Language (UML) - An OMG standard language for specifying the structure and behavior of systems. The standard defines an abstract syntax and a graphical concrete syntax.

UML Profile - A standardized set of extensions and constraints that tailors UML to particular use.

XML Metadata Interchange (XMI) - An OMG standard that facilitates interchange of models via XML documents.

Robotics-DTF

Date: Friday, 29th June, 2007
Chair: Tetsuo Kotoku, YunKoo Chung, Hung Pham
Group URL: http://robotics.omg.org/
Group email: robotics@omg.org

➢Highlights from this Meeting:

Robotics Seminar(Mon., PM, 6 Talks + Panel Discussion, 40 participants)

- **RoSta: A comparative evaluation of robotic software systems: A case study (Azamat Shakhimardanov and Erwin Prassler, RoSTA)**
- **Why Do We Need Standardization of Robot Technology? (Masayoshi Yokomachi, NEDO)**
- **Robotics DTF and Robotic Technology Component (Rick Warren, RTI)**
- **OpenRTM-aist: A reference Implementation of the Robotic Technology Component Specification (Tetsuo Kotoku, AIST)**
- **Korean Thrust for Intelligent Service Robot Standards (Sukhan Lee)**
- **Implementation and Application of URC and its standardization (Hyun Kim, ETRI)**

Robotics/SDO Joint Plenary: (29 participants)

- Robotic Localization Service RFP recommended for issuance
- 2 WG Reports [Service WG, Profile WG]
- 2 Interesting Talks
  - CANopen introduction (Holger Zeltwanger, CiA)
  - Anybot studio - Samsung Network Robot SW Platform (Hyun-Sik Shim, Samsung)

Joint meeting with C4I (Tue.) and ManTIS(Thu.):

- Robotic Localization Service RFP presentation and discussion

Robotics-DTF

Date: Friday, 29th June, 2007
Chair: Tetsuo Kotoku, YunKoo Chung, Hung Pham
Group URL: http://robotics.omg.org/
Group email: robotics@omg.org

➢Deliverables from this Meeting:

- Robotic Localization Service RFP
-

➢Future deliverables (In-Process):

- Human Robot Interaction (HRI) RFP
- Device Abstraction Profile RFP

➢ Next Meeting (Jacksonville):

- Robotic Localization Service RFP (initial submission pre-review)
- Guest presentations
- Roadmap discussion (HRI, Device abstraction Profile)
- Contact reports (ISO/TC184/SC2, KIRSF)