RoboNexus2005

October 6-9, 2005 San Jose Convention Center, San Jose, CA, USA

Conference Session:

- ***Model Driven Architecture (MDA) Software Development in Robotics***
  Jon Siegel, Ph.D., Vice President, Technology Transfer, OMG
  Thursday, October 6, 2005
  < presentation >

- ***Standards on Action: Prototype Robots at Aichi International Exposition 2005***
  Masayoshi Yokomachi, Project Coordinator, New Energy and Industrial Technology Development Organization (NEDO)
  Friday, October 7, 2005
  < presentation >

- ***Standards are Boring***
  Richard Mark Soley, Ph.D., Chairman and CEO, OMG
  Friday, October 7, 2005
  < presentation >

BOF Meeting:

‘ Establishing Standards in Robotics Software’ Sponsored by Object Management Group's Robotics Special Interest Group
Thursday, October 6, 2005 18:00 - 19:30, San Jose Marriott Ballroom III

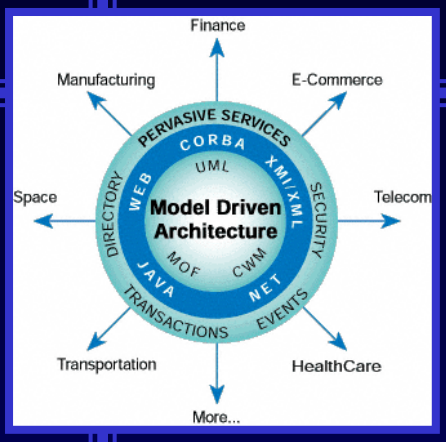
- ***OMG organization, Process, and Role in Standards-Setting***
  Dr. **Jon Siegel** (OMG, Vice President, Technology Transfer)

- ***Why We Need RT Middleware***
  Kazuo Tanie (Tokyo Metropolitan University ; President of IEEE Robotics and Automation Society)
  < presentation >

- ***IT Based Ubiquitous Robotic Companion and Standardization in OMG***
  Yun Koo Chung (Electronics and Telecommunications Research Institute, Korea)
  < presentation >

- ***Candidates of Robotics Standardization Issues in OMG -Request for Information***
  Makoto Mizukawa (Shibaura Institute of Technology; Co-chair, Robotics-DSIG, OMG)
  < presentation >

- ***Basic Framework for Robot Technology Components -Request for Proposal***,
  Tetsuo Kotoku (National Institute of Advanced Industrial Science and Technology (AIST);
  Co-chair of Robotics-DSIG and SDO-DSIG, OMG)
  < presentation >



Model Driven Architecture (MDA) Software Development in Robotics

October, 2005

Jon Siegel, Ph.D.
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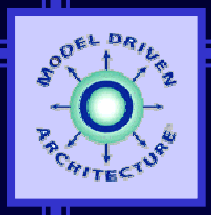
What is OMG?

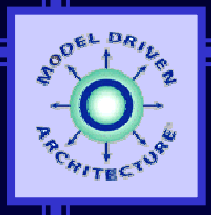
- Object Management Group - 16-year-old not-for-profit Computer Industry Standards Consortium
- Home of UML, the Industry's Modeling Standard
- and the Model Driven Architecture (MDA)
- Open Membership and Adoption Process
  - One-member, One-vote
- Specifications Available Free on our Website
- Buy Implementing Products from Vendors
  - Vendors may be OMG members, or may not
- Over 500 members including Companies, Government Agencies, Universities



Why Focus on Modeling?

Because Modeling is the only way to ensure that enterprise IT systems deliver the functionality that a business requires, comprehensive and stable, yet able to evolve in a controlled manner as business needs change over time.

Object Management Group



Why Focus on Modeling?

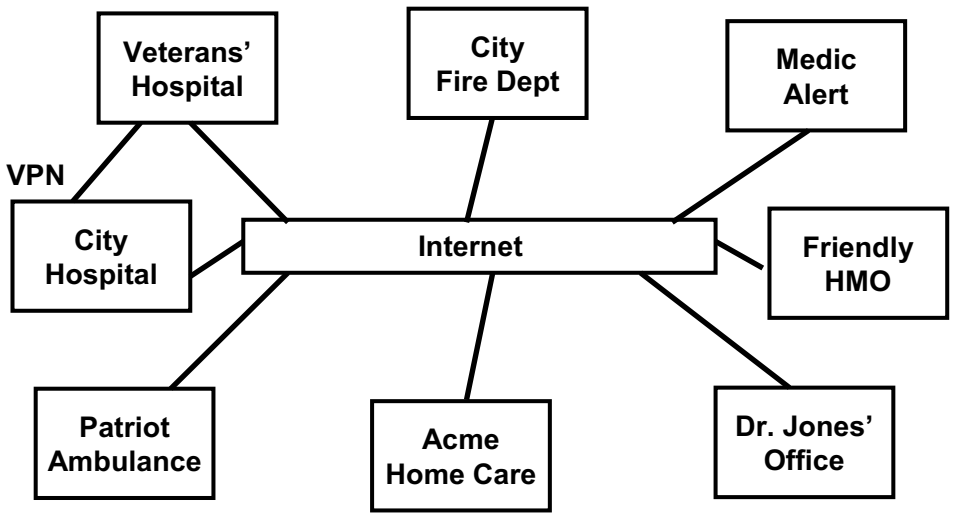
Models built in the Unified Modeling Language (UML) represent exactly what a business application - even a complex, multi-platform integrated application - can do, and record it with a clarity and stability that far exceeds that of the applications themselves.

Why Focus on Modeling?

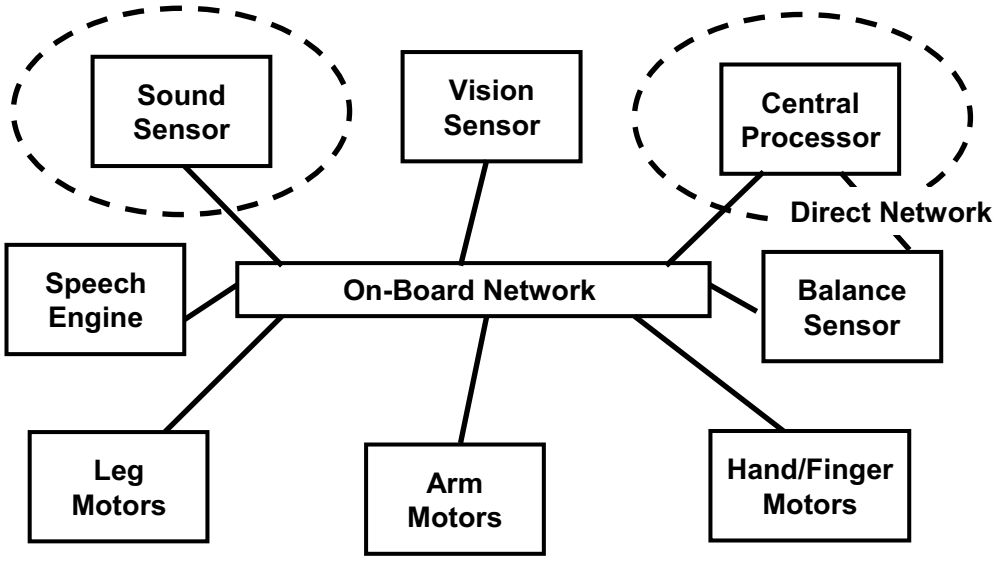
Based on technology-independent representations of their business functionality and behavior, modeled applications last for decades and maximize IT return on investment.

Jon Siegel, OMG: www.sdtimes.com/news/064/special1.htm

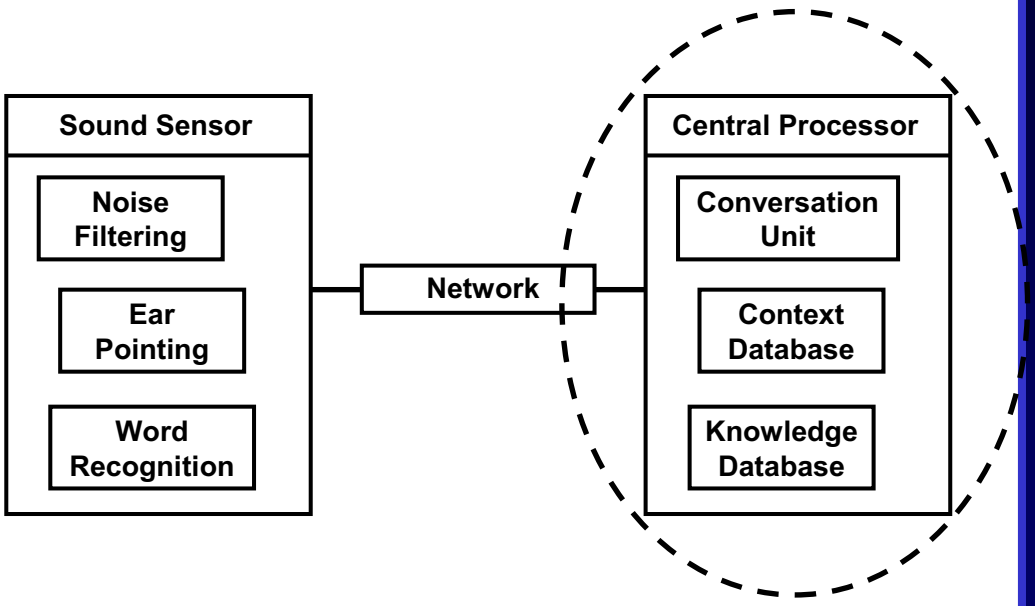
Architectural View



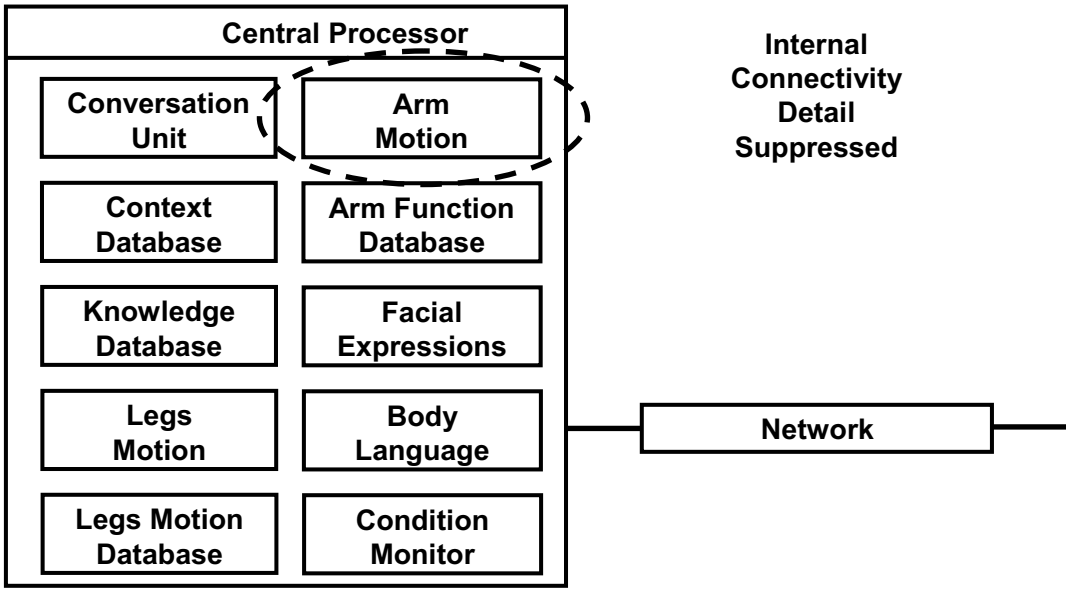
Robotics Version!



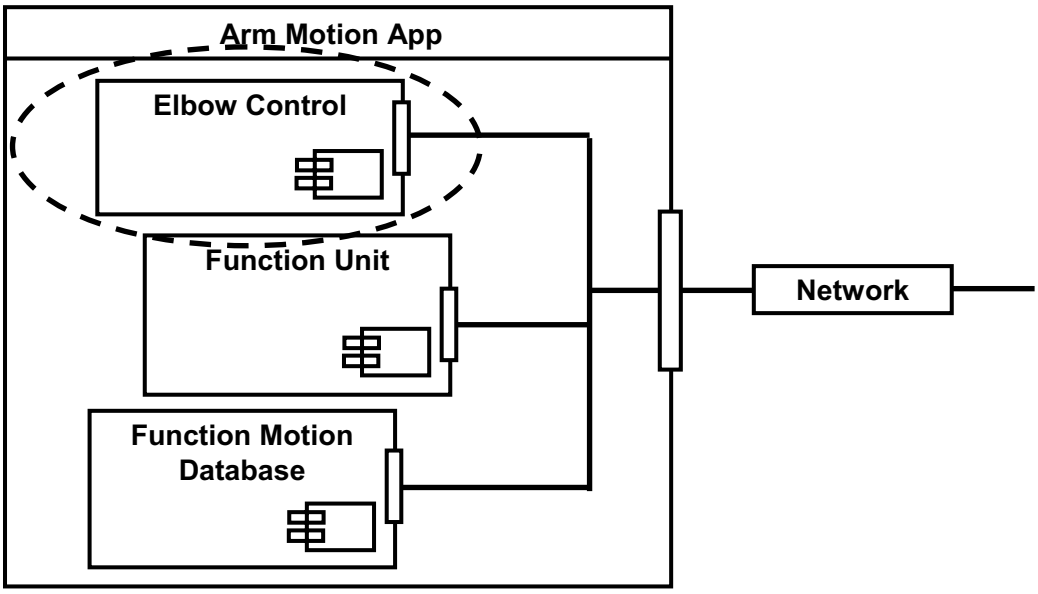
Zoomed In, Still Architectural



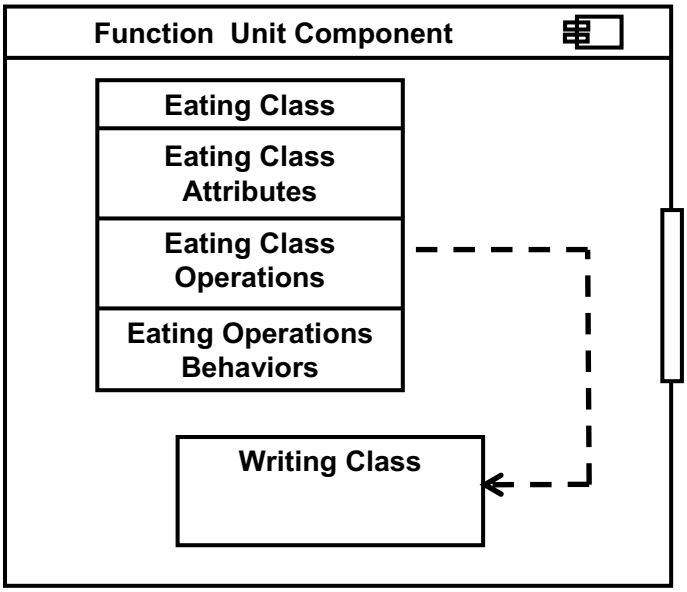
Enterprise Architecture View



Application Model



Component Model



Then MDA *Generates* the application *and its connectivity* from this detailed model

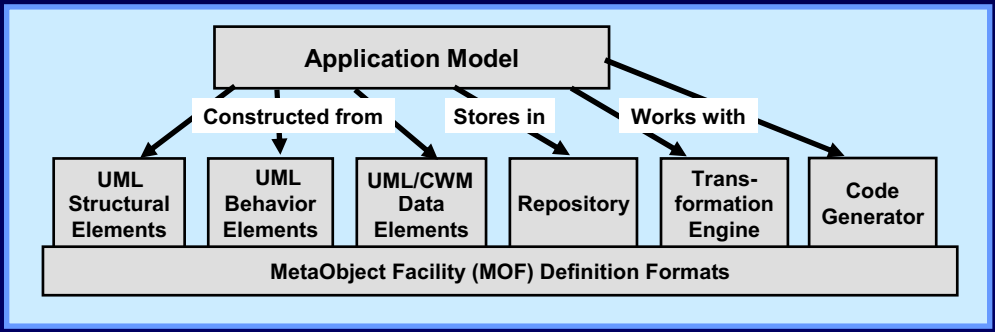
So you know that the application conforms to the model, connectivity works, and changes to any level model work in the real world

OMG Modeling Support

- MOF: Meta-Object Facility 2.0
  - Integrated Repository
  - Standard MetaModel
- Unified Modeling Language UML 2.0
  - World Standard for A&D
  - Representation for Structure, Dynamics, Deployment
- XMI: XML Metadata Interchange
  - Model & MetaModel Interchange
  - XML-Based Format, including DTDs
- CWM: Common Warehouse Metamodel
  - Data Warehousing Integration
  - Record, Table formats; Data Loading & Transformation

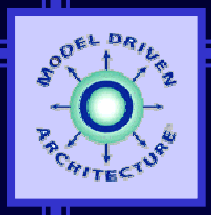
MOF - Foundation for Modeling

- MOF standardizes the basis for the elements that modeling languages define for you to model with
- Based on MOF, all of these diverse model elements can share repositories and interchange models among compliant tools:
  - Interchange of models and metamodels among toolsets
  - UML, MOF Itself, CWM, SPEM, XMI, UML Profiles
- And Especially, MOF supports the MDA!



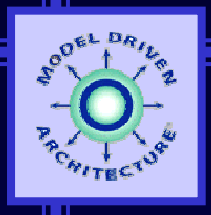
UML – The Modeling Standard

- Integrates all the modeling you need to do
  - Functional and Business Modeling
  - Architectural/Deployment Modeling
  - Application Structure and Behavior
  - Component-Based Applications
  - Classes and Objects
  - Data Structures
  - Behavior, as State Machines, Data and Control Flow, Use Cases, more
  - The Industry Standard for Modeling



Start at Highest Level

- MDA *Raises the Level of Abstraction* with full connection from modeling to development
- Start with an Architectural Viewpoint of all your networked applications, and zoom in to a single application
- Also work from High Level Function and Process Viewpoint
- Then, model Structure and Behavior
- Finally, MDA tools *generate* your applications from your detailed application models

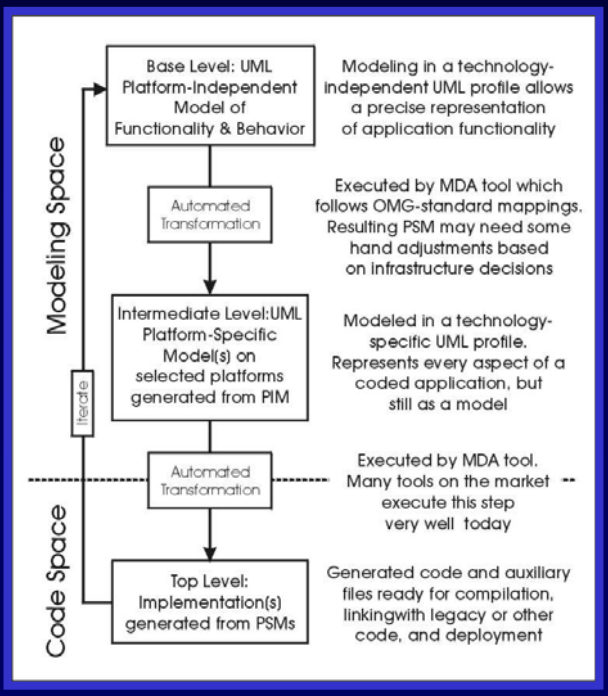


MDA – Two Benefit Areas

- The Design/Functionality Advantages:
  - Architectural Viewpoint brings out how your applications work with each other, and with those on the outside
  - Higher level of abstraction lets you define functionality and behavior separate from implementation
  - Define the Functionality and Behavior of each application as a technology-independent model
  - Focus your IT investment in defining core functionality, not in implementing it
- The Technological Advantages:
  - Interoperability and Portability are built into the MDA
  - MDA speeds development as it concentrates investment on functionality
  - Move easily to the next generation of robotics networking, or interoperate with it, quickly and easily

MDA: Designed for Efficiency

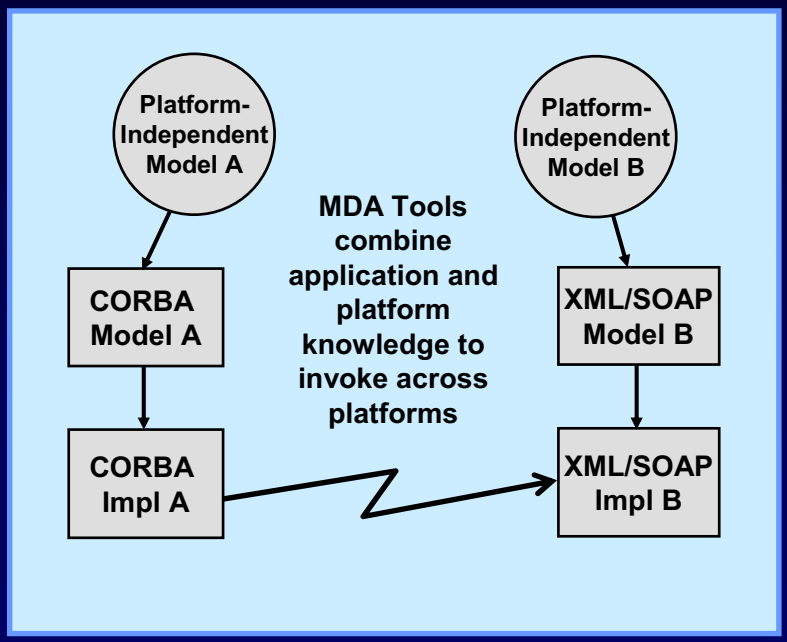
- Structure is a Spectrum progressing from Modeling at the Top to Code development at the bottom



MDA Applications Interoperate

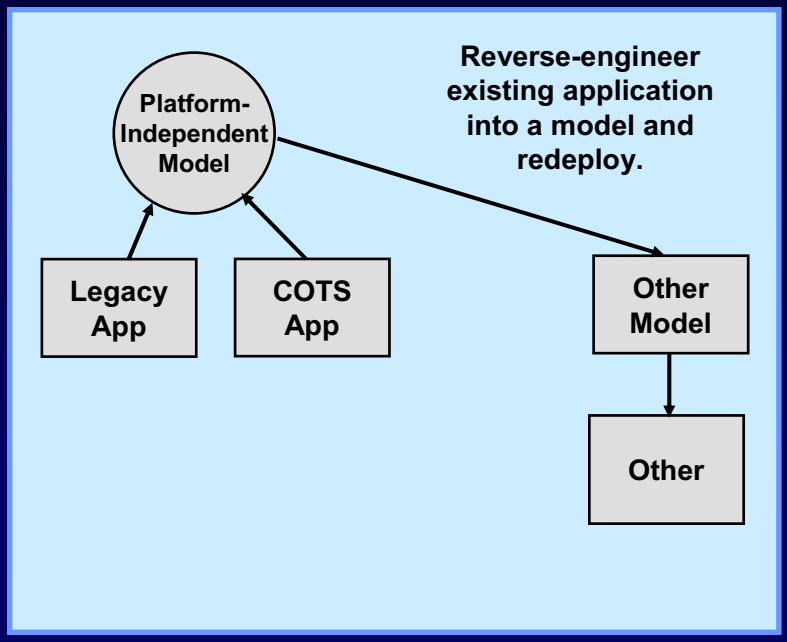
MDA Tools will generate cross-platform invocations connecting either instances of a single MDA application, or one application to another.

Standard *Pervasive Services* – directory, security, more – will also be accessed through cross-platform invocations where necessary.



Integrating Legacy & COTS

Tools for Reverse Engineering automate creation of models for re-integration on new platforms



MDA Specifications

- MDA Architecture (June 2003)
- UML 2.0 (Complete)
- UML Profiles:
  - Profile for EDOC (complete)
  - Profile for EAI (complete)
  - Profile for CORBA (complete)
  - Profile for EJB (JCP, complete)
- Support from XMI, CWM (complete)
- Pervasive Services (coming)
- Domain Specifications

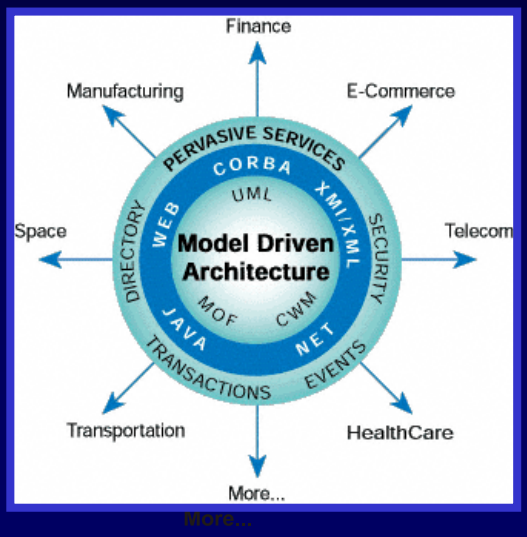
MDA in Industry Standards

OMG (and other) Task Forces standardize Domain (Industry-Specific) Facilities as PIMs.

With implementations on multiple platforms, no technology or platform barriers prevent widespread adoption and use.

Interoperate cross-platform with other standard applications.

Both PIM and set of PSMs and interface code – on *every* mapped platform – become OMG standards.



Robotics Standards at OMG

- OMG members are defining Robotics standards based on the MDA
- Group Leaders include
  - NEDO (New Energy and Industrial Technology Development Organization; www.nedo.go.jp/english)
  - AIST (National Institute of Advanced Industrial Science and Technology; www.aist.go.jp/index_en.html)
  - Members of JARA (Japan Robot Association; /www.jara.jp/e/)
- To get started, members have issued a Request for Information, and a Request for Proposals for their first specification

Robotics RFI

- An RFI may be issued to gather industry requirements and comments at the beginning of an adoption
- Any person or company may respond
- OMG members decide how to proceed, based on input from both inside and outside the organization
- Access the RFI document at www.omg.org/robotics_rfi.htm
- Response deadline is 14 November, 2005

Robotic Technology Components RFP

- First OMG Robotics Standard
- Based on MDA
- Will abstract behavior of Robotics Modules, which may include SW and HW
  - Sensors
  - Actuators
  - More
- Until the first deadline – Dec 15, 2005 – any company may join OMG and participate in writing the specification

OMG Robotics BOF This Evening

- OMG's Robotics SIG will hold a BOF this evening from 6:00 to 7:30
- Come find out what our members are doing in Robotics and how your company can join and participate
- Presentations on OMG process (short!) and Robotics Activity inside OMG and at our member companies
- Please come see us this evening!

OMG: Background

- About 500 member companies; Not-for-profit open-membership specifications consortium.
- Founded April 1989 - Sixteen Years Old
- Small staff (22 full time); no internal development. Representatives in Germany, Japan.
- Home of the Model Driven Architecture and MDA-Based Standards, Maximizing IT ROI by extending software and infrastructure lifetime across technology transitions

Worldwide Scope

Alcatel	Computer Assocs	Fraunhofer Fokus	NEC	Siemens
Artisan	Compuware	HP	NIST	Software AG
BEA Systems	Daimler-Benz AG	Hitachi	Nokia	Sony
Bank of America	Deere & Co.	IBM	Northrup	Sun
Boeing Corp.	EDS	IONA	Oracle	Telelogic
Borland	Ericsson	Lockheed	PrismTech	Thales
BAE Systems	Fair Isaac	MetaMatrix	Raytheon	Unisys
CBOE	Fujitsu	Mitre	Sandia	W3C
Charles Schwab	GCHQ	Motorola	SAP AG	Workflow Mgmt

Meetings, Meetings!

- OMG Specifications are adopted at our meetings
- Held Five times a year in various cities around the USA and the world
- Lasts a week and attracts over 250 people
- Every subgroup meets; up to 30 simultaneous sessions on some days
- Dates, locations on the web at www.omg.org/news/schedule/upcoming.htm
- You're invited to come as an observer! Just let me know (email: info@omg.org)

Adoption Process

- RFI (Request for Information) to establish range of commercially available software.
- RFP (Request for Proposals) to gather explicit descriptions of available software.
- Letters of Intent to establish corporate direction.
- Submissions entered and revised.
- Task Force evaluation & recommendation; simultaneous Business Committee examination.
- Board decision based on TC and BC recommendations.

Availability

Innovative approach for selection of standard interfaces to adopt:

1. OMG adopts & publishes MDA PIMs and PSMs, and Implementation Interface Specifications.
2. Implementations of the Interface Specifications must be available commercially from OMG Platform, Domain, or Contributing member.
3. MDA PIMs and PSMs, and Interface Specifications, are freely available to members and non-members alike.
4. MDA PIMs and PSMs, and Interface Specifications chosen from existing products or prototypes in a competitive selection process.

OMG Links & Contacts

- OMG Homepage:
  - http://www.omg.org
- Download our specifications:
  - http://www.omg.org/specifications
- MDA Central:
  - http://www.omg.org/mda
- MDA Executive overview:
  - http://www.omg.org/mda/executive_overview.htm
- Find out about UML:
  - http://www/omg.org/uml
- Find out about CWM:
  - http://www.omg.org/cwm
- Contact OMG:
  - Email info@omg.org or siegel@omg.org

Standards in Action: Prototype Robots at Aichi International Exposition 2005

～ A 2020 City: Living with Robots ～

MASAYOSHI YOKOMACHI
Project Coordinator
Machinery System Technology Development Dept.
NEDO
(New Energy and Industrial Technology Development Organization)

Background and Concept

【Background】

The New Energy and Industrial Technology Development Organization exhibited a wide variety of robots at Expo 2005 as part of its "Project for the Practical Application of Next-Generation Robots." This project is designed to demonstrate the technology that is expected to find its way into commercial robot applications in generations to come.

【Concept】

Each of the robots to be exhibited is based on the concept that people and robots will coexist in the world of tomorrow, and that robots will become an integral part of our daily lives. For this reason, Expo 2005 represents not only a proving ground for the technology behind the robots as they move closer to commercial reality, but also a place to consider the scope of the relationship between people and robots.

PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

Theme

A 2020 City: Living with Robots

- The demonstration area will show how a city will look like in year 2020, when the current prototype robots will have been put to practical use. The demonstrations will highlight how the robots will be useful in various aspects of life.
- The aim is not to educate the public on specific functionalities of the robots, but to inform how robots can be useful.
- In order to manufacture these life support robots efficiently, the assembly-based robot manufacturing should be realized by standardizing RT middleware in near future.

PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

PROTOTYPE ROBOT EXHIBITION Overview

- The exhibition is one of the two pillars of the Project for the Practical Application of Next-Generation Robots to demonstrate next-generation robots that coexist in harmony with people, as is envisaged for the 21st century.

Project for the Practical Application of Next-Generation Robots

Practical Robots

Robots that have reached the level of practical use in terms of technologies and safety

- Cleaning robots
- Security guard robots
- Childcare robots
- Customer service robots
- Wheelchair robots

Prototype Robot Exhibition

Prototype robots that are expected to be in practical use by around 2020

- Robots that work in shops, factories, hospitals, etc.
- Robots that work in dangerous conditions such as disaster area.
- Robots that work in homes, etc.

PROTOTYPE ROBOT EXHIBITION

PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

Robots to Be Demonstrated

The prototype robots are designed to show Expo 2005 visitors how robots will interact in our daily lives, how we will use them, and what role they will play in the future.

Service Robot (Network Robotics, RT Middleware) 8 Types	Service Robot (Robot for Interaction between Humans and Robot) 7 Types
Outdoor Robot (Skilled Work) 8 Types	Outdoor Robot (Special Environment Work) 10 Types
Medical Welfare Robot 10 Types	Partner Robot 8 Types
Performance Robot 5 Types	Humanoid Robot 9 Types

Total : 65 Types in 8 Categories

PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

So many robots are now in action.

Industrial Robots ➡ Symbiotic Robots in human life

Caddie Robot
Candy-05

Playmate robot
NAGARA-3

Tag-playing robot
ASKA

Woodcutter Robot
WOODY－1

Reconfigurable Robot
with Authoring System

KINSHACHI ROBOT

PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

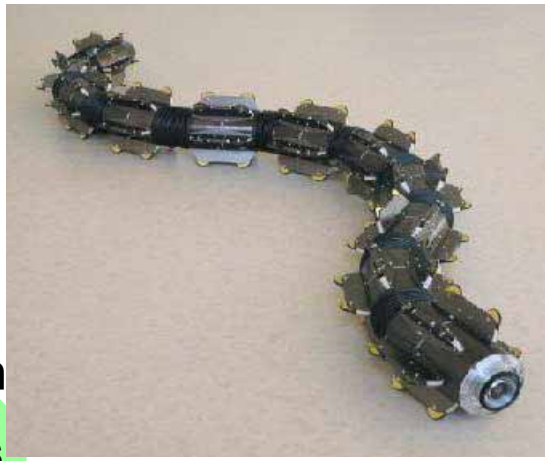
Outdoor Work Robot
(Specific Environment)

Amphibious snake-like robot ACM-R5

This snake-like robot is highly dust-proof and water-proof, and is so resilient that it can adapt itself to the worst possible environment.

*Rescue operation in fallen houses and in the rubbles

*Inspection under water



Tokyo Institute of Technology

PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

Service Robot
(Network Robotics)

ApriAlpha™ with omni-directional auditory function

This robot is equipped with refined hearing ability. When more than one person talk to it, it detects where the voice of each speaker came from and understands what was said.

*Excellent hearing sense that identifies plural voices

*Simultaneously inputs six microphones finds and identifies sounds from all directions

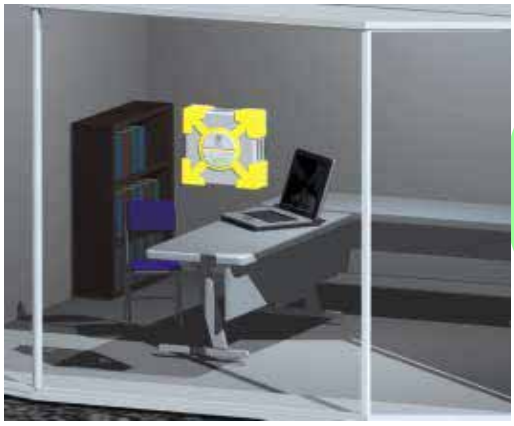
Toshiba Corporation

PROTOTYPE ROBOT EXHIBITION
プロトタイプロボット展

Outdoor Work Robot
(Outdoor Skillful Work)

WallWalker

This cleaning robot climes a wall and freely walks the ceilings just like 21st Century Ninjya.



MIRAIKIKAI Inc., et al.

*Replacement of a person to clean the the building walls and window glasses as well as inspection and maintenance

*Safe and effective operations

PROTOTYPE ROBOT EXHIBITION
プロトタイプロボット展

Service Robot
(Network Robotics)

EMIEW

This communication robot can make versatile and quick movements in accordance with human movements.

Hitachi, Ltd.

*A robot that acts as a workmate

*Operates in symbiosis with people

SmartPal

This wheel-based robot has highly flexible arms just like humans.

Yasukawa Electric Corporation

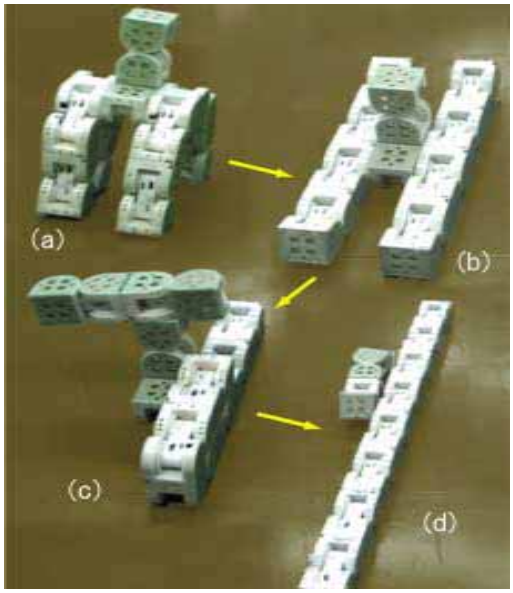
PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

Performance Robot

Modular Transformer (M-TRAN III)

The connections between modules can freely be joined and separated, to transform the robot into various different shapes.

*A wide range of applicability from disaster rescue operations to educational and entertaining uses



National Institute of Advanced Industrial Science and Technology

PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

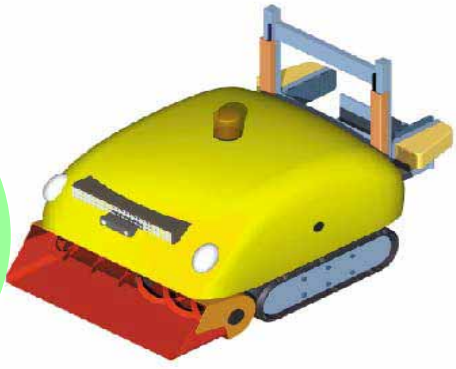
Outdoor Work Robot
(Special Environment)

"Yuki-Taro" the autonomous snowplow

This snow-plow robot supports the lives of those in the areas of heavy snowfalls. It works autonomously, and compresses the snow into blocks as it plows the snow.

*Autonomous movement avoiding obstacles

*Self-location recognition technology using image recognition method combined with high accuracy GPS



Niigata Industrial Creation organization

PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

Humanoid Robot

WABIAN-2

WABIAN-2 is a congregation of sensors and has human-equivalent mobility.

*A humanoid robot that can move identically as a human being will be used for experiments of medical/welfare equipment development.

Waseda University

PROTOTYPE ROBOT EXHIBITION プロトタイプロボット展

Service Robot

Hyper Robot

The distributed robots that together consist the entire room jointly provide the resident (s) various services.

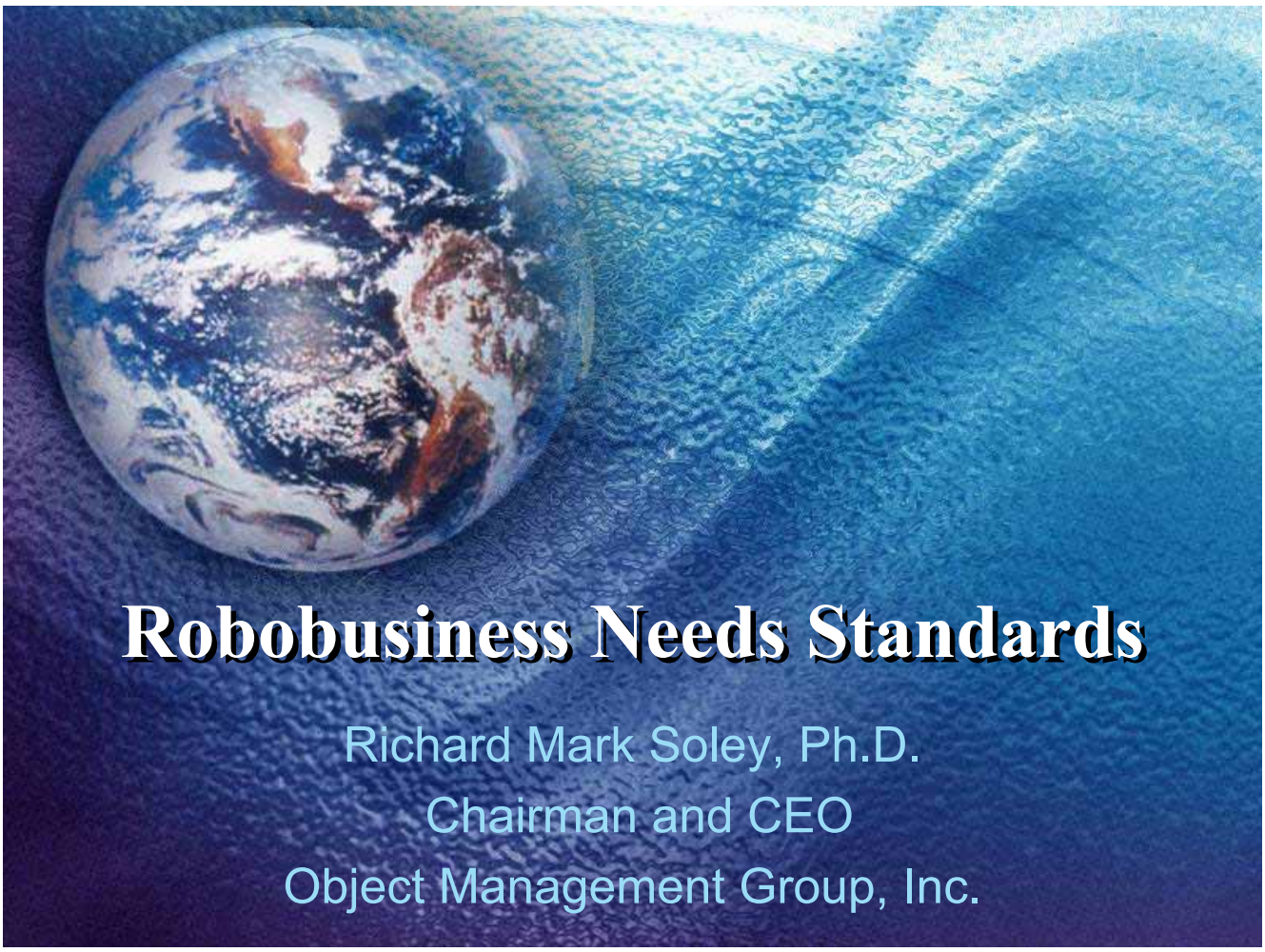
The University of Tokyo

Hyper Robot orders distributed robots to provide service to the users.
*Secretary robot: Projector,PC,Sensing floor
*Servant robot: Ceiling robot, Lighting appliances, Sensing floor
*Friend robot: Humanoid robot
*Pet robot: Plant type robot object

Thank you very much for your attention!!

Please enjoy the succeeding movie.

If you have any question, please send your e_mail to Yokomachimsy@nedo.go.jp
(NEDO)

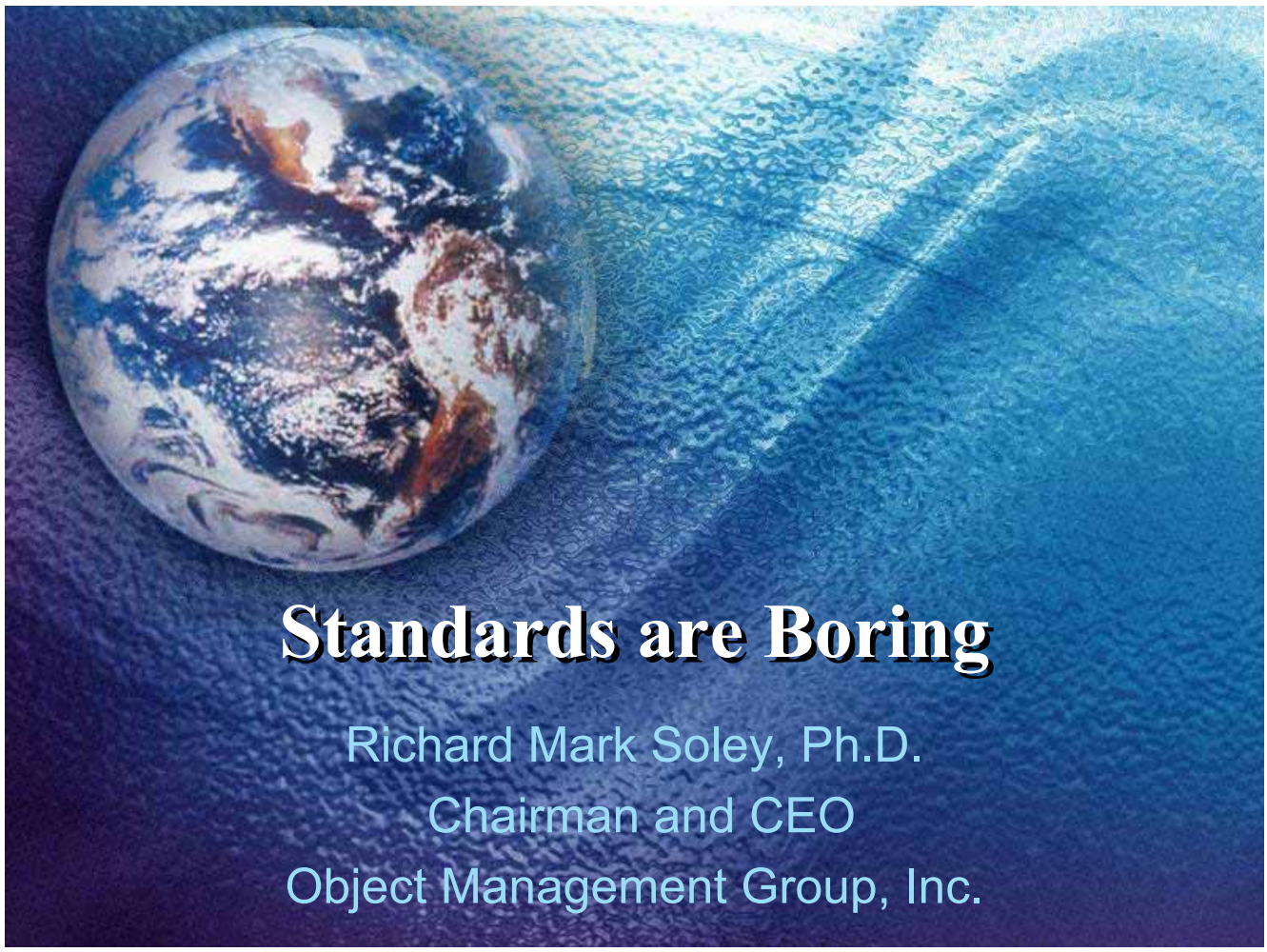


Robobusiness Needs Standards

Richard Mark Soley, Ph.D.
Chairman and CEO
Object Management Group, Inc.

Blah Blah Blah Blah

Blah B. Lah
Really Impressive Title
Some Standards Group, Inc.



Standards are Boring

Richard Mark Soley, Ph.D.
Chairman and CEO
Object Management Group, Inc.

Let's Get Excited!

- The idea of *any* robotics application being able to easily port to *any* robotics platform is exciting
- The idea of *any* robot being able to easily integrate ("interoperate") with *any* other robotics (or non-robotics!) platform is exciting
- The idea of having to design same is not particularly exciting ☺

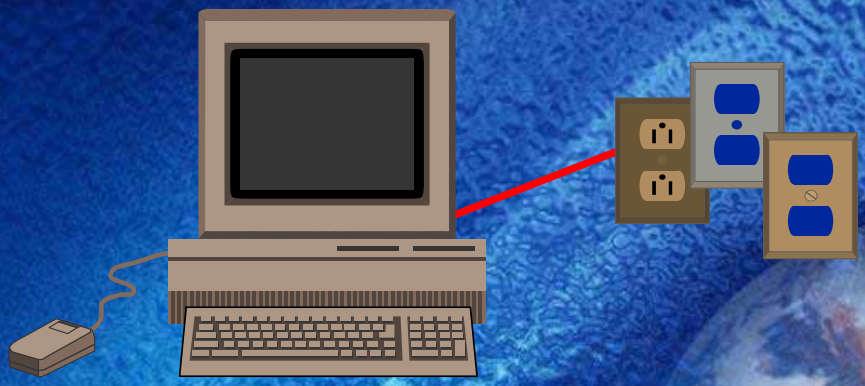
Hollywood Reality

What the public expects: any robot/computer to any other robot/computer

The Real World

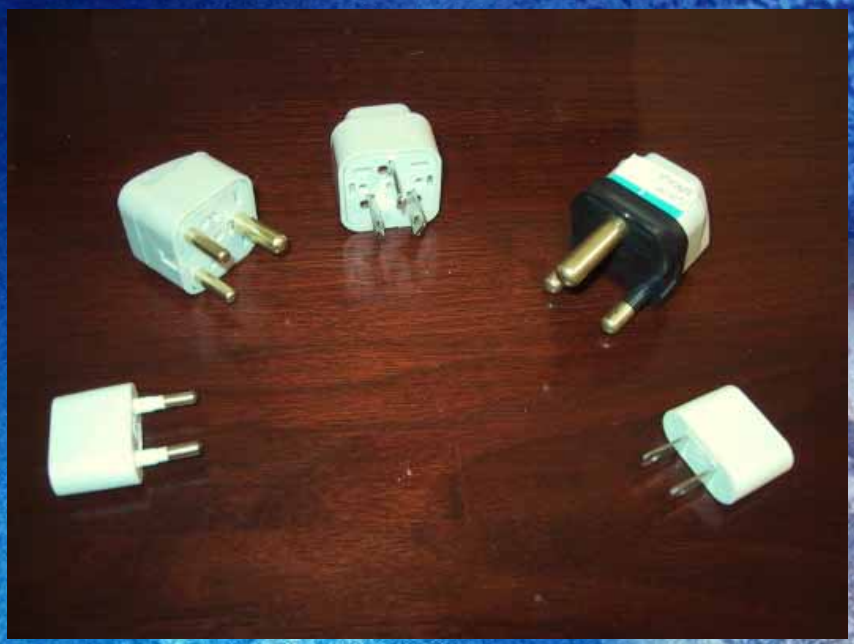
Disconnected islands of data, information, computational power and systems.

OMG's Mission



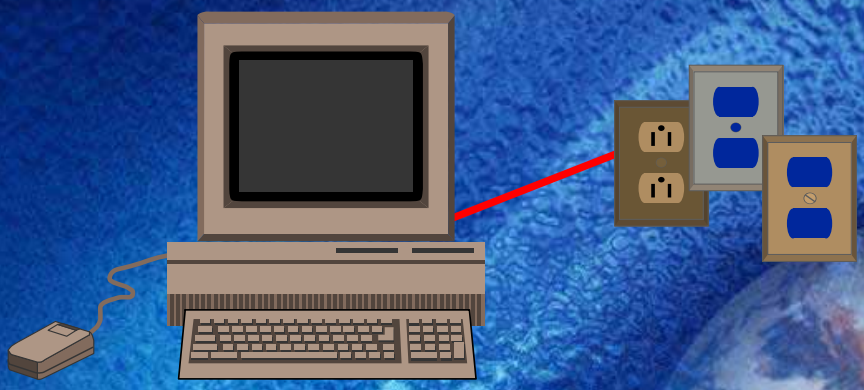
The Global Information Appliance

Not too bad for electrical power



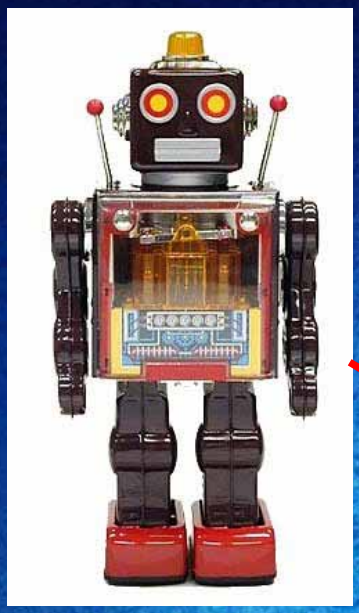
…but a mess for telephony!

OMG's mission…



The Global Information Appliance

…applies to robotics too



Unfortunately, Standards are Boring

Who Cares About Standards?

"The noisiest of those competitive battles will be about standards. The eyes of most sane people tend to glaze over at the very mention of technical standards. But in the computer industry, new standards can be the source of enormous wealth, or the death of corporate empires. With so much at stake, standards arouse violent passions."

The Economist, 27 February 1993

Standards Make a Market

- *Standards = Liquidity* *
- A great OMG example:
  - By 1997, there were literally *dozens* of OO software development methodologies and tools (some decades old); the overall worldwide market was US$30 million
  - In 1997, OMG standardized the Unified Modeling Language (UML); only eight years later the market is about US$4 billion
  - That's pretty good **

* *"The Value of Standards"*, Delphi Group report, June 2003

** The Richard Soley law of a "good" market: anything over 100% CAGR for anything over five years

An Optimist's View

Why worry about standards? Why not just keep doing things the way we've always done them?

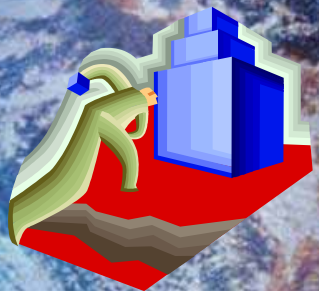
A Pessimist's View

Doing things "the way we have always done them" is often a dangerous plan!

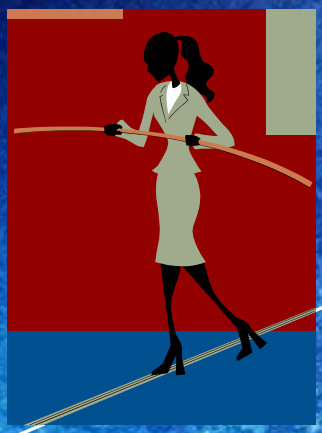
Unfortunately, Standards are Boring

Too Many Choices

- The great thing about standards is that there are so many to choose from
- Not to mention too many standards *organizations* to choose from
  - Gartner reports there are now more than 440 XML standards organizations alone
- In fact, there is a whole host of standards *strategies* to choose from



Standardization is a Tightrope



Wide-open market: fast, but "unfair" and potentially destructive

Legislated: "fair," but slow (and irrelevant)

Everything in Moderation

Where we want to be:

- ✓ encourage innovation
- ✓ empower users
- ✓ support fast-growing markets
- ✓ strongly back competition

Wide-open market: fast, but "unfair" and potentially destructive

Legislated: "fair," but slow (and irrelevant)

Vendors Don't Prioritize Standards

a. Market identification
b. Requirements analysis
c. Product definition
d. Product design
e. Product development
f. Delivery & distribution

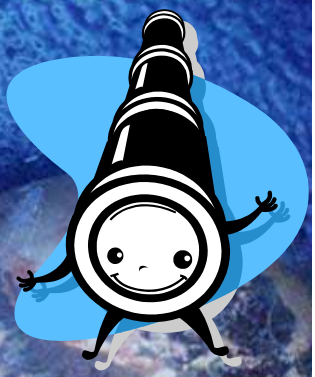
g. and oh yeah, *standards,* shoehorn that in

But Standards Support *Strategy*

- Market identification
  - Leverage a standard? Define a new one?
- Requirements analysis
  - Used with a standard product? Needs to be interoperable or portable?
- Product definition
  - Platform choice influenced by standard?
- Product design
  - Development environment is standard?
- Product development
  - Define a new standard? Build awareness through standards?

Standards *are* Strategic

- Standardization can be expensive and time-consuming, and irrelevant unless they are a component of
  - Strategic planning
  - Marketing
  - Technology decision-making
  - Distribution planning.
- Standards strategy is a key part of the business!



Unfortunately, Standards are Boring

The Standards World is Huge

- International accredited standards bodies
  - ISO, ITU, etc.
- National accredited standards bodies
  - ANSI, DIN, AFNOR, etc.
- Consortia and fora
  - OMG, TOG, TMF, etc.
- Why so many?

Why We Consort

- To push vendors' solution(s)
- To band together end-users against perceived vendor control
- To promote a market
- *To share expertise and develop the best possible solution in the shortest possible time*
- *To rapidly develop multilateral agreements between organizations*

Do Standards Have Problems?

Issues with standardization:

- Commonly perceived to be slow & reactive
  - Internationally accredited standards can take years
- Organizations have a tendency to be national rather than international, and markets are worldwide
  - US-based doesn't necessarily mean US-specific
- IPR policy is *hard*
  - Are patents an *impediment* or a *defensible way to build a market?*
- Users don't get involved
  - Expect portability & interoperability without their involvement, or at least without cost
- … and of course …

Unfortunately, Standards are Boring

"Microsoft isn't boring," said Gates. (USA Today, 30 June 2003)

National vs. International

- There is no longer a “national” marketplace, so involvement of international organizations is critical
  - IBM (a great Paris-based company)
  - ICL (with headquarters in Tokyo)
  - Samsung (a great Silicon Valley firm)

IPR Policy

- No matter what we do, the apple-cart can be upset by an “outsider” to the standardization process…
- …but that’s no excuse for ignoring the issue.
- Organizations that do not offer flexibility in the face of fast-changing IPR will not last.

User Involvement

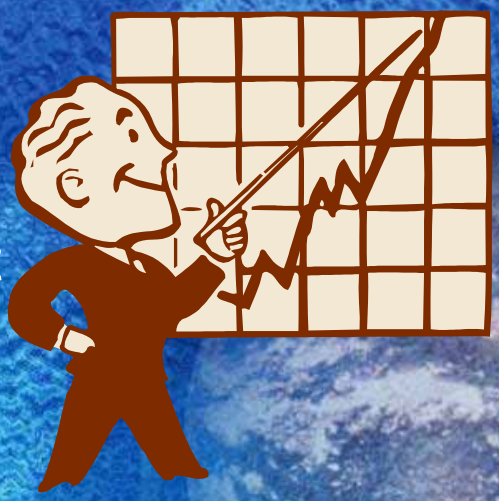
- The cost of standards involvement "upstream" from product choice is far lower than the cost of changing horses midstream
- "Users are indifferent to standards, or take them for granted"
- But user involvement has to be more than up-front requirements management

Key Ideas

- Some other key findings from the Delphi Report on standards
  - Standards will provide the foundation for long term advances in the way software is bulit, bought and deployed
  - The risk of picking the wrong standard will take a back seat to the risk and cost of not integrating
  - The economies introduced by standardization also reduce dramatically the tooling of the workforce
  - Standards and integration are not a luxury

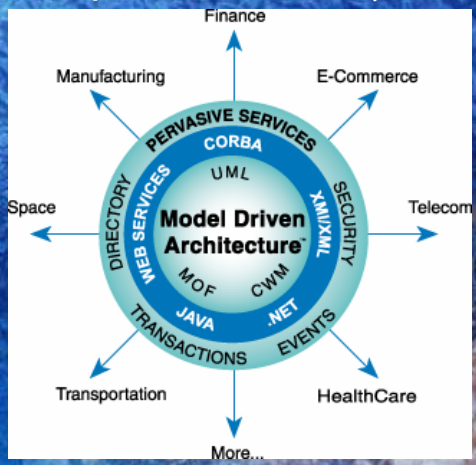
What is the Point?

- Reuse
- Interoperability
- Portability
- Maintainability
- Productivity
- Business Alignment



OMG's Core Technology

- A standardized architecture, MDA that focuses on easily expressed, reusable, agile systems
  - UML, MOF, XMI, CWM
  - Vertical-market standards (domain-specific models) in many areas
- http://www.omg.org/mda/
- Get the fundamentals right
- Focus on the verticals
- Robotics is "vertical"



- More to come tomorrow from Jon Siegel

Standards for Robotics

Don't miss: Walt Weisel, Innova Holdings

From Evolution to Revolution: Service and Personal Robots

Today at 3:15 P.M.

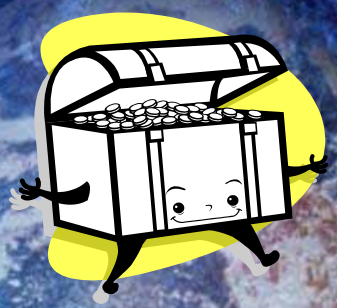
And to finish the thought: Jon Siegel, OMG

Model Driven Architecture Software Development in Robotics

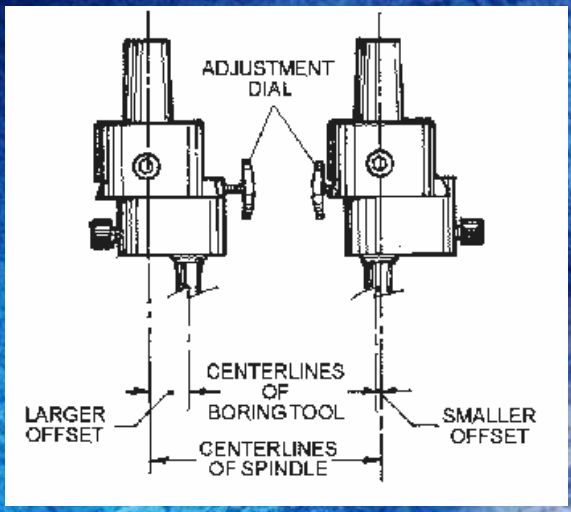
Tomorrow at 1:00 P.M.

Call to Action

- Plan standards participation as part of your business strategy
- Select group participation based on business ROI, well-defined goals and policies
- Don't just join, lead! Even small players can have a huge impact (especially true of end-users)
- Demand interoperability *between the groups*
- Leverage the results in product and marketing strategy
- And never forget, …



Unfortunately, Standards are Boring



Conclusions

- Ask me no questions, I'll tell you no lies:
  - OMG: http://www.omg.org/
  - Robotics Task Force: http://robotics.omg.org/
  - Me: soley@omg.org
  - This presentation: http://www.omg.org/~soley/boring.ppt

Why we need RT middleware?

Kazuo Tanie

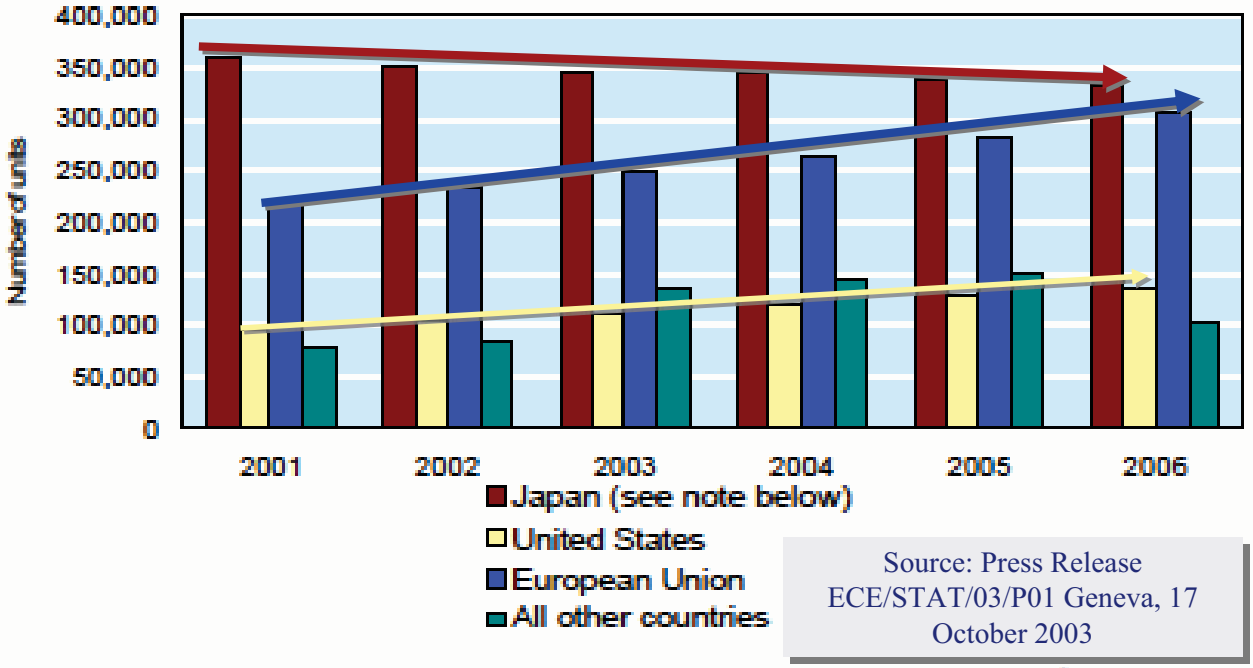
Professor
Tokyo Metropolitan University
Faculty of System Design

President
IEEE RAS

Contents

Industrial Robot

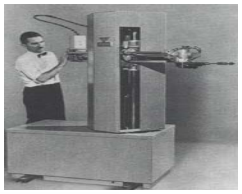
The Number of Industrial Robots used in the World (2003-2006 Predicted Number)

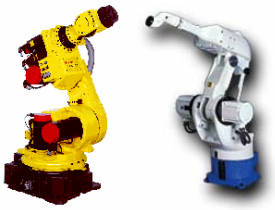


Source: Press Release ECE/STAT/03/P01 Geneva, 17 October 2003

Note 1: Addition to the stock data for Japan included dedicated robots up to and including 2000. Stock data shown here are therefore not fully comparable with those of other countries.

Expanding of Robot Applications
-From Industrial Applications to Non Industrial Applications-





Industrial Robots

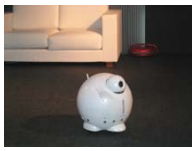
Application Expanding

Rehabilitation and Assistance for Handicapped People

Home Appliances

Guidance and Transportation

Security



Communications

Mental Commit

What is the Problems?

Each user's request is getting personal.

Difficult to identify the good product each user wants to buy?

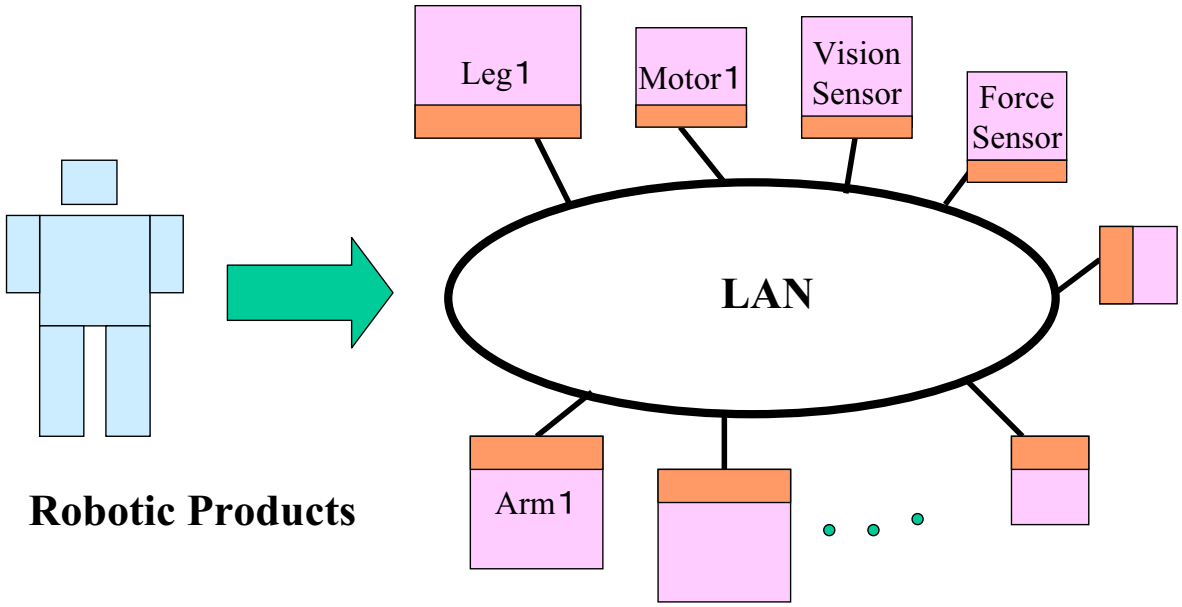
The Problems to be solved!

How to design the new products efficiently and quickly?

How to create a new industrial infrastructure which supports the efficient new product design.

Current New Robotic Product Development

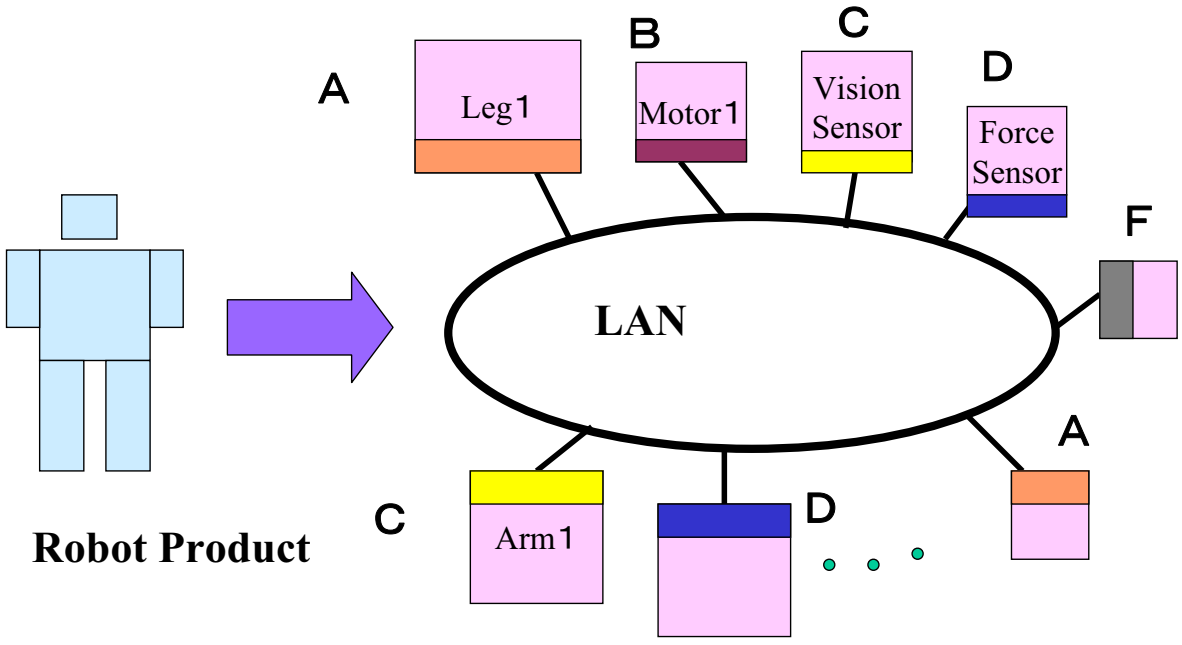
One company will make the whole system!



Software installed

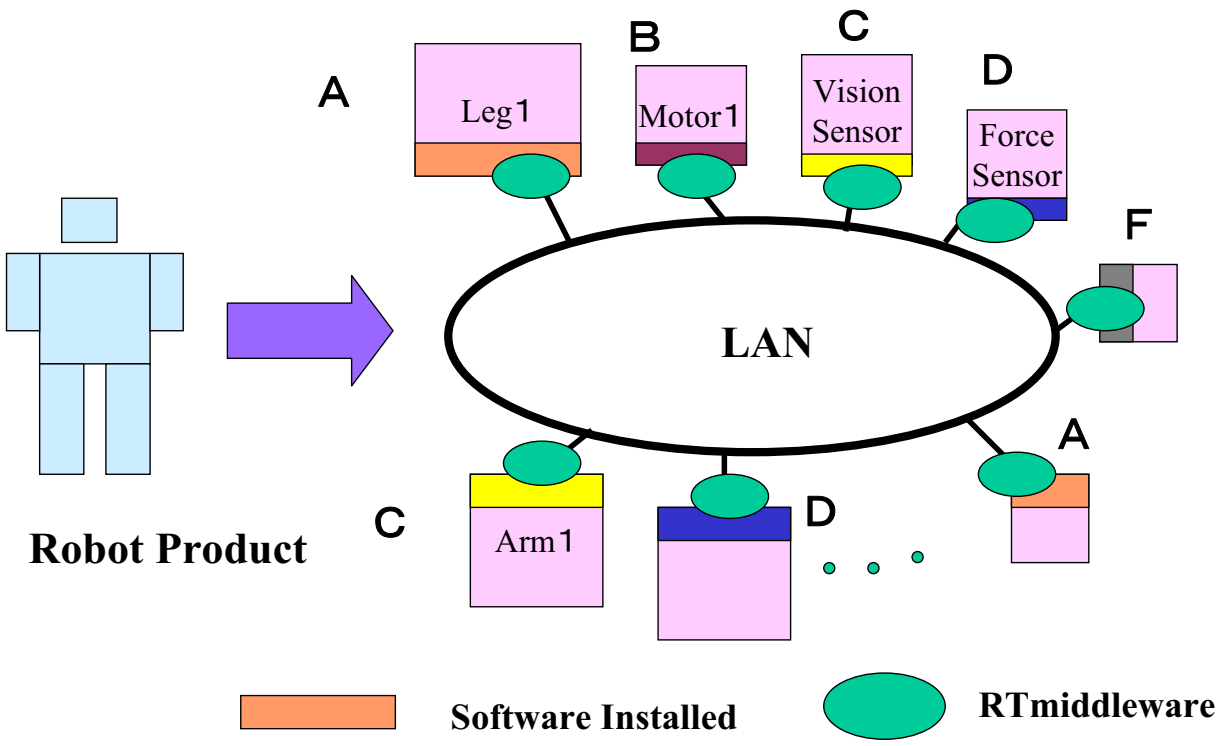
New Robotic Product Development using the components available in the Market

(Product will be made using components manufactured by different companies, A, B…)

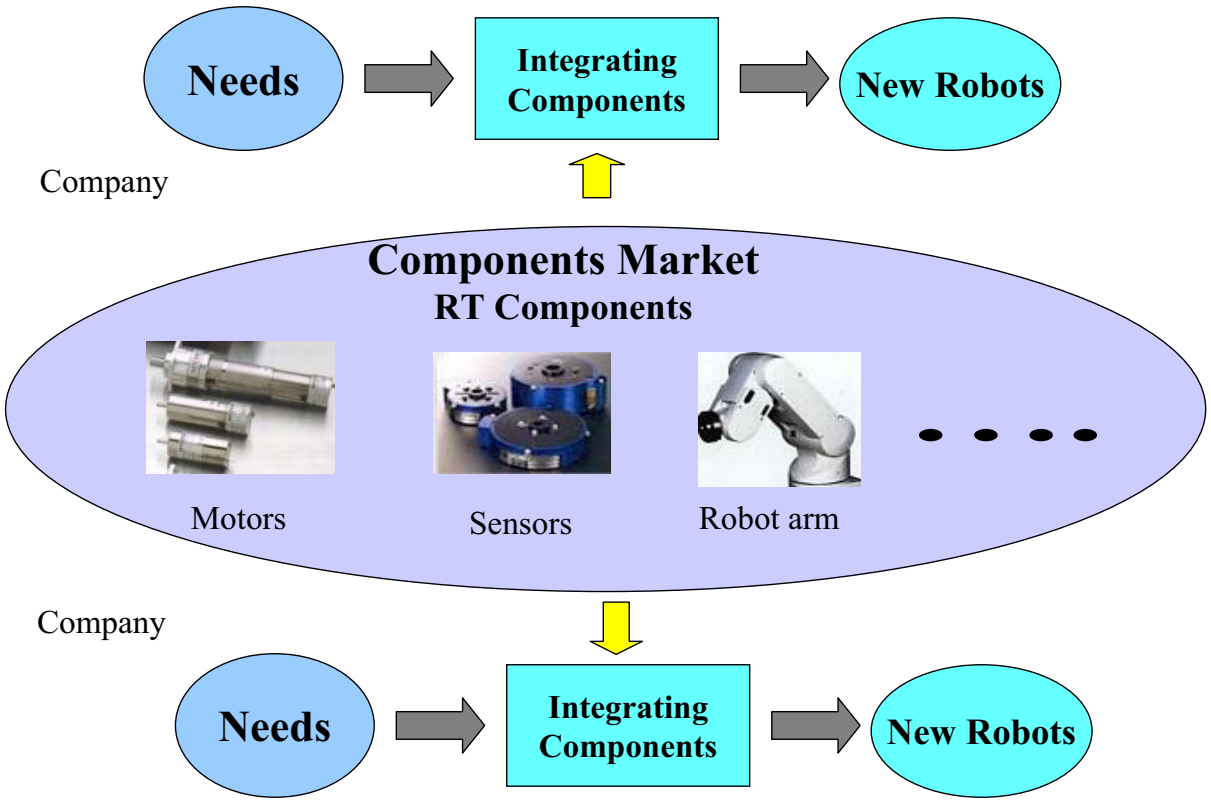


Software installed in computer

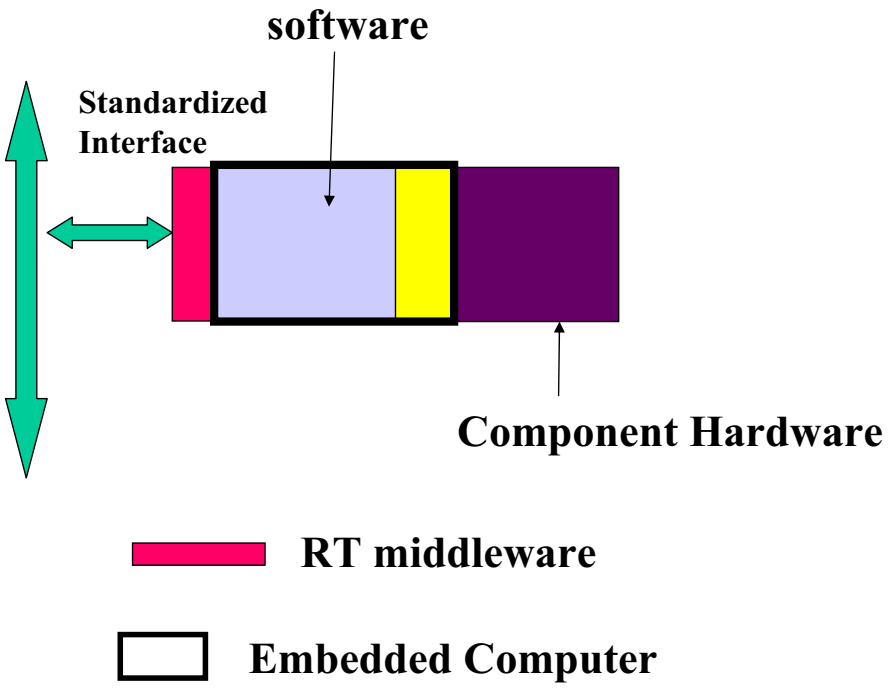
Robot Product Development using RT middle ware



How new robotic products will be produced?

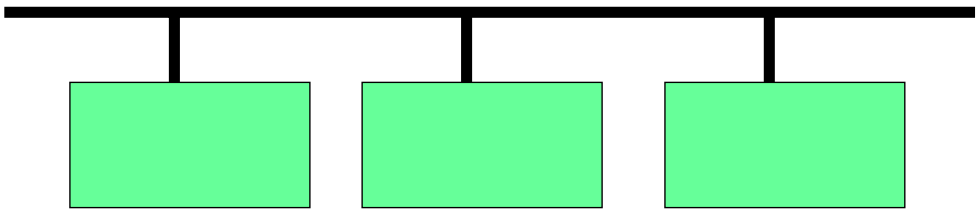


Modularized Component

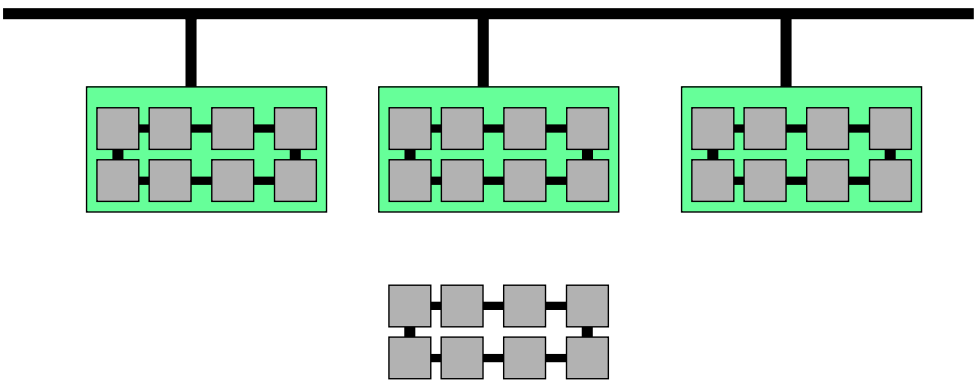


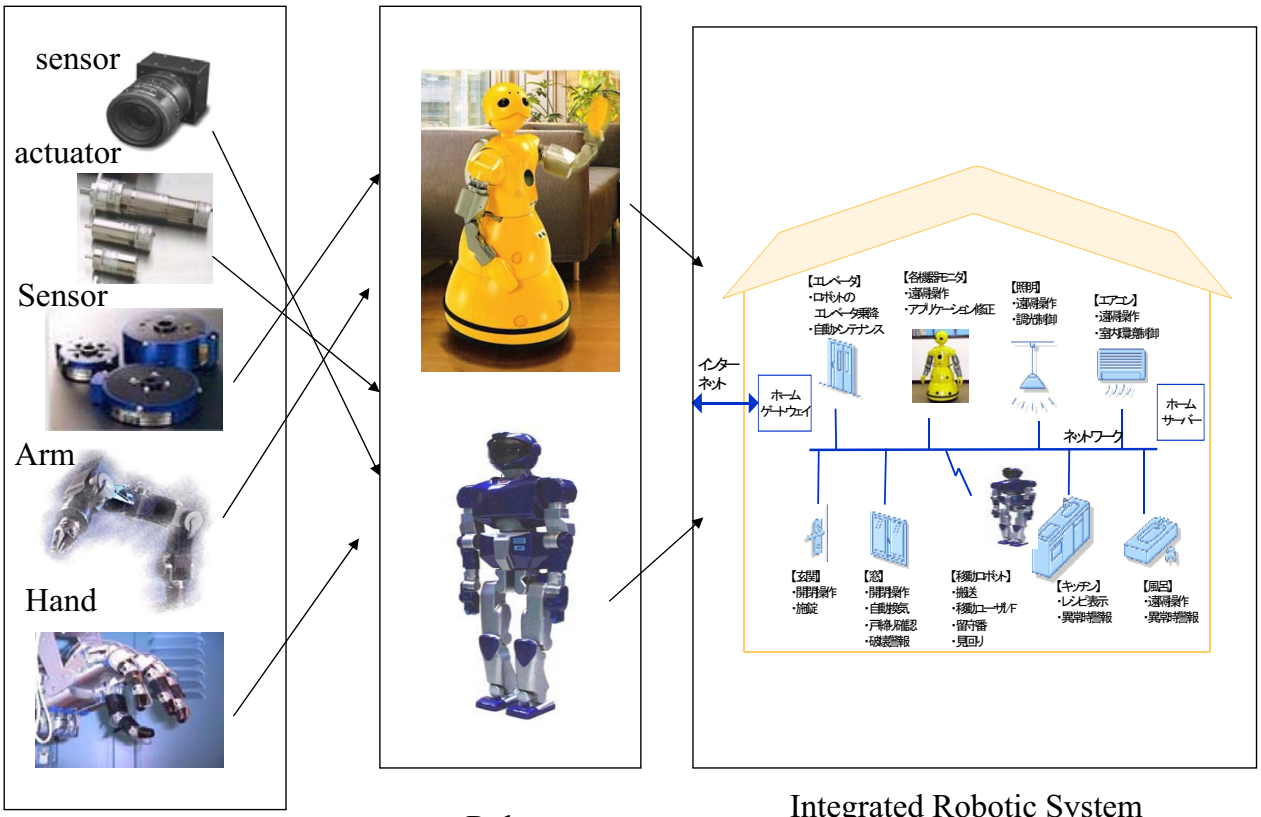
Two kinds of Modularization

Part I （Subsystem）



Part II （Component）

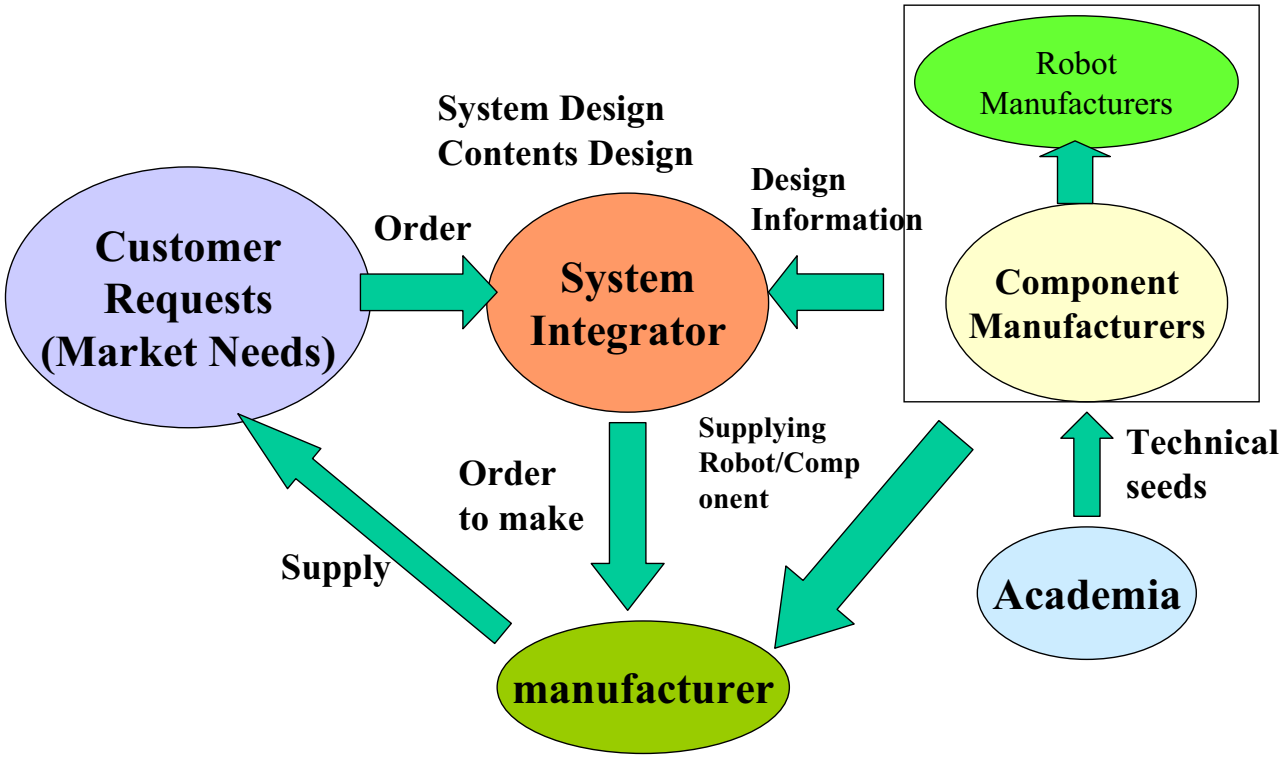




Three Kinds of Robotic Businesses

1. **Robot Component Manufacturer**
2. **Robot Manufacturer**
3. **Robot System Integrator**

A Future Robotic Industry Business Model



Thank you

RoboNexus 2005, San Jose

IT based Ubiquitous Robotic Companion and Standardization in OMG

October 6, 2005.

Yun Koo Chung

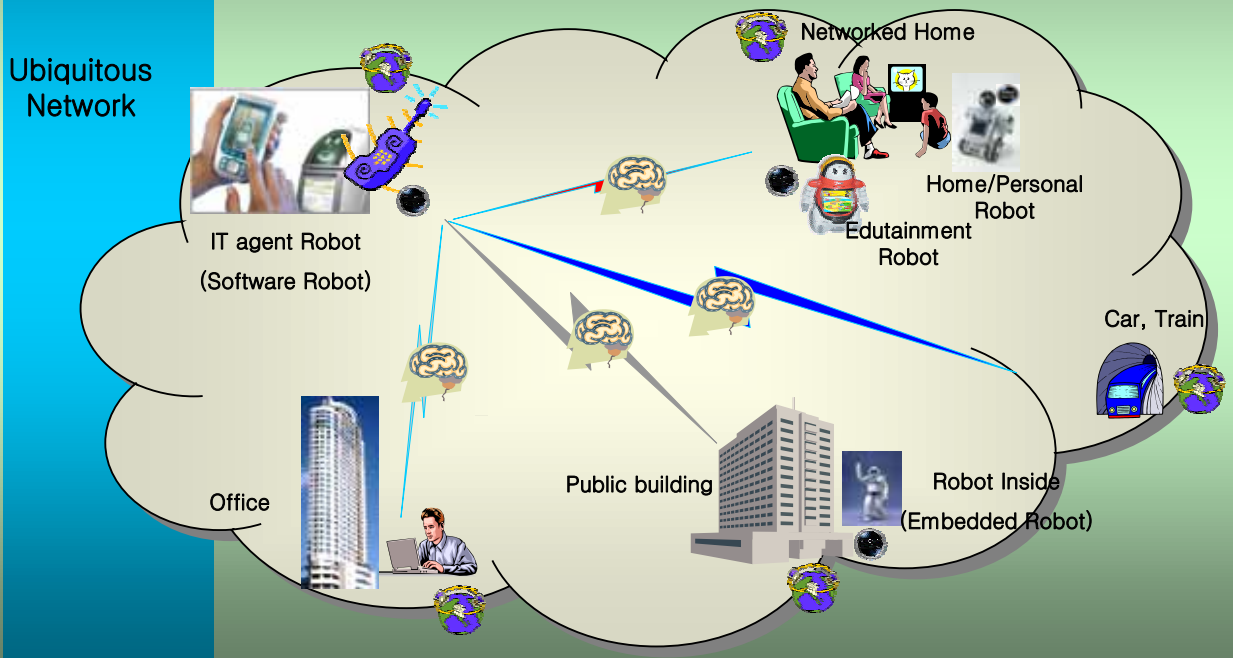
Intelligent Robot Research Division

ETRI Electronics and Telecommunications Research Institute

The Concept of URC (Ubiquitous Robotic Companion)

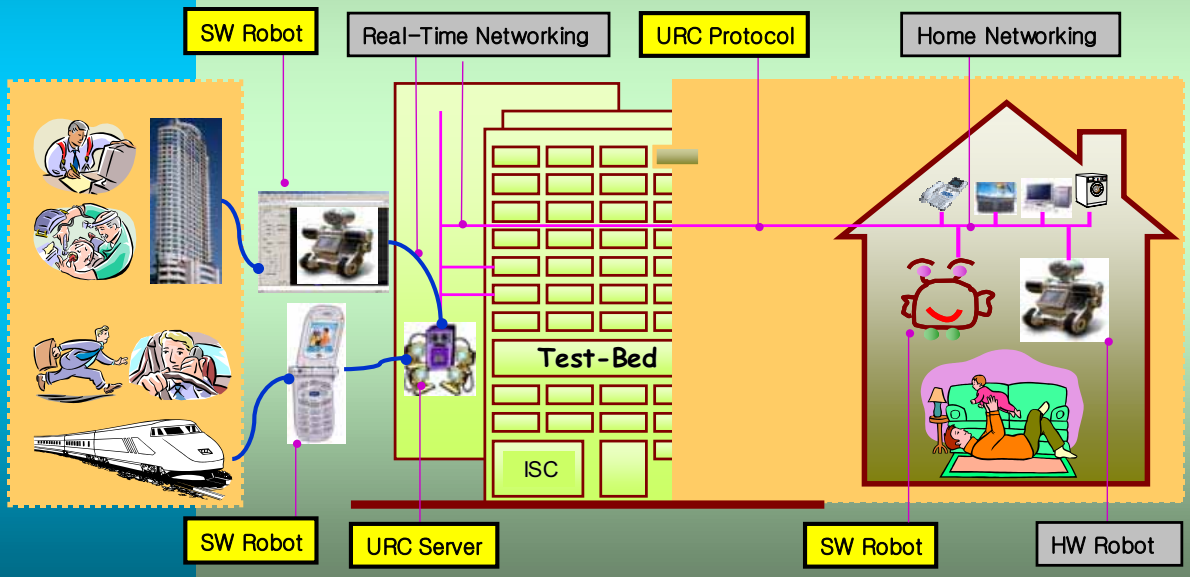
A Robot which provides various necessary services "whenever" and "wherever"

→ Robot Tech. + Information Telecommunication Tech. (Worldwide best IT infra systems)

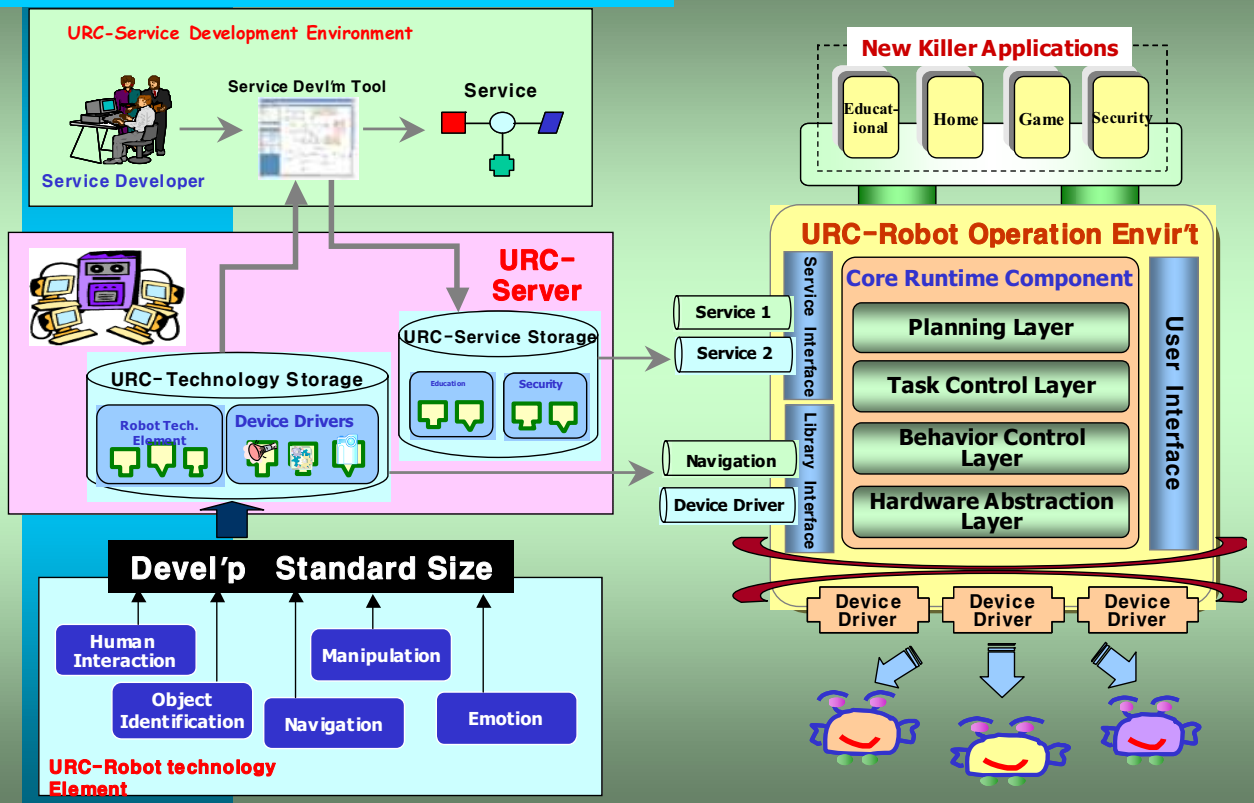


URC Infra System Research Introduction

IT Infra System supports robots providing all necessary services at anytime and any places
- Software robot tech.: movement and transition to various devices (whenever, wherever)
- URC protocol tech.: real-time service and security protocol (through the Network)
- URC server based service tech. :high usability server and URC various services



URC Embedded Component Technology Research Introduction



States of ISR Standardization in OMG

- Beginning stage:
  - Planning, meetings, events
  - RFP: proposal activity for robot standardization
  - RFI: extracting items of standardization
- Active development of Technologies
  - Many robot projects are ongoing.
  - Intelligent robot technology forum activities
- Efforts for active standardization of robots
  - Intelligent Robot Standard Forum activities
  - Close relationship with member institutes(KATS, TTA, KIRA)
  - Exchanging standardization information & technology through international meeting (OMG, ISO, IEEE, ITU …)

Q&A

Thank you.

ETRI
Yun Koo Chung
Ykchung@etri.re.kr

Candidates of Robotics Standardization Issues in OMG -Request for Information-

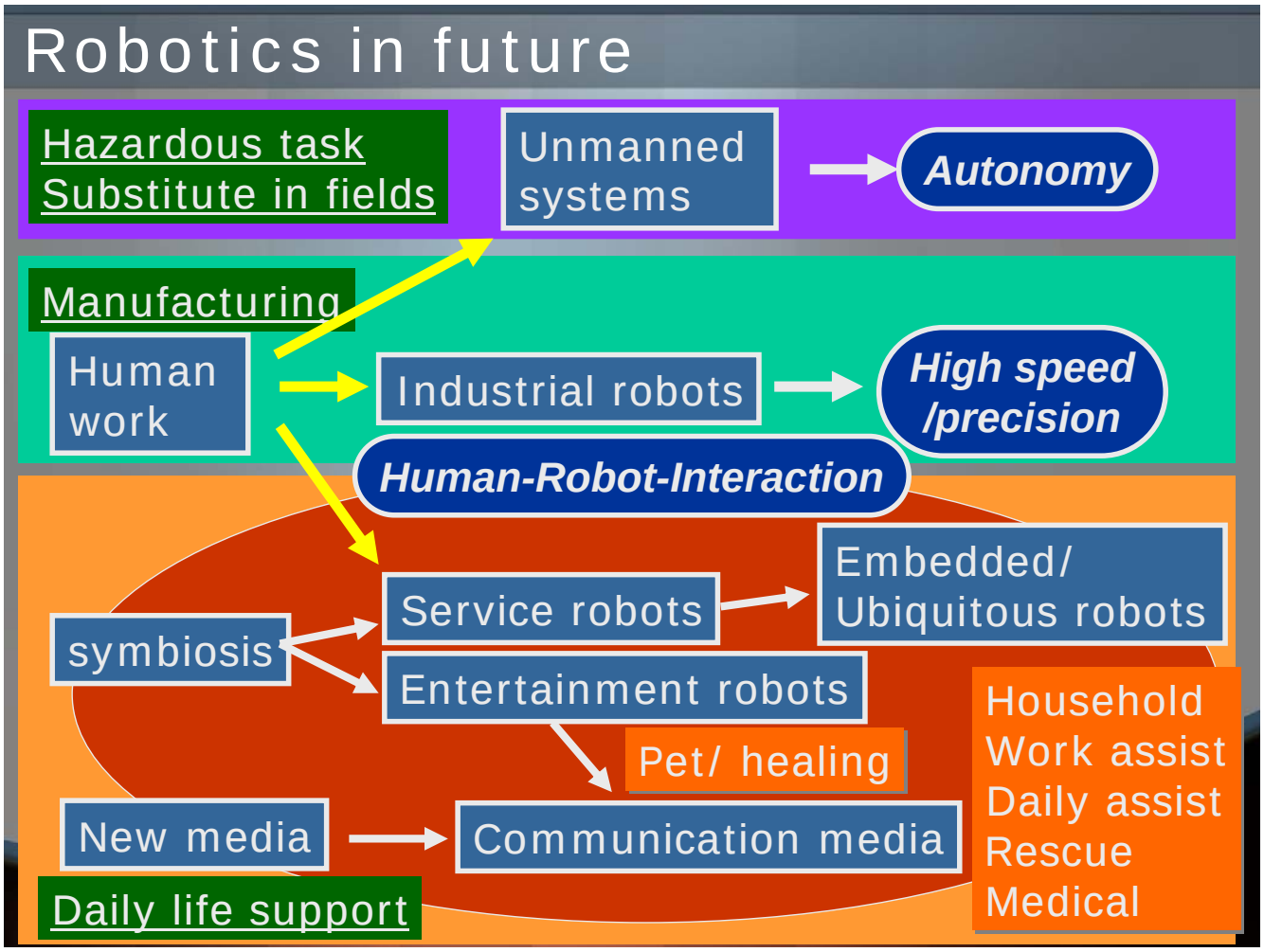
OMG BoF session, RoboNexus
San Jose - Oct 6th,2005

OMG Robotics DSIG Co-chair

Prof. Makoto Mizukawa
Dept. Electrical Eng. , Faculty of Eng.
Shibaura Institute of Technology
Tokyo, Japan

Robot, what?

Robotics in future



Is someone trying to address the challenges of OPEN Robotic Systems for Solution Businesses?

Of Course ! …
But…

Related Activities (examples)

for Telecom

FIPA:The Foundations for Intelligent Physical Agents

http://www.fipa.org/

for Mfg

ISO TC-184, JARA
Robots, Device profiling. middleware for application
http://www.orin.jp/

for IT+RT services

MPHPT: Ministry of Public Management, Home Affairs, Posts and Telecommunications, Japan
Network Robot Pjt.

http://www.soumu.go.jp/english/index.html

MIC: Ministry of Information and Communication, KOREA.

www.vcl.uh.edu/~rcv03/materials/slides/SangRok.ppt

for controllers/OS

OROCOS
Softwares for Robot controller
http://www.orocos.org/

OMG
SDO, Robotics
SBC, DAIS…

for Field

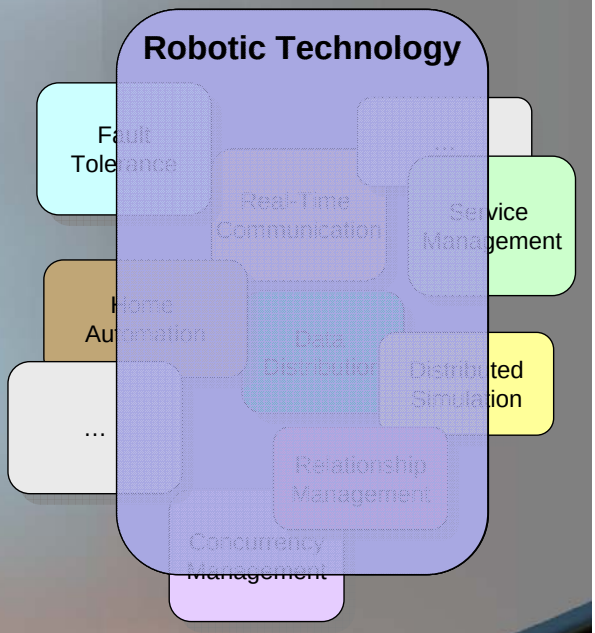
IRS
Rescue Robot

DARPA
Ground Challenge

JAUS

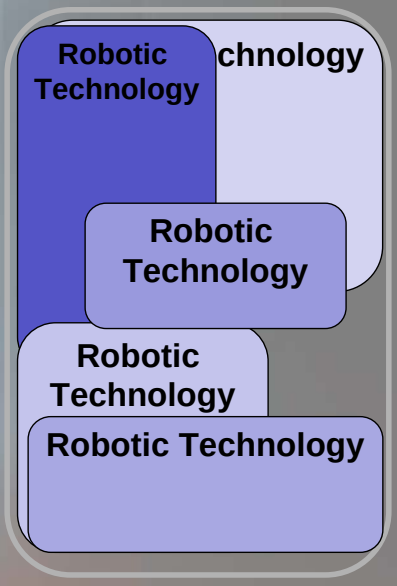
We need a Framework,... not a Patchwork !

- *There are standard frameworks addressing problems related to distributed objects*
- *Most of them are either :*
  Too general
  - Hard to understand and support
  …or too limited
  - Some specific aspects of the robotic technology are not covered
- *They can't always integrate well*
  - Based on different technologies
  - Overlapping and conflicting
- ***We need a framework that would homogeneously address the problematic of robotic system***



Some frameworks do exist ...

- Many research groups around the world have been and are still trying to address
- Most of them take a similar approach which indicates that **a consensus could be reached**, but...
- Most of them are research oriented
  - Technically correct, unusable as is
  - None of them as yet been backed up by the industry
- Some companies are trying to develop their own solution which usually
  - Cover only their needs
  - Is proprietary
- None of these solutions is even close to reach the volume to make it a de-facto standard

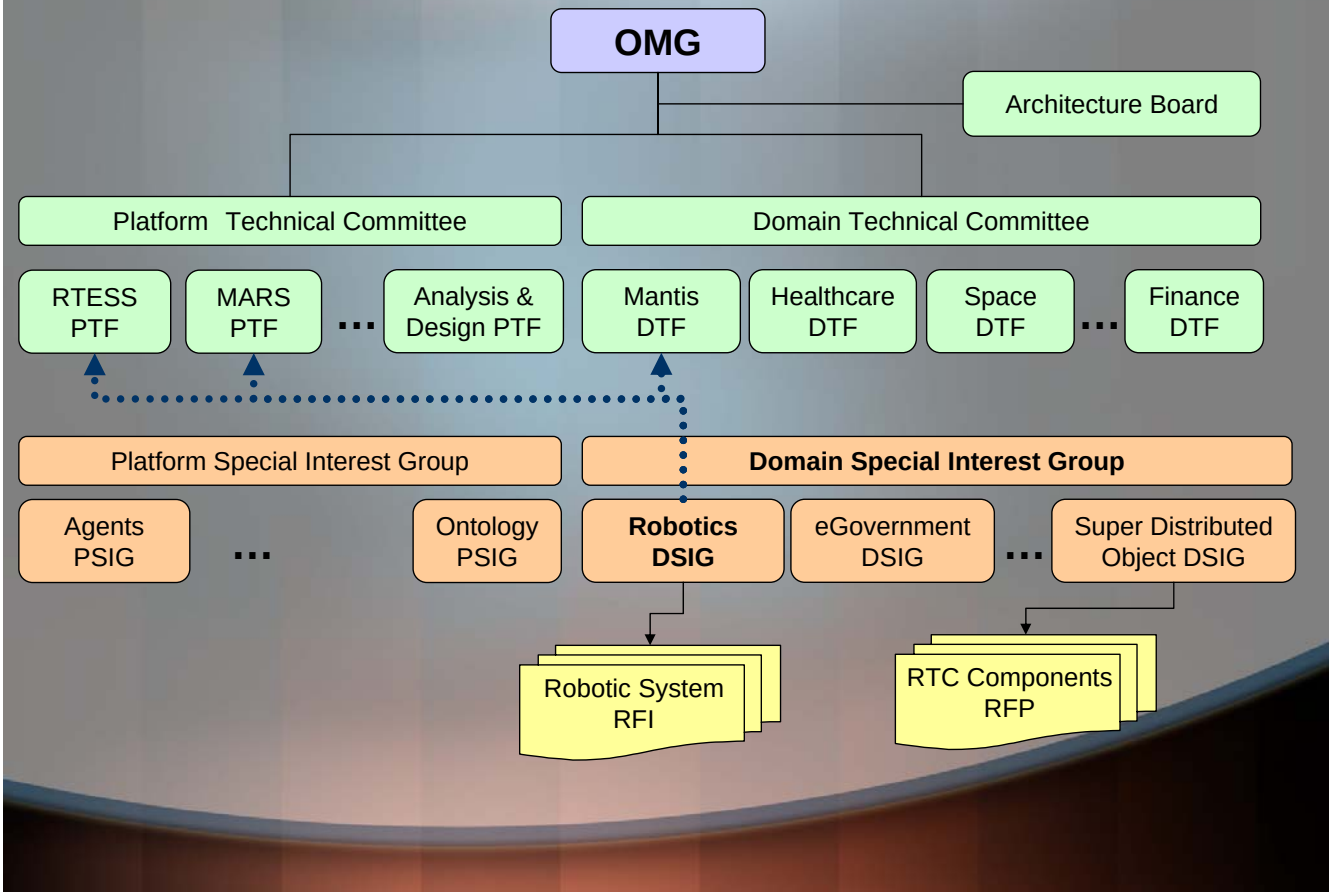


Conclusion

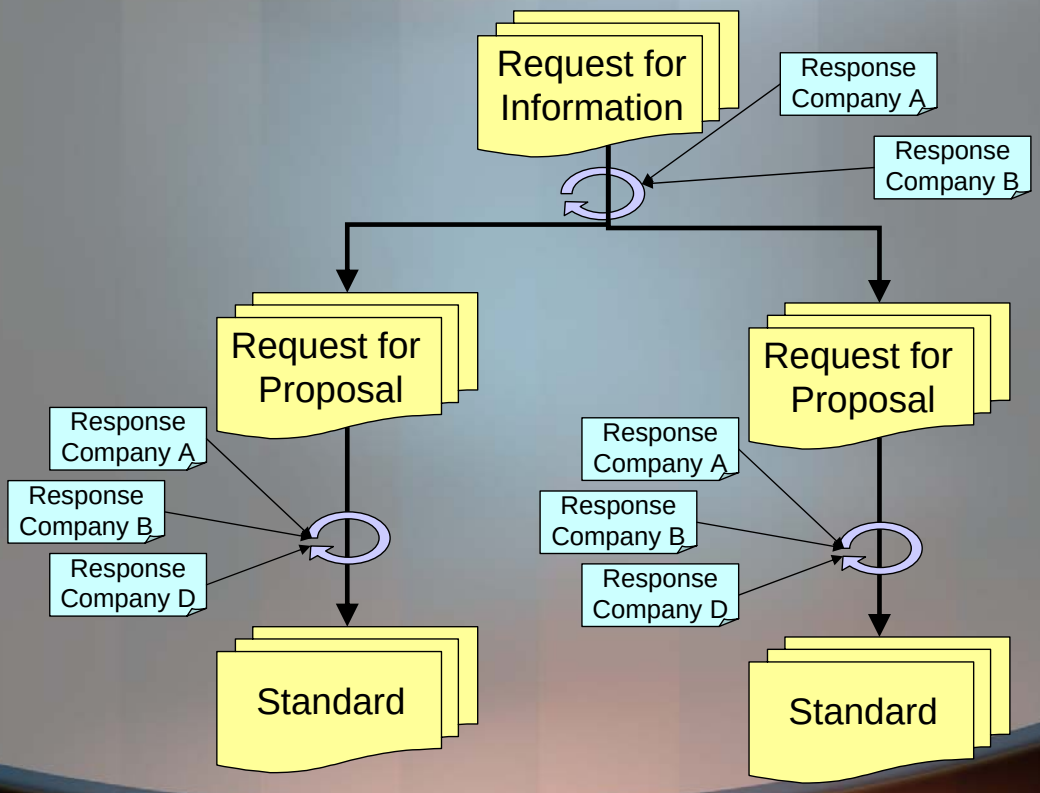
- To work efficiently in a **multi-vendor** environment, a Robotic System must be supported by a **common model**
- Robotic System Technology has **particularities** that are **not yet covered** by any recognized standard
- **No de-facto standard** seems to be emerging, the establishment of a de-jure standard will be necessary

Robotic System Request for Information

Organization of OMG activities



Standardization process at the OMG



What is an OMG RFI

- The intent of an OMG Request for Information (RFI) is to gather information for the purpose of guiding a subgroup in its efforts to provide solutions to industry problems.
  - Acquiring general or specific information about industry requirements.
  - Soliciting assistance in identifying potential technology sources.
  - Soliciting input to validate a subgroup's roadmap.
- This OMG request for information (RFI) solicits information on :
  - Available products, projects
  - Theories, models, requirements

  to support development of Service Robotic Systems based on distributed objects

Purpose

- Determine the areas that need standardization and their respective priorities
- Identify recurrent functional / architectural patterns in existing robotic systems so as to propose common platform independent models
- Help define working groups to work on potential RFPs

Information being Requested

- Identification of areas where Robotics Technology is used
- Needs for standardization of Robotics Technology
- Motivation to respond to this RFI
- Technical Information
  - Existing Implementations
  - Standards
  - Requirements
  - Models
  - Theoretical studies
  - Other Information

Scope of Robotic Systems

- We defined Robotic systems as :

> "Systems that provide intelligent services and information by interacting with their environment, including human beings, via the use of various sensors, actuators and human interfaces."

- **Large variation of physical characteristics**
  - **mobile robots**
  - **humanoid robots**
  - **pet robots,**
  - **manipulator robots**
  - **autonomous vehicles**
  - **robot house**
  - **etc.**
- **Broad span of applications**
  - **communication and entertainment robots**
  - **lifestyle support robots**
  - **rescue robots**
  - **transportation robots**
  - **medical robots**
  - **etc.**

Technical Topics (I)

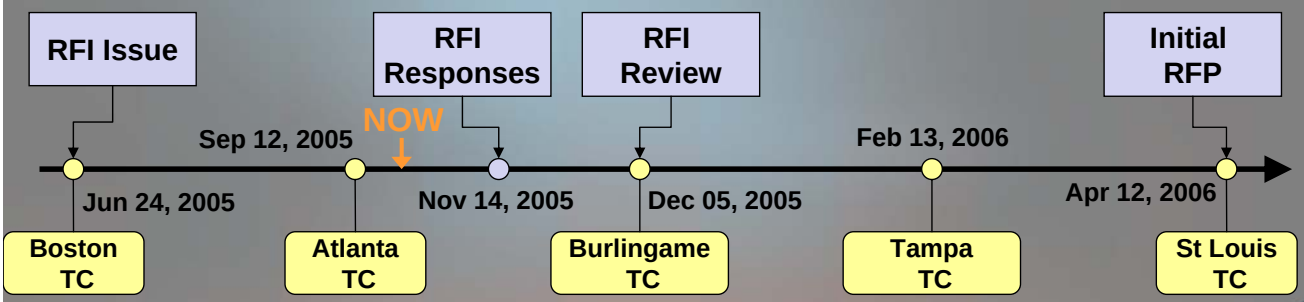
- Robotic System Software Infrastructure
  - **Transport / Protocol**
  - **Data Flow**
  - **Command Flow**
  - **Middleware**
  - **Use of component model**
  - **Security**
  - **Deployment**
- Robotic System Architecture
  - **Functional Layering / Block Decomposition**
  - **Common Data Structures (such as Images, Laser scan, 3D position, etc.)**
  - **Hardware Abstraction**
  - **Supporting mechanisms**
    - **Configuration, Dynamic Reconfiguration**
    - **Component capabilities modeling and advertisement**
    - **Capability Composition**
    - **Monitoring**
    - **Physical Space / Time Management**
    - **Task Synchronization / Prioritization**
    - **Physical Resource Management**
    - **Safety Management**
    - **Error Detection / Propagation / Management**
    - **Fault Tolerance / Recovery Strategies**
    - **Security**

Technical Topics (II)

- Robotic System Applications
  - Robotics Technology (RT) Services
    - World model repository
    - Behavior composition and sequencing
    - Integration with IT Systems
  - Capabilities
    - World modeling
    - Navigation
    - Path-Planning
    - Localization
    - Motion Control
    - Manipulation
    - Kinematics
    - Behavior/State Management
    - Task planning / synchronization
    - Visual Processing
    - Sound Processing
    - Human interface
    - Sensor fusion
- Robotic System design
  - Tool Support
    - Component Code Generation
    - Application Generation
    - Visualization / Analyzer
    - Design rules checking
    - Language Profiles
    - Scheduling support
    - Development APIs
  - Verification Techniques
    - Unit Testing
    - System Testing
    - Simulation
    - Evaluation Metrics
- Related Standards and Reference Documents
  - Within the OMG
  - From other organizations
  - Possible collaborations with other organization

Schedule

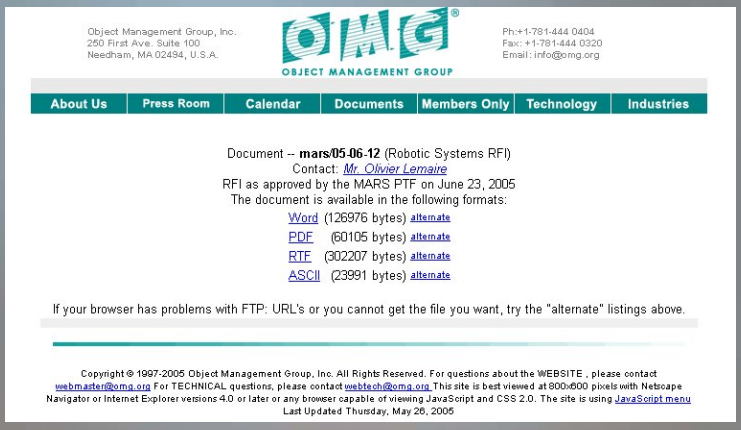
- RFI Issued (Boston Meeting) — Jun 24, 2005
- RFI Responses due — Nov 14, 2005
- Review of RFI Responses — Dec 05, 2005
- DTF recommends issuing initial RFP — Apr 12, 2006



The Official Document

- You can download freely the official RFI at :

  http://www.omg.org/cgi-bin/doc?mars/05-06-12



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OBJECT MANAGEMENT GROUP

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Document -- **mars/05-06-12** (Robotic Systems RFI)
Contact: *Mr. Olivier Lemaire*
RFI as approved by the MARS PTF on June 23, 2005
The document is available in the following formats:

Word (126976 bytes) alternate
PDF (60105 bytes) alternate
RTF (302207 bytes) alternate
ASCII (23991 bytes) alternate

If your browser has problems with FTP: URL's or you cannot get the file you want, try the "alternate" listings above.

- Responses from **anyone** in industry, government, or academia with practical knowledge of robotic systems are welcome

- **Visit our web-site for past activities to see past activities.**
  http://robotics.omg.org/robotics_info.htm#documents

Come and join us at the OMG !

- **Influence the Technology Adoption Process**
  - You will influence the worldwide technology adoption process
  - Attain competitive advantages
  - Acquire a significant head start in developing your implementation of adopted specifications

- **Network with Industry Experts:**
  - Provides opportunities to develop critical industry relationships and collaborations.
  - Direct access to the vendors, users, software developers and marketers that are driving distributed object computing.
  - Provides unparalleled access to the best minds in distributed computing.

Present members

- Are already actively participating :
  - AIST (Japan)
  - JARA (Japan)
  - ETRI (Korea)
  - John Deer (US)
  - Real-Time Innovation (US)
  - Systronix (US)

Be the next on the list !

Next OMG Robotics DSIG

December 5-9, 2005
(Burlingame, CA, USA)

Robotics-DSIG Plenary Meeting
[Dec.6 Tuesday]

- RFP promotion (SDO-DSIG joint meeting)
- RFI response presentation
- guest & participants presentation
- mediator reports
- co-chairs election

Basic Framework for Robot Technology Components

- Request for Proposal -

Tetsuo KOTOKU
National Institute of Advanced Industrial Science and Technology (AIST);
Co-chair of Robotics-DSIG and SDO-DSIG, OMG

Objectives

- Activity Promotion
- Recruit Challengers

Introduction (AIST)

The National Research Institute

an Independent Administrative Institution (IAI) under the Ministry of Economy, Trade and Industry (METI)

Researchers: ~2,400
- Tenured: ~2,000
- Fixed-term: ~400
Administrative Staff: ~700

http://www.aist.go.jp/index_en.html

Introduction (ISRI)

Intelligent Systems Research Institute

The objective of the Intelligent Systems Institute is to conduct researches on fundamental and component technologies, system integration technologies for the computer-oriented intelligent systems, and also physical systems which support human activities in the real world.

Researchers ~60

Information Science, Robotics, Mechatronics

http://unit.aist.go.jp/is/index_e.html

AIST

Research Activities

Humanoid Robot Project (HRP) (1998-2002)

HRP-1

Remote Operation

Robot Assistant

HRP-2

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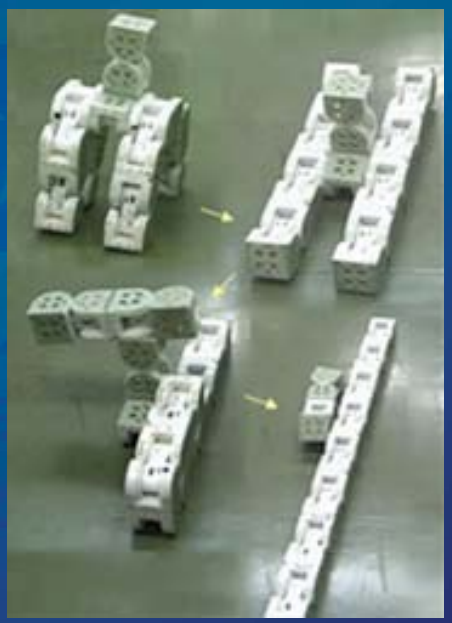
Contact : Humanoid Research Group
http://www.is.aist.go.jp/humanoid/index.html

AIST

Research Activities

Distributed Modular Robot (M-TRAN) travels by transforming itself between an quadruped walker, H-shape, and a caterpillar.

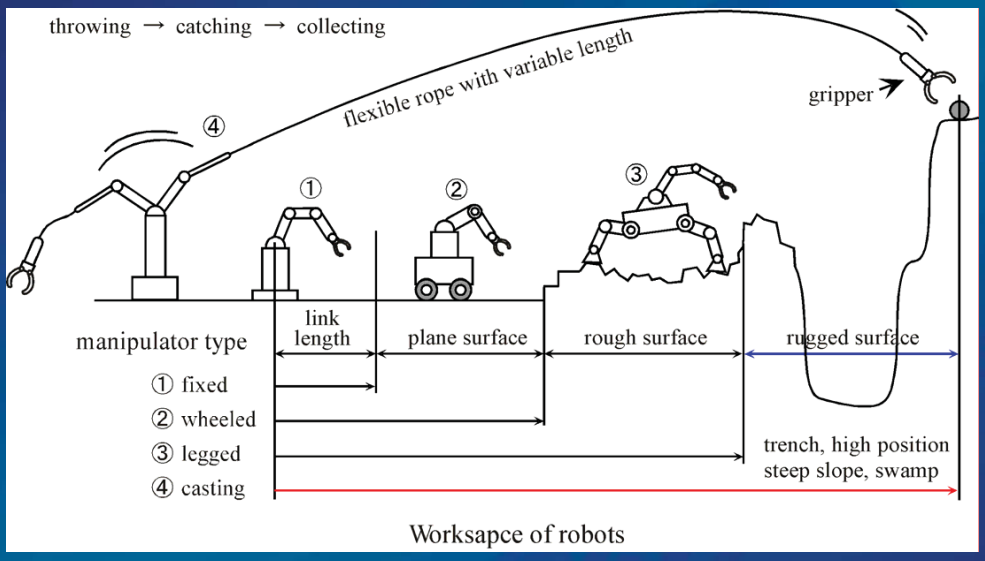


OMG OBJECT MANAGEMENT GROUP

Contact : Distributed System Design Group
http://unit.aist.go.jp/is/dsysd/index.html

Research Activities

Casting Manipulation

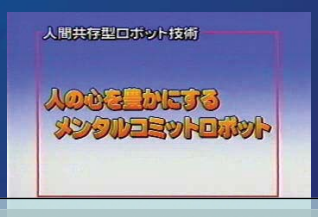


Contact : Dr. Hitoshi ARISUMI
http://staff.aist.go.jp/h-arisumi/english.index.html.htm

Research Activities

Human Interactive Robot

for Psychological Enrichment and Robot Therapy

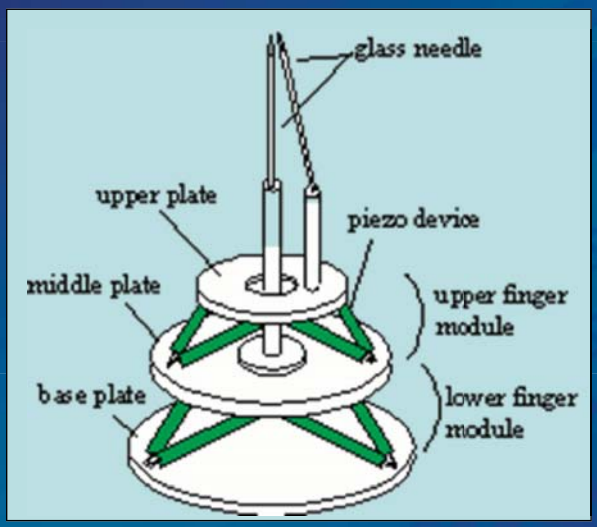


Contact : Dr. Takanori SHIBATA
http://staff.aist.go.jp/h-arisumi/english.index.html.htm

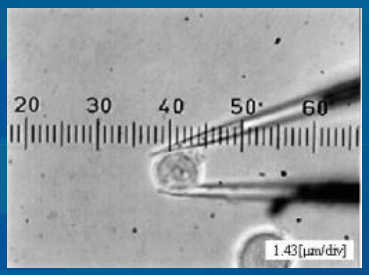
AIST

Research Activities

Micro Manipulation



two fingered micro-hand



white blood cell manipulation

Contact : Dr. Tamio TANIKAWA
http://staff.aist.go.jp/tamio.tanikawa/

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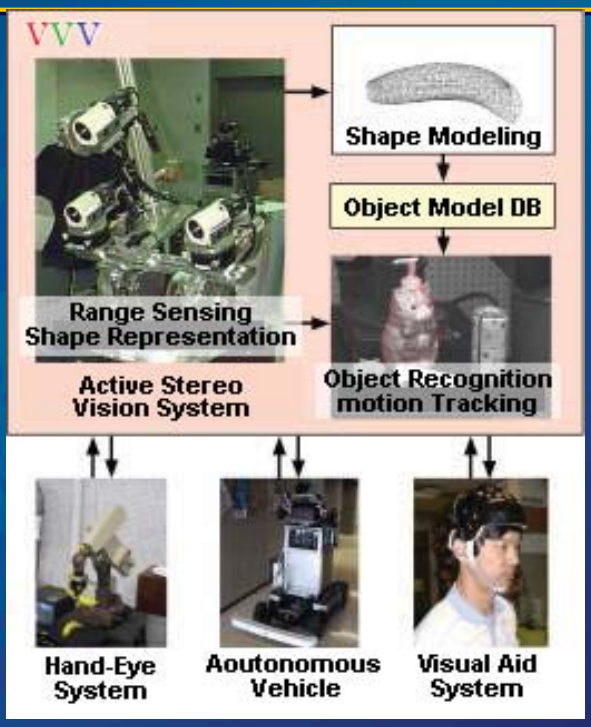
AIST

Research Activities

3D Vision System

Versatile Volumetric Vision (VVV)
- Range sensing
- Shape modeling
- Object Model DB
- Object Recognition
- Motion Tracking



Real-time 3D Vision System

Contact : 3D Vision Systems Research Group
http://unit.aist.go.jp/is/vvv/index.html

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Research Activities

For the efficient research activities in Robotics

- Rapid prototyping for experiments
- Easy to transfer the technology developed
- Easy to modify the system for comparison

Needs for sharing results and increasing specialization

interoperability

Expectation for standardization

Common research platform

Technology Trends

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:

Computer Technology

Network Technology

Robot Systems

- **larger**
- **more complicated**

Single robot

Networked robot

Efficient Development

Technology Trends

Unfortunately, most of these pioneering initiatives are developed independently of the others, driven by specific applications and objectives. In order to settle this state of chaos, we would like to contribute to the promotion of standardization in the field of robotics based on the mutual understanding between the relevant parties.

Integration of robot systems based on modular components

Robotics standards based on the MDA

Robot Technology Component RFP

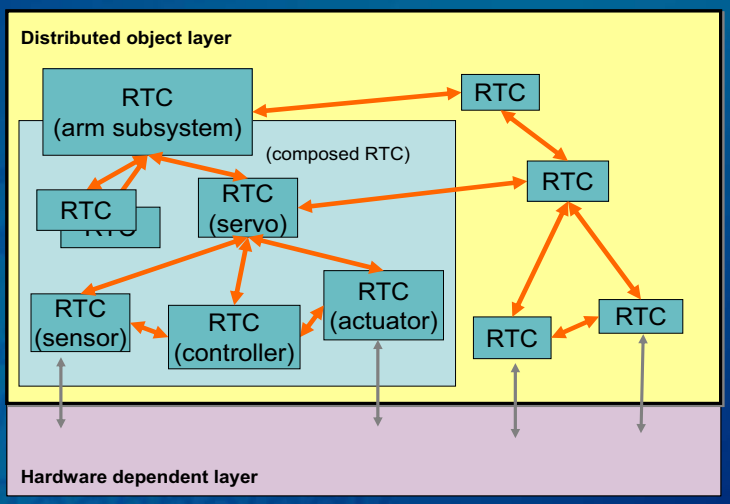
- Robotics based on MDA
- Basic framework for modular components
  - interoperability
  - composability
  - Simple

http://www.omg.org/cgi-bin/doc?ptc/05-09-01

Robot Technology Component RFP

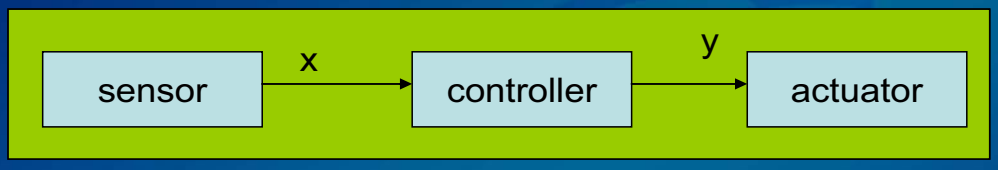
Robot System :

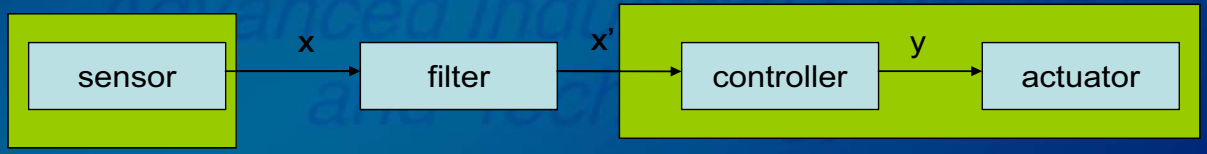
- **Data flow IF**
- **Command IF**
- **Internal state**
- **composable**



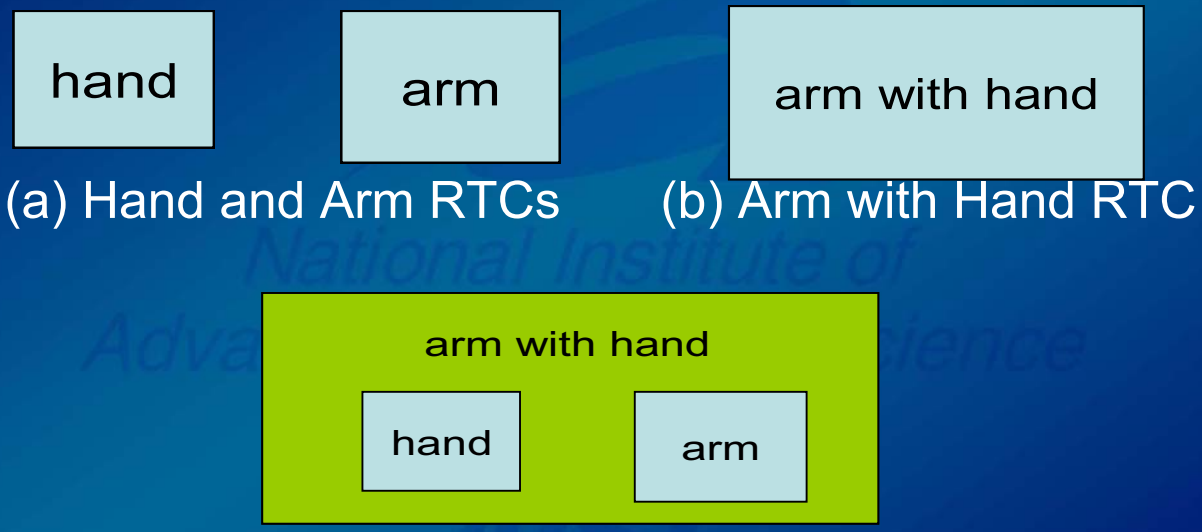
Simple specification for Interoperability

Interoperability of data flow





Interoperability in Composition



Robot Technology Component RFP

cooperation:

- **Proposal Submission**
  provide discussion base model
  (Platform member or higher)
- **Meeting Participation**
  technical discussion
  to find better, or, best model
  (Influencing member or higher)

AIST

Robot Technology Component RFP

Schedule:

- Sept. 15,2005 RFP issued
- Dec. 15,2005 LOI due
- Jan. 23, 2006 Initial submission
- Jun. 5, 2006 Revised submission
- Jun. 30, 2006 PTC vote for recommendation
- Sept., 2006 Adopt Specification

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AIST

Call for Participation

OMG Technical Meeting in Burlingame

December 5-9, 2005

Hyatt Regency San Francisco Airport

http://www.omg.org/registration/

RFI responders will be invited as guest presenters

OMG OBJECT MANAGEMENT GROUP

Next Meeting Agenda

December 5-9, 2005 (Burlingame, CA, USA)

Monday :

Steering Committee **[Dec.5]**

Tuesday :

Robotics-DSIG Plenary Meeting [Dec.6]

- RFP promotion (SDO-DSIG joint meeting)
- RFI response presentation
- guest & participants presentation
- co-chairs election

Conclusions

- We've just started the robotics-related activities in OMG.
- Call for participation
- Call for volunteers

Steering Committee, Robotics-DSIG

Monday, Dec. 5 15:00-17:00

http://robotics.omg.org/