Robotics Domain Task Force Final Agenda ver.1.0.4 **robotics/2006-09-01**

OMG Technical Meeting - Anaheim, CA, USA -- September 25-29, 2006

		TF/SIG				
		Host	Joint (Invited)	Agenda Item	Purpose	Room
Sunday (Sept. 24)						
15:00	17:00	SDO	Robotics	Robot ic Technology Compornent (RTC) Submitter's Meeting		Santa Cruz, Bonita
Monday (Sept. 25) WG activity						
8:40	9:00	Robotics	(SDO)	Welcome and review agenda	Robotics/SDO Joint Meeting Kick-off	Coronado D, Marina
9:00	10:00	MARS	SDO, Robotics	Robot Technology Components RFP revised submission review	review,	Balboa, Sierra
10:00	12:00	Robotics	(SDO)	**Robotic Services WG(2h)**: Definition of Functional Services in Robotic Systems, WG Steering Committee, Roadmap Update - Olivier Lemaire and Soo-Young Chi	discussion	Coronado D, Marina
12:00	13:00	**LUNCH**				Marina 2/3, Marina
13:00	18:00			Architecture Board Plenary		
13:00	15:00	Robotics	(SDO)	**Profile WG(2h):** Discussion on profile standardization - Seung-Ik Lee, Bruce Boyes	Sharing common concept on profile standarization	Coronado D, Marina
15:00	17:00	Robotics	SDO	Steering Committee of Robotics DTF (include Publicity SC discussion)	Volunteer recruit	
Tuesday (Sept. 26) WG activity						
8:30	11:00	Robotics	SDO	**Robotic Service WG (2.5h)**: - Olivier Lemaire and Soo-Young Chi	discussion	Coronado D, Marina
11:00	12:00	Robotics	SDO	**Profile WG:** Wireless Robot Sensors: SunSPOT - Bruce Boyes (Systronix) and Eric Arseneau (Sun)	Informative	
12:00	13:00	**LUNCH**				Marina 2/3, Marina
13:00	14:00			**Canceled**		Coronado D, Marina
14:00	15:00	Space	(SDO)	**Robots in Space** (joint with Space Information Day) Space Robotics in Past, Current and Future - Hiroshi Ueno (JAXA)	Infomative	Marina 4, Marina
15:00	16:00	Robotics	SDO	**Special Talk:** SysML Tutorial - Sanford Friendenthal (Lockheed Martin)	Informative	Coronado D, Marina
16:00	17:00	Robotics	SDO	**Infrastructure WG(1h):** - Saehwa Kim, Noriaki Ando, and Rick Warren	discussion	
17:00	18:00	OMG	SDO	The Return of the Revision and Finalisation Task Force Chairs' Tutorial	discussion	Balboa, Sierra
Wednesday (Sept. 27) Robotics Plenary						
8:50	9:00	Robotics	(SDO)	Joint Plenary Openning	Robotics/SDO joint plenary kick-off	Balboa, Sierra
9:00	9:40	Robotics	(SDO)	Robot Ontology and Related Research in ETRI - Minsu Jang (ETRI)	Infomative	
				Break (20min)		
10:00	12:00	Robotics	(SDO)	WG Reports and Roadmap Discussion (Infrastructure, Robotic Service, Profile)	reporting and discussion	
12:00	14:00	**LUNCH and OMG Plenary**				Marina 2/3, Marina
14:00	15:00	SDO	Robotics	Robot Technology Components RFP revised submission presentation - Rick Warren and Noriaki Ando	reporting	Balboa, Sierra
				Break (30min)		
15:30	16:00	Robotics	SDO	**Newcomer Presentation:** Autonomous systems for Japanese Agriculture in Paddy Field - Yoshisada Nagasaka (NARC)	Infomative	
16:00	16:30	Robotics	SDO	Contact Reports: - Makoto Mizukawa(Shibaura-IT), and Yun-Koo Chung(ETRI)	Information Exchange	
16:30	17:00	Robotics	(SDO)	Publicity SC Report, Next meeting Agenda Discussion	Robotics/SDO joint plenary closing	
17:00				Adjourn joint plenary meeting		
17:00	18:00	Robotics		Robotics WG Co-chairs Planning Session (Agenda for Washington DC, Draft report for Friday)	planning for next meeting	Balboa, Sierra
18:00	20:00	**OMG Reception**				Marina 4, Marina
Thursday (Sept. 28)						
8:30	10:00	Robotics		Canceled		Coronado D, Marina
10:00	**10:30**	**MARS**	**SDO, Robotics**	**Robot Technology Components RFP revised submission voting**	**V2V and vote to Adopt**	Avalon A, Marina
10:30	12:00	Robotics		Canceled		Coronado D, Marina
12:00	13:00	**LUNCH**				Marina 2/3, Marina
13:00	18:00			Architecture Board Plenary		Marina 1, Marina
13:00	17:00	Robotics		Canceled		Coronado D, Marina
17:00	18:00	MARS		Agenda Coordinatging Meeting - Washington DC TM	planning for next meeting	Coronado F, Marina
Friday						
8:30	12:00			AB, DTC, PTC		Marina 2, Marina
12:00	13:00	**LUNCH**				Garden Room, Bonita

Other Meetings of Interest

Monday						
8:00	8:45	OMG		New Attendee Orientation		Avalon AB, Marina
9:00	12:00	OMG		Tutorial - Introduction to OMG's meeting and Middlewere Specifications		Avalon AB, Marina
13:00	17:00	OMG		Tutorial - An Overview of UML 2.0		Avalon AB, Marina
18:00	19:00	OMG		New Attendee Reception (by invitation only)		Garden Room, Bonita
Tuesday						
9:00	12:00	OMG		Tutorial - Introduction to the Data Distribution Service		Avalon A, Marina
13:00	17:30	OMG		Tutorial - MDA -- Where it Came From and Where it's Going		Avalon A, Marina
Wednesday						
9:00	12:00	OMG		Tutorial - Intruduction to the XML Telemetric and Command Exchange (XTCE) Specification		Avalon A, Marina
14:00	17:00	OMG		Tutorial - Introduction to OMG's new Ontology Defenition Metamodel (ODM) Specification		Avalon A, Marina

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

Minutes of the Robotics DTF Plenary

Jun 28-29, 2006
Boston, MA, USA
(robotics/2006-09-02)

Meeting Highlights

RTC submission recommended for adoption by MARS
1 special talk was given by the Ontology PSIG
Reports received from 3 active Technical WGs
Contact reports received for a number of activities
Contacts Sub-Committee formed

Prof. Makoto Mizukawa was authorized as a contact between ISO TC184/SC2.

List of generated documents

robotics/2006-06-03 Final Agenda (Tetsuo Kotoku)
robotics/2006-06-04 St. Louis Meeting Minutes [approved] (Hung Pham)
robotics/2006-06-05 Roadmap for Robotics Activities (Tetsuo Kotoku)
robotics/2006-06-05 Roadmap fot Robotics Activities (Tetsuo Kotoku)
robotics/2006-06-06 Robotics Services WG: Introduction to RUPI (Soo-Young Chi)
robotics/2006-06-07 Robotics Services WG: Definition of Functional Services (Olivier Lemaire)
robotics/2006-06-08 Profile WG: Discussion on profile standardization (Seung-Ik Lee)
robotics/2006-06-09 Steering Committee Presentation (Tetsuo Kotoku)
robotics/2006-06-10 Publicity SC: Flyer discussion (Masayoshi Yokomachi)
robotics/2006-06-11 Publicity SC: Flyer rough draft (Abheek Bose)
robotics/2006-06-12 Robotic Services WG: POEM - an implementation of position estimation module (Takashi Tsubouchi)
robotics/2006-06-13 Robotic Services WG: SAIT Proposal of Standards for Localization based on MDA (Yeon-Ho Kim)
robotics/2006-06-14 Robotic Services WG: Issues on Localization Services (Wonpil Yu)
robotics/2006-06-15 Robotic Services WG: Discussion on Localization Technology (Olivier Lemaire)
robotics/2006-06-16 Spur - a Locomotion Command System for Mobile Robot (Takashi Tsubouchi)
robotics/2006-06-17 Robot Modeling Framework (Abheek Bose)
robotics/2006-06-18 Infrastructure WG: Understanding RSCA with Example (Seongsoo Hong)
robotics/2006-06-19 Infrastructure WG: Agenda for Infrastracture WG (Saehwa Kim)
robotics/2006-06-20 Infrastructure WG: Infrastructure WG minutes (Saehwa Kim)
robotics/2006-06-21 Plenary Opening / Ending Presentation (Tetsuo Kotoku)
robotics/2006-06-22 Robobusiness2006 Presentation (Jon Siegel)
robotics/2006-06-23 Robotic Device and Data Profile WG Report (Seung-Ik Lee)
robotics/2006-06-24 Robotic Functional Services WG Report (Olivier Lemaire)
robotics/2006-06-25 Infrastructure WG Report (Rick Warren)
robotics/2006-06-26 Introduction to RTC (Rick Warren)
robotics/2006-06-27 Contact Report: ISO TC184 / SC2 (Makoto Mizukawa)
robotics/2006-06-28 Contact Report: Introduction of JAUS for the benefit of Robotic Standardization (Wataru Inamura)
robotics/2006-06-29 Contact Report: KIRSF (Yun-Koo Chung)
robotics/2006-06-30 Flyer first Draft candidate #1 (Abheek Bose)

robotics/2006-06-31 Flyer first Draft candidate #2 (Abheek Bose)
robotics/2006-06-32 Agenda Coordination for Anaheim Meeting (Tetsuo Kotoku)
robotics/2006-06-33 Ontology Definition Metamodel (ODM) Background and Overview (Elisa Kendall)
robotics/2006-06-34 DTC Report Presentation (Hung Pham)
robotics/2006-06-35 Boston Meeting Minutes - DRAFT (Hung Pham and Olivier Lemaire)
robotics/2006-06-36 MARS RTC Presentation [same as mars/2006-06-22] (Rick Warren)

Plenary proceedings

Wednesday, Michelangelo Suite, 2nd FL
Meeting called to order at 8:58am (Toku, AIST)

Review of the St. Louis Minutes (Toku)
(robotics/2006-06-04)
- Lee (ETRI) requested that the report document from the Profile WF be given a document number
- Mizukawa pointed out a name misspelling

Action:
- Toku (AIST) motioned to accept minutes
- Mizukawa (Shibaura-IT) seconded motion
- Chung (ETRI) suggested white ballot
- Motion passed w/o dissent.

Review of Agenda (Toku)
(robotics/2006-06-21)
- Voting list members of RTC encouraged to join MARS for vote of RTC on Thursday

"RoboBusiness2006 Report" – Jon Seigel
(robotics/2006-06-22)
- RoboNexus for consumer robots
- RoboBusiness for military robots and commercial robots
- Keynote speech stressed role of standards in FCS
- Microsoft announced Robot Development Kit
- Provided a brief review of the talk presented at RoboBusiness

WG Reports
Profile WG report (Lee, ETRI)
(robotics/2006-06-23)
- Following issues were discussed within WG
  * survey of typical devices
  * general approach
  * scope of WG
  * nomenclature and classification
- Potential issues to be addressed in RFP (tentative)
  * characteristics used to classify devices
  * device hierarchy
  * types of devices
  * interfaces
  * management and enumeration of devices
  * device configuration

  * how to integrate with existing standards
  * proof-of-concept, *i.e.*, provide definition
  * differences between devices and functional services?
- Roadmap discussion
  * RFP to be issued in Mar 2007
- Future informational presentations
  * IEEE 1451
  * JAUS
  * stressed need for presentations showing current implementation of RFP-related topics

Q: where is the divide between Functional Services and Robotic Devices?
A: the answer is not clear

Robotic Services WG report (Lemaire, JARA)
(robotics/2006-06-24)
- Review of presentations given to WG
  * RUPI presentation on Monday
  * Pose estimation module presentation (Tue)
  * Proposal for standards for robot localization (Tue)
- Roadmap update
  * Localization service RFP issue postponed to San Diego
- Discussion of naming

Action:
  * AIST motioned to rename WG to ***Robotic Functional Services WG***
  * SIT seconded motion
  * ETRI suggested white ballot
  * vote passed w/o dissent
  * ETRI motioned to rename Profile WG to ***Robotic Devices and Data Profiles WG***
  * JARA seconded
  * RTI suggested white ballot
  * vote passed w/o dissent

- Discussion summary
  * localization services could have a potentially very wide scope that we need to restrict
  * should focus on developer or user's point o fview
    + developer POV: define main typical building blocks of localization service so as to distribute them
    + user's POV: define only the external interfaces
  * should figure out how to evaluate the submissions
  * first RFP draft to be written prior to next (Anaheim) mtg

Infrastructure WG report (Warren, RTI)
(robotics/2006-06-25)
- Review of presentation given to WG
  * RSCA and an approach to deployment and configuration
- Discussion summary
  * review of minutes and notes from St Louis mtg
  * decided to delay issuing RFP by 1 mtg
  * draft written prior to Anaheim
  * volunteers to draft some or part of RFP
    + ADA software

+ AIST
+ RTI
+ SNU

Q (JARA): have you talked about this RFP to other OMG members?
A (RTI): we should do this
Q (JARA): you should present a clear motivation for why we need a new D&C.
A (RTI): it may be that we can leverage CORBA D&C or SDR D&C and extend it, but it's up to the respondents of the RFP to stress that.

Roadmap for DTF presented (Toku)
(robotics/2006-06-05)
- Updates were made based upon member input.
- ADA software suggested that supplement mailing list with WiKi. Has taken AI to look into coordinating logistics with OMG and presenting to group about WiKi.

Progress report on RTC submission (Warren, RTI)
(robotics/2006-06-26)
- Presented current status; noted that vote-to-vote was passed
- formal vote for adoption to take place on Thu
- provided use-case example of navigation using RTC
- encouraged feedback on the RTC

Contact reports
Makoto Mizukawa (SIT) ---------
(robotics/2006-06-27)
ISO TC184/SC2 Plenary held in St Denis, France
- Scope: standardization in the filed of industrial automation and integration concerning discrete part manugfacturing and encomassspping the application of mult technologies, i.e. IT, machines and equip, etc
- 4 subcommittees:
  * physical device control
  * robots for industrial environments (PT10218)
  * industrial data architecture,
  * comms and integration frameworks
- long term direction
  * widened scope of "robots for industrial environments" to *robots and robotic devices*
    + standardization in the field of automatically controlled … robots and robotic devices;
    + excluding toys and military apps
  * started new initiative in *robotics in personal care*
  * exploring needs for standardization in the field of *service robots*

ISO TC 184/SC2 shall send liaison to IEEE "Robotics and Automation Society" and to OMG

ORiN and RAPI
- ORiN (Open Resource interface for the network)
- RAPI (Robot communication framework and Application Program Interface)
  + to distribute a new work item proposal based on RAPI to ISO TC 184/SC2
  + abstraction of ORiN
  + a subset of ORiN functionality

Wataru Inamura (IHI) ----------
(robotics/2006-06-28)
“Introduction of JAUS for the benefit of Robotic Standardization”
- Presented an overview of JAUS
- Recalled how to implement a JAUS-compliant component based upon the emerging RTC specification
- Showed an example of a JAUS-compliant subsystem
  + component definitions
  + message definitions
  + message formats
- suggested that we may be able to use JAUS as a starting point for our activities

Yun Koo Chung (ETRI) ----------
(robotics/2006-06-29)
Korean Intelligent Robot Standardization Forum (KIRSF) contact report
- Robot Unified Platform Initiative (RUPI)
  + initiative to be launched on Jul 4
  + specifications for testing and performance evaluation of commercial home service robots
  + communication protocols for URC robots
  + supports OMG and ISO standardization activities
- Held Korea-Japan Robot Standardization Workshop 2006 on Jun 16th in Jeju, Korea

Action:
AIST made motion to ask Prof Mizukawa to be contact person to ISO TC 182/SC2
JARA seconded motion
ETRI suggested white ballot
Motion passed without dissent

Publicity Committee Report
Abheek Bose (ADA Software)
(robotics/2006-06-30, -31)
- Presented two possible formats for the brochure
- Will send draft of brochure to mailing list to solicit feedback

New Business
(robotics/2006-06-21)
On forming the Contacts Sub-Committee consisting of Chung (ETRI) and Mizukawa (SIT)
- should there be Contacts Sub-committee to be formed (Toku)?
- why do we need this sub-committee (Lemaire)?
- we need to have people be in charge exchanging information back and forth with other organizations (Toku)

Action:
- RTI made motion to form Contact Sub-Committee
- AIST seconded motion
- motion passed w/o dissent

Upcoming publicity activities (Toku)
- IROS 2006 Workshop
  + Oct 9-15, Beijing, China
- SICE-ICASE International Joint Conference

Next meeting agenda was tentatively discussed / proposed (Toku)

Meeting was adjourned at 5:15 pm

Thursday, Michelangelo Suite, 3rdnd FL
09:45 am
Next Meeting Agenda Coordination – Tetsuo Kotoku
(robotics/2006-06-32)
Mon: (WG activity)
  AM: Infrastructure WG(2h) drafting RFP
  AM: Service WG(2h) discussion
  PM1: Profile WG(2h) presentation(IEEE1451) + discussion
  PM2: Steering Committee
Tue: (WG activity)
  AM1: Service WG (2h) presentation (User Identification) + discussion
  PM1: Profile WG (1.5h) discussion
  PM2: Infrastructure WG (2h) discussion
Wed: (Plenary)
  SP1: John Hogg "Introduction to Zeligsoft Component Enabler 2.4?"
  SP2: Bruce Boyes "Microsoft Robotics Studio?"
  SP3: SysML (ManTIS is postpone to the Washington DC (Tue. or Thu.))

10:00 am
Special Talk : "Introduction to OMG Ontology-PSIG" – Elisa F. Kendall
(robotics/2006-06-33)
- Ontology is vocabulary with formal set of rules to "dis-ambiguate" communications
  + Necessary for "reasoning engine"
- Ontology Definition Metamodel
  + Five EMOF platform independent metamodels (PIM)
  + Mappings
  + UML2 Profiles
    * RDF & OWL
    * Topic Maps
  + Generate collateral
  + Conformance

Meeting was adjourned at 11:00 am

Participants:

Hideo Shindo (NEDO-DC)
Yun Koo Chung (ETRI)
Noriaki Ando (AIST)
Seiichi Shin (UEC)
Hung Pham (RTI)
Rick Warren (RTI)
Roger Burkhart (Deere & Company)
Eul Gyoon Lim (ETRI)
Soo Young Chi (ETRI)
Seung-Ik Lee (ETRI)
Fumio Ozaki (Toshiba)
Tomoki Yamashita (Maekawa MFG)
Eijiro Takeuchi (Tsukuba Univ.)
Takashi Tsubouchi (Tsukuba Univ.)

Takashi Suehiro (AIST)
Yeon Ho Kim (Samsung)
Olivier Lemaire (JARA)
Wataru Inamura (IHI)
Tetsuo Kotoku (AIST)
Wonpil Yu (ETRI)
Makoto Mizukawa (SIT)
Hiroyuki Nakamoto (SEC)
Saku Egawa (Hitachi)
Jim Kulp (Mercury)
Glenn Bakecki (Motorola)
John Hogg (Zeligsoft)
Robbin Teegarden (No Magic)
Elisa Kendall (Sandpiper Software)

Prepared and submitted by Hung Pham (RTI) and Olivier Lemaire (JARA).

Robotics-DTF Meeting Kickoff

September 24, 2006

Anaheim, CA, USA

Disneyland Hotel

Boston Review

Boston Minutes review

- **RTC submission recommended for adoption by MARS**
- **1 special talk was given by the Ontology PSIG**
- **Reports received from 3 active Technical WGs**
- **Contact reports received for a number of activities**
- **Contacts Sub-Committee formed**
- **Prof. Makoto Mizukawa was authorized as a contact between ISO TC184/SC2.**

Anaheim Meeting Quorum : 5

Review Agenda

September 25-29, 2006 (Anaheim, CA, USA)

Monday :

Steering Committee

Monday-Tuesday :

WG activities

Wednesday :

Robotics-DTF Plenary Meeting

- Guest and Member Presentation
- WG reports & Roadmap discussion
- Contact reports

Latest agenda is ver.1.0.0

Introduction to RTC

Robotic Technology Component Specification

Second Revised Submission

MARS, September 2006

Anaheim, CA

National Institute of Advanced Science & Technology (AIST)

Real-Time Innovations (RTI)

Timeline

- September 2005: RFP issued
  - ptc/2005-09-01
- February 2006: Initial submissions
  - National Institute of Advanced Industrial Science and Technology (AIST)
    - mars/2006-01-05
    - Japan Robot Association (JARA) and Technologic Arts Incorporated join as supporters
  - Real-Time Innovations (RTI)
    - mars/2006-01-06
- June 2006: Revised submission
  - Joint submission by AIST and RTI
    - mars/2006-06-11
  - Seoul National University (SNU) joins as third supporter
  - Recommended by MARS, but AB raised issues to be addressed prior to adoption
- September 2006: Revised submission
  - Addresses specific AB feedback
  - mars/2006-08-01 (specification), -02 (XMI), -03 (IDL)

Problem Statement

- Domain: Distributed robotic systems
- Process problem characteristics
  - Lack of common programming practices makes collaboration among developers difficult
- Technical problem characteristics
  - Complexity in time and space
  - Behavioral design patterns
    - Periodic ordered execution
      - Strict causality requirement
    - Stimulus response
    - Autonomous components cooperating without timeliness contract

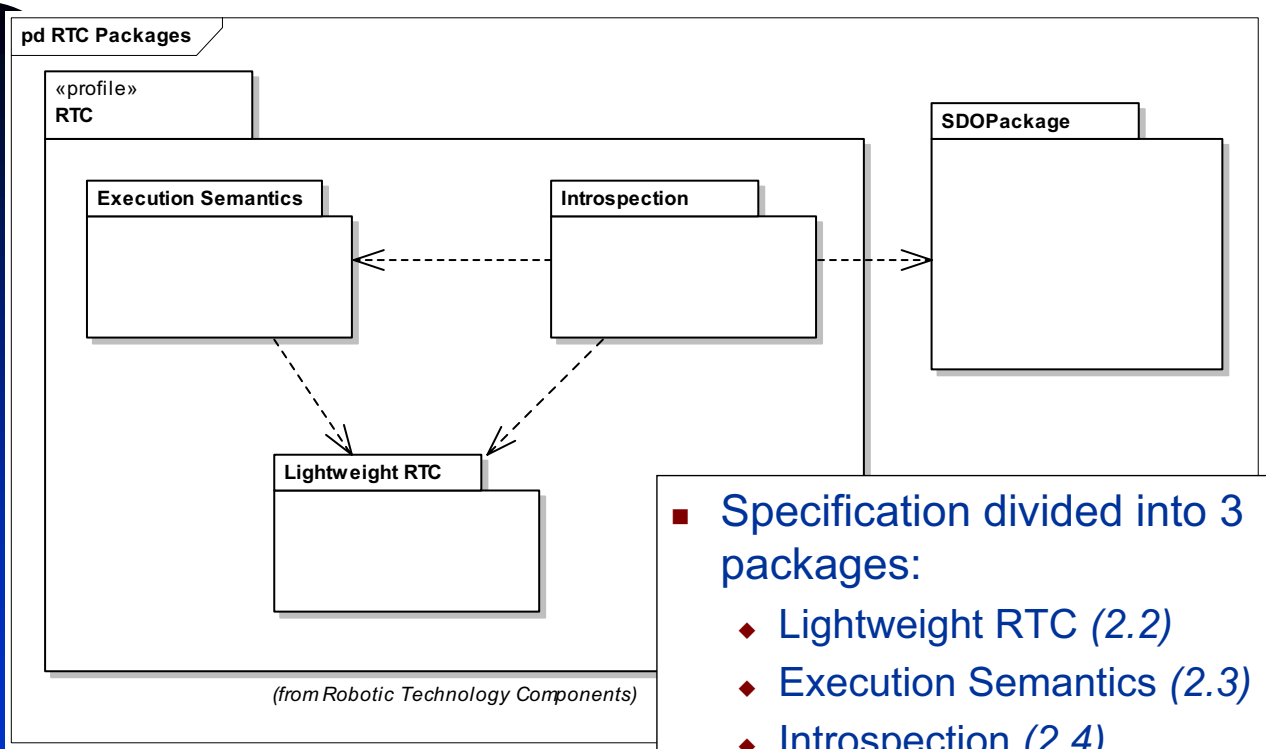
Features of RTC

- Provides rich component lifecycle to enforce state coherency among components *(2.2.2.3)*
- Defines data structures for describing components and other elements *(2.4.1)*
- Supports fundamental design patterns
  - Collaboration of fine-grained components tightly coupled in time (*e.g.* Simulink) *(2.3.1)*
  - Stimulus response with finite state machines *(2.3.2)*
  - Dynamic composition of components collaborating synchronously or asynchronously *(2.4.2)*

Relation to Existing Standards

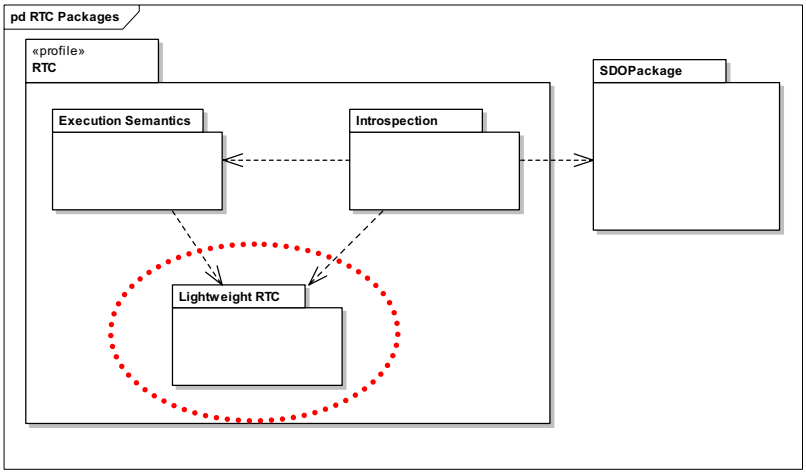
- UML
  - Domain-specific profile for UML components
- Super Distributed Objects (SDO)
  - Introspection of distributed components
  - Ports exposed as SDO services
- May be combined or implemented with another model
  - *e.g.* Lightweight CORBA Component Model
  - *e.g.* Software Radio components

PIM Overview



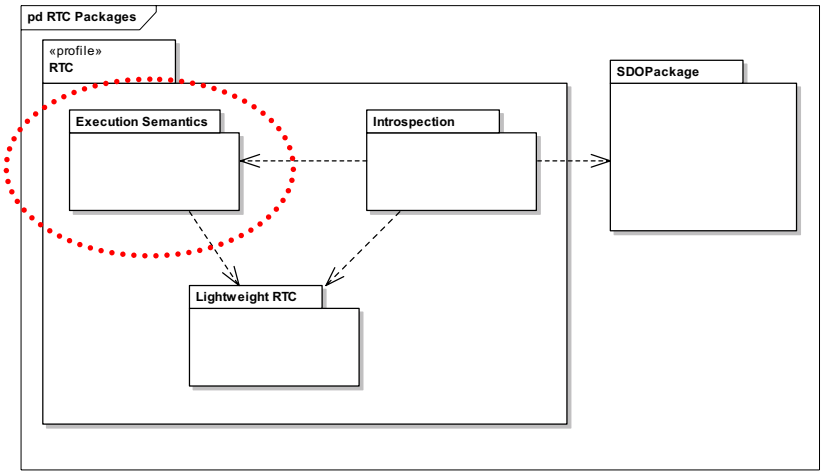
- Specification divided into 3 packages:
  - Lightweight RTC *(2.2)*
  - Execution Semantics *(2.3)*
  - Introspection *(2.4)*

PIM Overview: Lightweight RTC



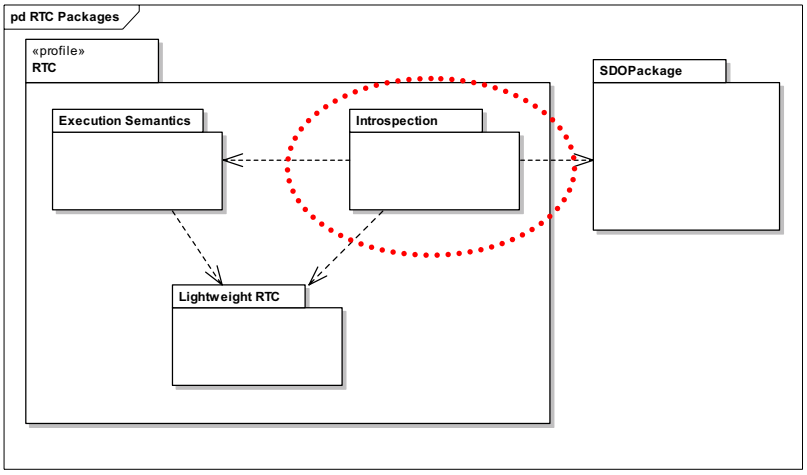
- Lightweight RTC
  - Minimum compliance point
  - Stereotypes and constraints for components, ports, and connectors
  - Component lifecycle
  - Baseline support for component execution

PIM Overview: Execution



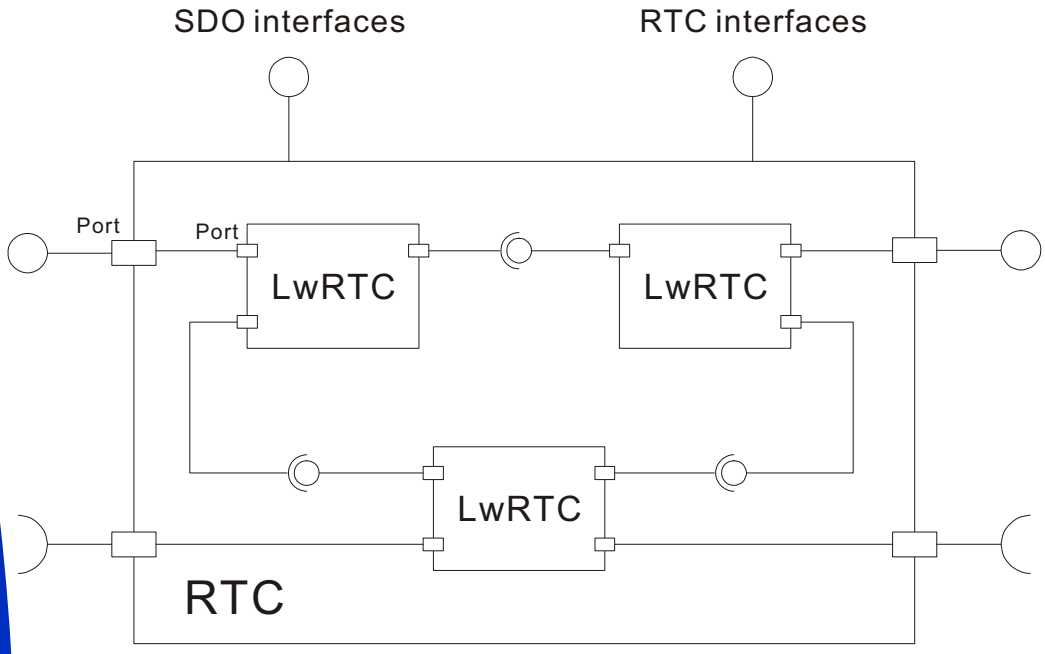
- Execution Semantics
  - Common behavioral design patterns
    - Periodic synchronous execution (“data flow”)
    - Stimulus response/event-driven execution (FSMs)
    - Multi-modal behavior

PIM Overview: Introspection



- Introspection
  - Query and modify component properties and connections at runtime
  - Based on Super-Distributed Objects (SDO)

RT Component Example



Platform-Specific Models

- CORBA IDL *(3.1, 3.2)*
- Lightweight CORBA Component Model *(3.4)*
  - Distributed CORBA-based components
- Local components *(3.3)*
  - Low-overhead communication in a single process

Change Summary

- Changes limited to responses to specific AB issues
- AB Recommendations
  1. Define PSM conformance criteria more precisely
  2. Define PIM-to-IDL mappings more precisely
  3. Clarify modeling of error conditions
  4. Clarify modeling of basic types
  5. Update models and diagrams to eliminate UML 1.x elements

1. PSM Conformance Criteria

- **Issue**: Ambiguity about what level of PSM support was required
- **Resolution**: New language:
  - *At least one of the [PSMs] must be implemented for each of the conformance points … to which conformance is claimed.*

2. PIM-to-IDL Mappings

- **Issue**: Mappings from certain PIM UML features to IDL were ambiguous
- **Resolutions**
  - PIM-to-IDL mapping rules described in more detail and reorganized for clarity
  - Non-normative material removed from PSMs to avoid confusion

3. Modeling of Error Conditions

- **Issue**: Error conditions are reported with `ReturnCode_t` objects, which may be mapped to return codes or exceptions by PSMs
  - Why not model with exceptions explicitly?
- **Resolution**
  - While conceptually elegant, exceptions can be problematic in practice
  - Specification retains `ReturnCode_t` convention, but with additional description
    - This convention has precedent in DDS specification

4. Modeling of Basic Types

- **Issue**: Additional primitive types *(e.g.* floating point types) are defined in the RTC PIM
  - Why not import IDL type definitions from CORBA UML Profile?
- **Resolution**
  - CORBA is a platform w.r.t. RTC
    - RTC PIM dependency on CORBA is inappropriate
  - Specification retains basic types, but with additional description
    - This practice has precedent in SWRadio specification

5. Eliminate UML 1.x Elements

- **Issue**: Update diagrams and XMI to eliminate UML 1.x-isms
- **Resolution**: Tool upgrade provided improved UML2 support

Conclusion

- RTC defines domain-specific extensions to a general-purpose component model
  - Behavioral design patterns
  - Introspection of distributed components
- RTC is founded on proven technologies
  - Existing standards
    - UML
    - SDO
    - CORBA Component Model
  - Existing proprietary middlewares
    - OpenRTM from AIST
    - Constellation from RTI
- New revision addresses all issues raised at last meeting
- Vote(s) Thursday morning

- OMG Robotics DTF-
- Robotic Functional Services Working Group -

Meeting Schedule

- Anaheim TC Meeting -

Anaheim (California, USA) – September 25, 2006

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

Schedule

- Monday 25th
  - 10:00 – 10:30 : WG Steering Committee
  - 10:30 – 12:00 : Robot Localization RFP Discussion
    - *SAIT Expectation on Standards for Robot Localization* (Yeon-Ho Kim - SAIT)
    - RFP for Localization Service for Robotics (Dr Han – ETRI)
    - Discussion
- Tuesday 26th
  - 8:30 – 10:00 : Robot Localization RFP Discussion (cont'd)

Roadmap

Item	Status	St. Louis Apr-2006	Boston Jun-2006	Anaheim Sep-2006	Was. DC Dec-2006	San Diego Mar-2007	TBD Jun-2007
Localization Service	On-going	Topic Discussion	Topic Discussion	Draft RFP	Draft RFP	RFP	
User Identification Service	Stand-by	Proposed	--	?	?	?	?

Steering Committee

- Roadmap Update
  - "User Identification" activity need to gather members
    - Set to Stand-by
  - "Localization Service" RFP issuance postponed to San Diego meeting
- Working Group Renaming
  - The terms "Service WG" and "Profile WG" are confusing. We proposed a renaming to :
    - "Robotic Capability WG"
    - "Robotic Functional Services WG"

Discussion Summary

- Localization service could have a potentially very wide scope that we need to restrict
- Should focus on Developer or User Point of View ?
  - Developer PoV : Define main typical building blocks of localization service so as to distribute them
  - User PoV : Define only the external interfaces
- Should figure out how to evaluate the submissions
- First RFP draft to be written until Anaheim meeting so as to have a base for a focused discussion

Modularized Robot Localization Function

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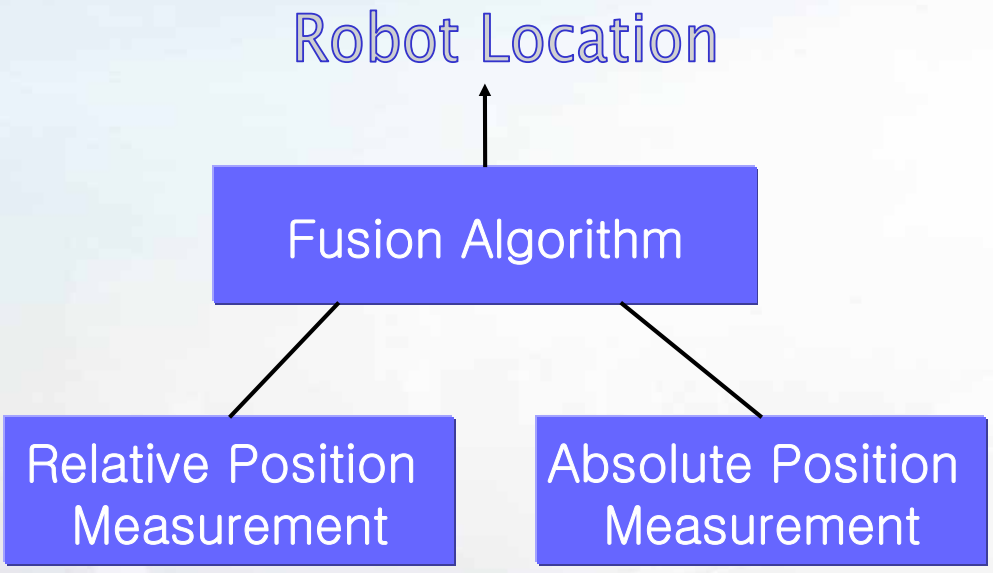
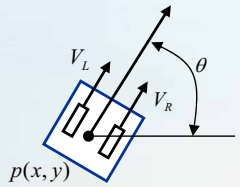
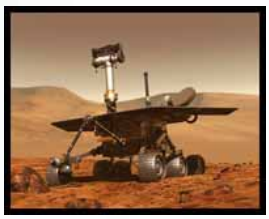
General Robot Localization Function

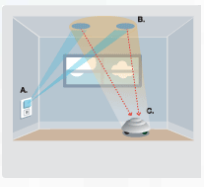


Current Existing Relative Position Measurements

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

[1] 'Where am I' by J. Borenstein, H. R. Everett, and L. Feng

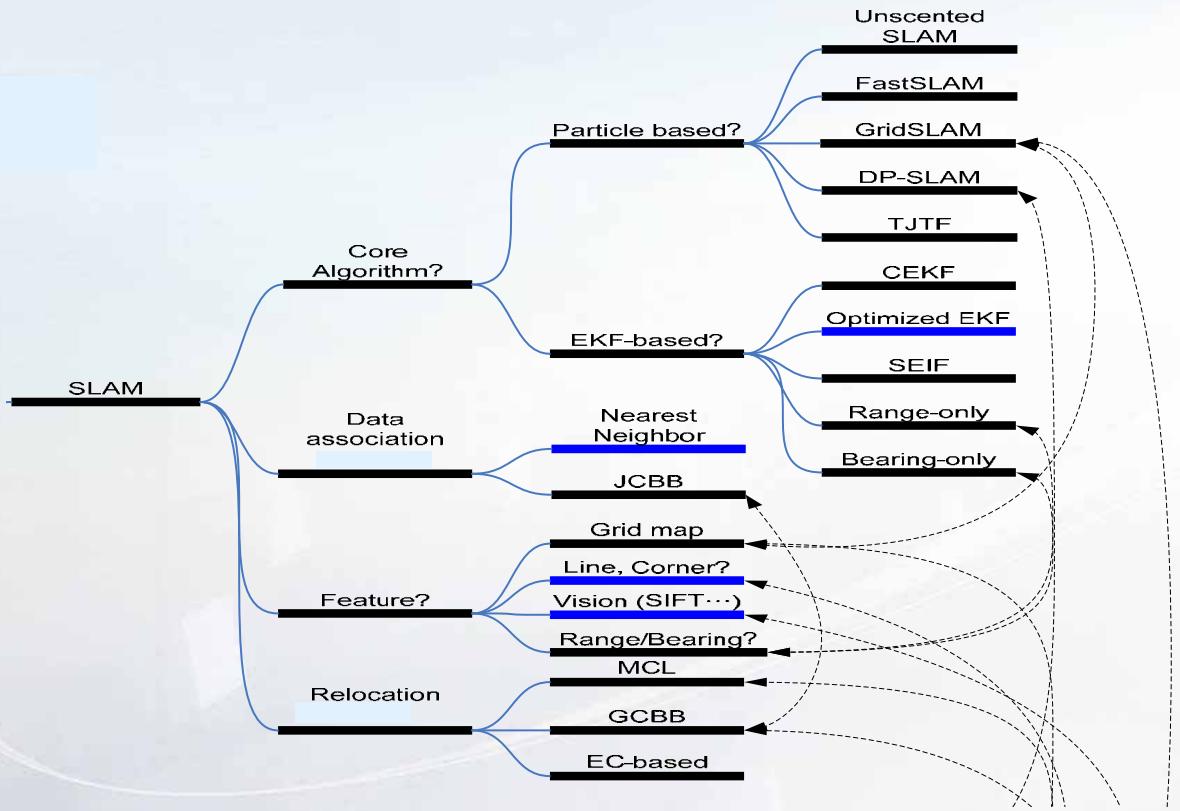
Current Existing Absolute Position Measurements

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

Current Existing Sensor Fusion Methods

Statistical Fusion Methods		Probabilistic Fusion Methods
❑ Least Squares Optimization – Basis of all the statistical estimation method $\hat{x} = \arg\min_x \sum_{j=1}^{k} R_j^{\,2}$ $R_j = (y_j - a_j x)^2$	❑ Kalman filtering – Most popular statistical fusion operator – EKF: for nonlinear system $\hat{x}_k = W_1 \hat{x}_{k-1} + W_2 y_k$	❑ Bayesian Reasoning ❑ Evidence Theory ❑ Robust Statistics ❑ Recursive Operators
• Pros – No explicit assumption about the probabilities – Fast & Simple • Cons – Weak to outliers	• Pros – Well Defined – Easily Decentralized • Cons – Weak to dynamic environment – Unable to use with unknown sensor models	• Pros –Able to use with unknown sensor models by learning – Robust • Cons – Not practical

A Taxonomy of SLAM (Simultaneous Localization And Mapping)



Why We need Modularization

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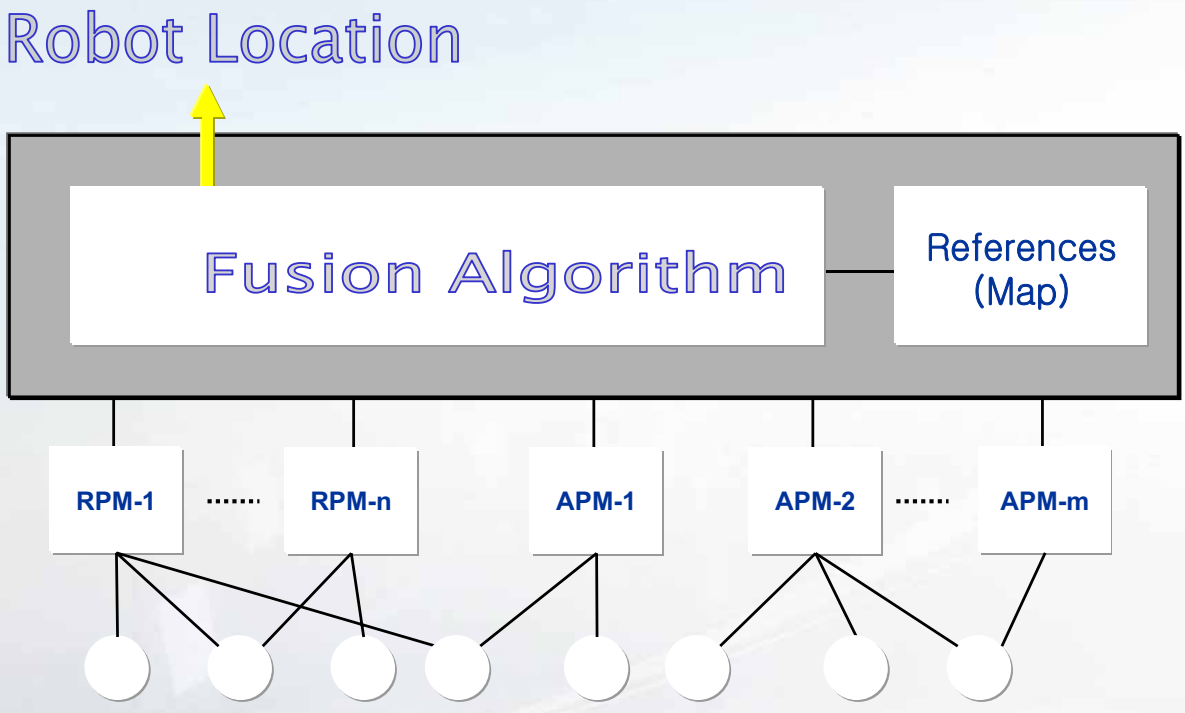
- We believe that modularization of robotic systems and standardization of robotic technology components will greatly help reduce the development and integration cost of robotic systems.
  – from Robotics Systems RFI

- Modularization of the localization problem can reduce the complexity and cost of the localization problem by tackling smaller portions of the problem independently.

Modularized Robot Localization Function

SAMSUNG



RPM: Relative Position Measurement

APM: Absolute Position Measurement

Object Management Group

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Building A Suite 300
Needham, MA 02494
USA

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

Request For Proposal

OMG Document: <taskforce>/YYYY-MM-NN

Letters of Intent due: <month> <day>, <year>
Submissions due: <month> <day>, <year>

<Note to RFP Editors: spell out month name; e.g., January>

Objective of this RFP

< Note to RFP Editors: Provide a brief statement of the problem>

This RFP solicits proposals for the following:

- <Item>
- <Item>
- <Item>

For further details see Chapter 6 of this document.

< Notes to RFP Editors. (1) Instructions to RFP authors are included in this red text. Delete or hide all red notes in your finished RFP. No red text should remain in your RFP! (2) When the actual RFP is in draft form, a truncated document comprising of this cover page , Chapter 6 and Appendix A suffice for review purposes. However, all chapters and appendices must be present in the published version. (3) You MUST replace the running header and footer with the name, document number and date of the RFP. (3) If additional chapters

beyond Chapter 6 and appendices beyond Appendix B are added to the RFP, make sure to include them for the truncated review document, and make sure to insert a brief description of each additional chapter and Appendix in section 1.2. (4) Do not change the contents of any sections other than those mentioned in item (2) above. >

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.

< Note to RFP Editors: Additional RFP-specific chapters may also be included following Chapter 6. If additional chapters are included, please insert brief description of each such chapter here. Insert the additional chapters immediately following Chapter 6, and preceding Appendix A. >

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

< Note to RFP Editors: Please insert any references that are specific to this RFP in section A.1 as per the instructions that appear in that section.

Note to RFP Editors: Please insert any glossary items that are specific to this RFP in section A.2 as per the instructions that appear in that section. >

Appendix B – General References and Glossary

< Note to RFP Editors: Additional RFP-specific appendices may also be included following Appendix B. If additional appendices are included, please insert brief description of each such appendix here. Insert the additional appendices immediately following Appendix B. >

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

In the field of mobile robotics, localization refers to a systematic approach to determine the current location of a mobile robot with respect to a predefined reference frame by utilizing uncertain sensor readings of the robot. Localization technology in the field of mobile robotics has been well studied and a multitude of methods have been proposed so far.

Localization technology may be classified into two groups: 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 installed within the body of a robot. On the other hand, absolute localization utilizes beacons or landmarks whose locations are known with respect to a predefined reference frame. Localization of a mobile robot is carried out by recognizing beacons or landmarks, thereby eventually estimating the current location of the robot with respect to the reference frame. GPS (Global Positioning System) is one of the commercially available absolute localization solutions for outdoor navigation.

Localization solutions differ from one another in accordance with employed sensors, working environment and strategic use for a specific application. For example, kidnapping problem of a robot can only be solved by using absolute localization, whereas relative localization in this case dose not provide an effective means to recover from kidnapping. In addition, 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 which can handle a broad spectrum of robotic applications. Meanwhile, new markets utilizing localization technology are emerging: wireless sensor network, RTLS (Real Time Locating System) as well as mobile robotics, localization technologies of which may be readily employed for robotic applications. Collectively, the aforementioned broad spectrum of robot hardware and software platforms, sensors, applications, and so on adversely affect the development of a robotic system which utilizes location information, thereby impeding interoperability, reusability, and portability of robotic programs. Therefore, it is very important to standardize a localization function, since a robot must utilize location information of itself and nearby objects in question in

order to realize robotic services based on mobility. We call the localization function in this context as “Localization Service”.

To state it in a general terminology, localization service refers to a mechanism or function for mapping a physical object of some sort to its corresponding location. Localization service is a software component which takes in raw sensor readings, calculates the location of an object or a robot with respect to a given environment map, and provides the estimated location data in response to an application’s request. Figure 1 illustrates an exemplary structure of a localization service component.

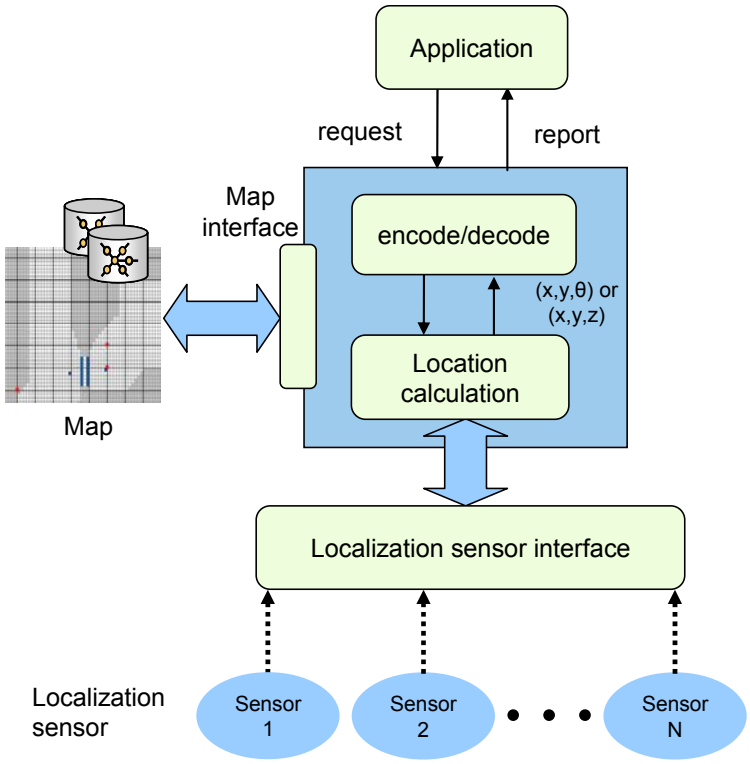


Figure 1: Structure of a localization service component

The localization service component of Figure 1 consists of four basic modules: sensor interface module, location calculation module, encoding/decoding module, and map interface module.

A sensor interface module carries out various low level tasks, mainly preparing raw sensor readings to be appropriate for location calculation. Coordinate transformation, time synchronization, low level signal processing, and so on can be included in the sensor interface module. Since there is a plurality of localization sensors, it is a formidable task to provide a unified way of representing sensor readings in order for them to be readily used at a location

calculation module. However, an emerging standard for sensor data interface (e.g., IEEE1451) may be effectively utilized to realize a widely-applicable sensor interface module.

A map interface module should be provided in order for a location calculation module to carry out estimation of the current location of an object or a robot by retrieving location data of employed localization sensors. The map interface module also carries out recording the current location of the object on the map in a prescribed map data format. The map data are then used for a presentation service for a remote user or developer to view the current geographic situation of the environment in question. Generally, a map is necessary for absolute localization; localization information obtained from relative localization can be combined with that from absolute localization in order to enhance reliability of a localization result.

An encoding/decoding module carries out a function to transform coordinate data into semantic spatial data so that an application incorporating space ontology can easily utilize the location data provided by a location service component. Conversely, when location data from a third party comes into the localization service component in the form of a semantic data (e.g., I see my robot is standing next to my desk, update this new location of the robot in the map), the semantic data should be properly interpreted into a coordinate data to update the map data.

Finally, a location calculation module is a core function that any localization service component should implement internally to calculate the coordinate data of an object or a robot with reference to a predefined coordinate frame. The location calculation module should also be able to provide representation of uncertainty embedded in the estimated location data, which is closely related to semantic processing afterwards and/or implementing robot navigation or tracking in a probabilistic framework such as Kalman filter.

Localization service component can be located within a robot body or in a remote server, which for the latter case, is then connected wirelessly to various constituting elements of a localization service.

6.2 Scope of Proposals Sought

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

It is necessary to consider the following in the specification of a localization service component:

1. The proposed localization service component (hereinafter, it is called as 'LSC' for short) specification should describe a general structure thereof to realize development of a variety of robotic applications utilizing localization information.

2. The structure or framework of the proposed LSC should satisfy interoperability and reusability to cope with a myriad of robotic applications and working environments.

3. The proposed LSC specification should describe how it is interconnected to an external application component and localization sensors. Relevant input and output data specification of the proposed LSC should be provided to explain the interconnection with external components.

4. The proposed LSC specification should describe how it is interconnected to map data. Along with the issue of handling map data, the proposed LSC specification should provide a mechanism to handle semantic spatial data.

5. The proposed LSC specification should describe how it implements a localization sensor interface module. Uncertainty of sensor readings should be incorporated to a location calculation module; subsequently, estimated uncertainty of location information should be provided at the request of an external application component.

6. Benefits from adopting the proposed LSC should be validated. Important points are how a plurality of robotic applications utilizing localization information can be realized by the proposed LSC; how the proposed LSC successfully realize localization of different scales—absolute, relative localization, and a hybrid of both; and how the proposed LSC eases effort during development of a robotic application based on localization.

7. Real-time operation is especially important for localization service. The proposed LSC specification should be able to demonstrate its real-time support.

6.3 Relationship to Existing OMG Specifications

< Note to RFP Editors: Describe the possible relationships that proposals may have to existing OMG specifications in terms of potential reuse of models, mappings, interfaces, and potential dependencies on pervasive services and facilities. >

6.4 Related Activities, Documents and Standards

- Open Geospatial Consortium (There are a bunch of implementation specifications)
- Open Mobile Alliance
- Geography Markup Language
- ISO
- Search and write down existing standards!!!

6.5 Mandatory Requirements

Proposals shall provide a platform independent model (PIM) and at least one platform-specific model of LSC. The models shall meet the following requirements:

1. Proposals shall specify common interfaces for localization sensor interfaces to transfer data and commands.
2. Proposals shall specify common interfaces for map interfaces to transfer data and commands.
3. Proposals shall specify sensor data formats as well as map data formats for coherent location calculation.
4. Proposals shall specify a transformation mechanism from coordinate data to semantic spatial data and vice versa.

6.6 Optional Requirements

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 utilizing the proposed LSC.
- Proposals shall discuss simplicity of implementation and extension to other fields of technology such as sensor networks, RTLS, and so on, which will demonstrate the versatility of the proposed LSC.
- Proposals shall discuss how the proposed LSC works seamlessly with RTC specification.

6.8 Evaluation Criteria

Proposals will be evaluated in terms of consistency in their specifications, feasibility and versatility across a wide range of different robotic applications based on localization information.

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	
RFP placed on OMG document server	*"Three week rule"*
Approval of RFP by Architecture Board *Review by TC*	
TC votes to issue RFP	*<approximate month>*
LOI to submit to RFP due	*<month> <day>, <year>*
Initial Submissions due and placed on	*<month> <day>, <year>*

OMG document server ("Three week rule")	
Voter registration closes	*<month> <day>, <year>*
Initial Submission presentations	*<month> <day>, <year>*
Preliminary evaluation by TF	
Revised Submissions due and placed on OMG document server ("Three week rule")	*<month> <day>, <year>*
Revised Submission presentations	*<month> <day>, <year>*
Final evaluation and selection by TF *Recommendation to AB and TC*	
Approval by Architecture Board *Review by TC*	
TC votes to recommend specification	*<approximate month>*
BoD votes to adopt specification	*<approximate month>*

< Note to RFP Editors: Insert additional chapter if needed here and update the list and brief description of chapters in Chapter 1. >

Appendix A References and Glossary Specific to this RFP

A.1 References Specific to this RFP

< Note to RFP Editors: Insert any references specific to this RFP that are referred to in the Objective Section, Section 6 and any additional sections in the same format as in Section B.1 and in alphabetical order in this section. >

A.2 Glossary Specific to this RFP

< Note to RFP Editors: Insert any glossary items specific to this RFP that are used in Section 6 and any additional sections in the same format as in Section B.2 and in alphabetical order in this section. >

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.

< Note to RFP Editors: Append additional appendices if needed here and update the list and brief description of appendices in Chapter 1. >

Introduction to localization service RFP

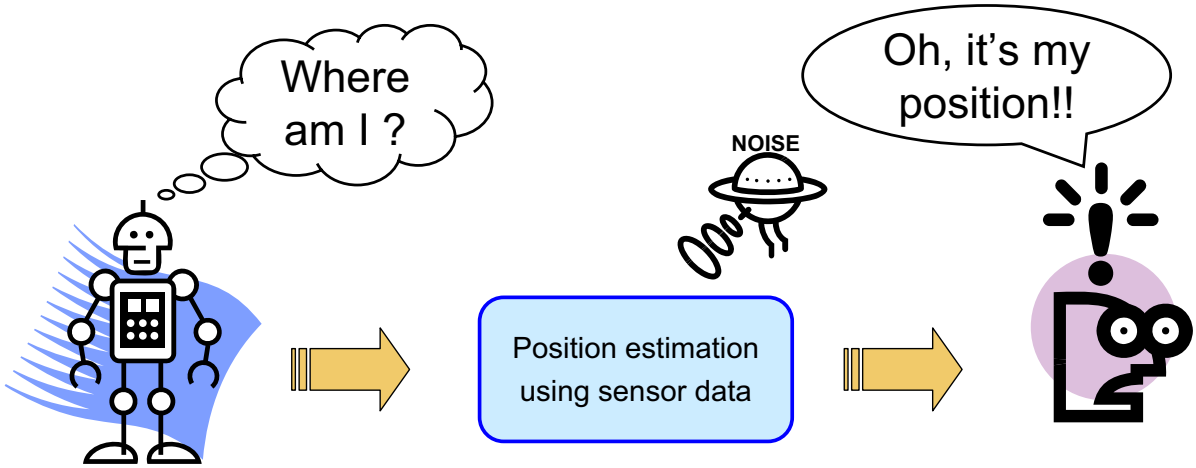
2006. 9. 25.
Kyuseo Han and Wonpil Yu
ETRI Intelligent Robot Research Division

Contents

- Why need to standardize localization
- A definition of localization service
- Scope of a successful proposal for localization service
- Mandatory requirements
- Issues to be discussed

What is localization in mobile robotics?

- Localization
  - A systematic approach to determine the current location of a mobile robot with respect to a predefined reference frame by utilizing uncertain sensor readings of the robot



Categorization of localization technology

Relative Localization
- Known initial location
- Odometry, inertial navigation
- Encoder, gyroscope, accelerometer, etc.

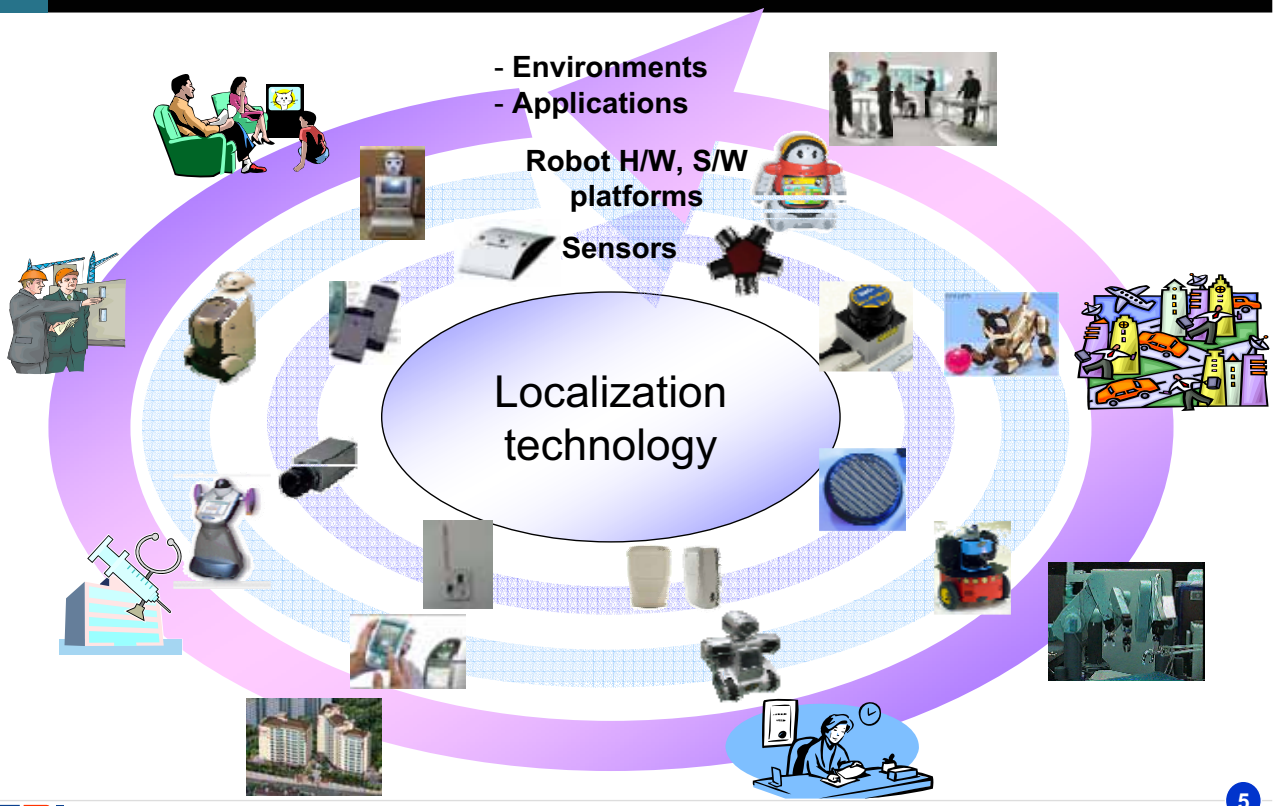
Absolute Localization
- Given reference frame
- GPS, Markov localization, particle filter
- Beacon, landmark

Exceptional

Kidnapped Problem
- Misleading initial location
- Markov localization, particle filter
- Beacon, landmark

Why need to standardize localization

Ecosystem of localization technology



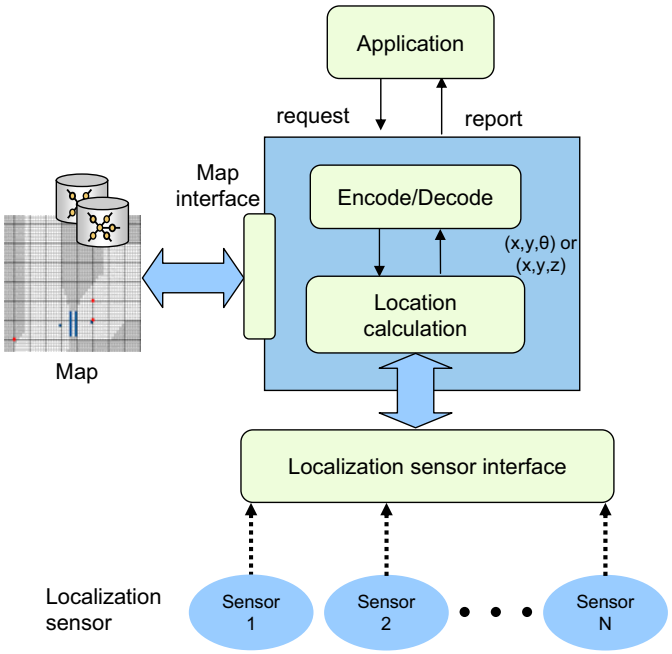
A definition of localization service

Needs for localization service

- A localization service is needed
  - To map physical objects to the corresponding locations
  - 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 location information

A definition of localization service

Conceptual structure of a localization service component



A definition of localization service

Roles of individual modules

Primarily for absolut localization
- Providing location
sensors
- Reco
locatio

Location calculation
- Fusion of relative and absolute localization

raw sensor data culation
ransform
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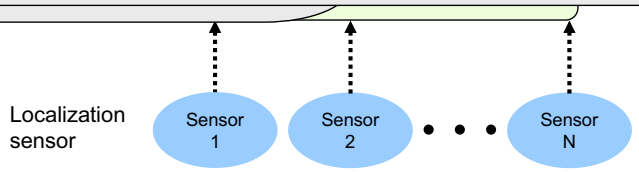
c.

Tra

Localization service component can be located either
- **Within a robot body or**
- **Within a remote server**



Scope of a successful proposal for localization service

A localization service component (LSC) should...

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

Scope of a successful proposal for localization service

A localization service component (LSC) should...

- Describe how it is connected to map data
  - A mechanism to handle semantic spatial data, too
- Describe how it implements a localization sensor interface module
  - Uncertainty handling of sensor data
- Validate benefits from adopting proposed LSC
  - How various applications can be realized
  - How relative, absolute, and a hybrid of both realized
  - How development effort can be eased
- Demonstrate real-time support

Mandatory requirements

- Provide PIM and at least one PSM of LSC
  - Specify common interfaces for localization sensor interfaces
  - Specify common interfaces for map interfaces
  - Specify sensor data formats as well as map data formats for coherent location calculation
  - Specify a transformation mechanism from coordinate data to semantic spatial data and vice versa

Issues to be discussed

- A proposal shall
  - Demonstrate its feasibility by using a specific application based on the proposed LSC
  - Discuss simplicity of implementation and extension to other fields of interest such as WSN, RTLS, and so on
  - Discuss how the proposed LSC works seamlessly with RTC specification

Things to do

- Review and revise the RFP draft
- We need to complete
  - Relationship to existing OMG specifications
  - Related activities, documents and standards

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

Profile WG Meeting

(OMG Boston Meeting)
2006.06.26 (13:00~15:00)

Seung-Ik Lee, co-chair of Profile WG

2006-09-27

Topics

- **Review of previous meeting**
- **Discussion on this meeting**
  - Typical devices
  - Top-down or bottom-up
  - Scope
  - Nomenclature and classification
  - Level of granulites
  - Size of specification
  - Integration with other existing standards
- **Roadmap discussion**

St. Louis Meeting (2006.04.26)

- **Agreed to use mailing list to carry on significant progress between meetings**
- **Chartering**
  - Mission Statement and Road Map

Perspectives

Application programmer's view

Overview

- **Application programmers should have an easy-to-use and abstract access to physical resources (like OSI layers 5-7)**
- **This what we typically think of as the “API”**

Mission Statement

- **Define scope and model of API**
  - devices used in any robotics field
  - starting with office or home domains
- **Define typical devices**
- **Device hierarchies (like class hierarchies)**
- **Define interfaces & Data structures**
  - Consider standards such as JAUS
- **Device Profiles**
  - Enumeration of available resources
  - Resource configuration and capabilities

Physical transducer and resource view

Overview

- Details of addressing and hardware interfaces are handled here (like OSI layers 1-4)
- This is what developers of hardware (transducers, communications, and other such physical devices) will use to create an abstracted and easy-to-use interface for application programmers.

Mission Statement

Apply relevant standards (IEEE, etc) to robotics

- **Smart sensors IEEE-1451**
- **Precision networked clock IEEE-1588**
- **Arrange presentations on the above at OMG meetings**
  - 1451 in Anaheim?
  - 1588 in Wash DC? (near NIST)

I/O point tagging, provides

- **Enumeration of available resources**
- **Storage of configuration and capabilities**
  - on the actual device or as close to it as possible

Boston Meeting (2006.06)

Issues to be Discussed

Proposal of typical devices

- Robot itself (we need to, say, turn it off or on)
- Differential wheel type (more generally speaking, movement devices)
- Head (pan & tilt devices)
- Camera (for getting images and others)
- Proximity sensors (such as IRs and sonars)
- Bumpers (collision detection)
- Battery Monitor
- Speaker
- Mic
- RFID

Proposal of typical devices (2)

- Gyros
- Accelerometers
- Odometry
- Wireless sensor device (e.g., Zigbee-enabled sensing devices)
- Display

Top-down v.s. bottom-up approach

- **Top-down**
  - First define what a "Device" in general is in an abstract way, what makes a device component (in contrast to a pure software component). Then, derive the definition to more specific devices)
- **Bottom-Up**
  - First define ad-hoc interfaces of devices and hope we will find commonness

Scope

- **What kind of devices are candidates for standardization**
- **Application area or domains**
  - Not necessary
  - Should we confie the scope to only service robotics ?

Define the nomenclature and classification

- **a Bumper could be considered as a proximity sensor (distance = 0)**
- **Can a Battery be considered as a device**
- **A Pan-Tilt Camera is a Head**

Level of granulity

- **Named after the kind of data they treat**
  - Accelometers
  - Proximity sensors
- **Named after technology**
  - RFID

One big specification?

- How we manage extensions?
- Definition of all these "devices" will be bundled into one big specification, into several unitary specification

Integration with other existing standards

- IEEE-1451
- JAUS

Naming of our WG

- **Robotic Device and data profiles WG !!!!**

Roadmap discussion

- **Any need to update or change the roadmap? → no need!!**

Roadmap for Robotics Activities

Item	Status	St. Louis Apr-2006	Boston Jun-2006	Anaheim Sep-2006	DC Dec-2006	TBD Mar-2007	TBD Jun-2007	TBD Sep-2007	POC / Comment
Programmers API: Typical device abstract interfaces and hierachies RFP [Profile WG]	Planned	Topic discussion	Topic discussion	draft RFP	Review RFP	RFP		Initial Submission	Proposed by Lee
Hardware-level Resources: define resource profiles RFP [Profile WG]	Planned	Topic discussion	Topic discussion	draft RFP	Review RFP	RFP		Initial Submission	Proposed by Boyce

Topics to be included in the RFP

- **How do you define devices?**
  - The difference between devices and services?
- **Several aspect can be considered to define a device :**
  - Data it deals with (input / output)
  - Physical Characteristics
  - Physical action on environment
  - -> How to combine all these aspects

- **For each aspect :**
- **Provide device classification system related to a given aspect**
- **How to manage composite devices? Virtual Devices ? From a given aspect point of view**
- **How can definition apply to any platform?**
- **How to enumerate devices present in a system from a given aspect point of view?**
  - What are requirements for enumeration (what does a query look like)
  - (list up all devices present in a robot)

- **How to manage device configuration and introspection**
- **How to integrate existing standards**
- **Discussion : As a proof of concept, provide definition main devices fond in home/service robot (give definition)**

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- **How to manage device configuration and introspection**
- **How to integrate existing standards**
- **Discussion : As a proof of concept, provide definition main devices fond in home/service robot (give definition)**

Robotics DTF
Steering Committee Meeting

September 25, 2006

Anaheim, CA, USA

Disneyland Hotel

Agenda

- Agenda Review
- Minutes
- Publicity
- Re-Charter
- Roadmap Discussion
- Next meeting Schedule

Review Agenda

Mon(Sep.25): Coronado D, Marina

Service WG, Profile WG, Steering Committee, Joint MARS-PTF(RTC RFP submission)

Tue(Sep.26): Coronado D, Marina

Service WG, Profile WG, Infrastructure WG, Special Talk (SysML), Space Info. Day

Wed(Sep.27): Balboa, Sierra

TF Plenary

Thu(Sep.28): Coronado D, Marina

MARS-PTF(RTC voting), WG activity follow-up

Joint Meeting with MARS/RTESS
Thursday, Sep. 28, 2006
10:00-10:30 (Avalon A, Marina)

Minutes

- 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 Disneyland Meeting
  - Hung Pham (RTI)
  - Olivier Lemaire (AIST)

We have to post our meeting minutes within a week!

Publicity Activities

- 4 page fly sheet
  Draft of Abheek@ADA Software
  Abheek@ADA Soft,
  Olivier@AIST,
  Chung@ETRI,
  Yokomachi@NEDO

Action:

Send each organization logo to Abheek.

4 page fly sheet will be authorized in Anaheim

AIST

Publicity Activities

- IROS2006 Workshop
  October 9-15, Beijing, China
  http://www.iros2006.org/
  Kotoku@AIST, Chung@ETRI, Mizukawa@Sibaura-IT
- SICE-ICASE International Joint Conference
  October 18-21, Pusan, Korea
  http://sice-iccas.org/
  Mizukawa@Sibaura-IT

NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST)

Re-Charter of Robotics-DTF

Proposal by Hung Pham

- Make attractive expression
- To understand easily by outsiders

Revised version will be proposed at the plenary

Organization

OMG OBJECT MANAGEMENT GROUP

Robotics-DTF
- Yun-Koo Chung (ETRI, Korea)
- Tetsuo Kotoku (AIST, Japan)
- Hung Pham (RTI, USA)

Steering Committee — All volunteers

Publicity Sub-Committee
- Abheek Bose (ADA Software, Indea)
- Masayoshi Yokomachi (NEDO, Japan)
- Olivier Lemaire (AIST, Japan)
- Yun-Koo Chung (ETRI, Korea)

Contacts Sub-Committee
- Makoto Mizukawa (Shibaura-IT, Japan)
- Yun-Koo Chung (ETRI, Korea)

Technical WGs

Infrastructure WG
- Noriaki Ando（AIST, Japan）
- Rick Warren (RTI, USA)
- Saehwa Kim（SNU, Korea）

Robotic Services WG
- Soo-Young Chi (ETRI, Korea)
- Olivier Lemaire(AIST, Japan)

Profile WG
- Bruce Boyes (Systronix, USA)
- Seung-Ik Lee (ETRI, Korea)

Next Meeting Agenda

Dec. 4-8 (Washington DC, USA)

Monday:

Steering Committee (Mon morning)
WG activity [3WG in parallel]

Tuesday:

WG reports, Joint activity with other SG

Wednesday :

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

Thursday:

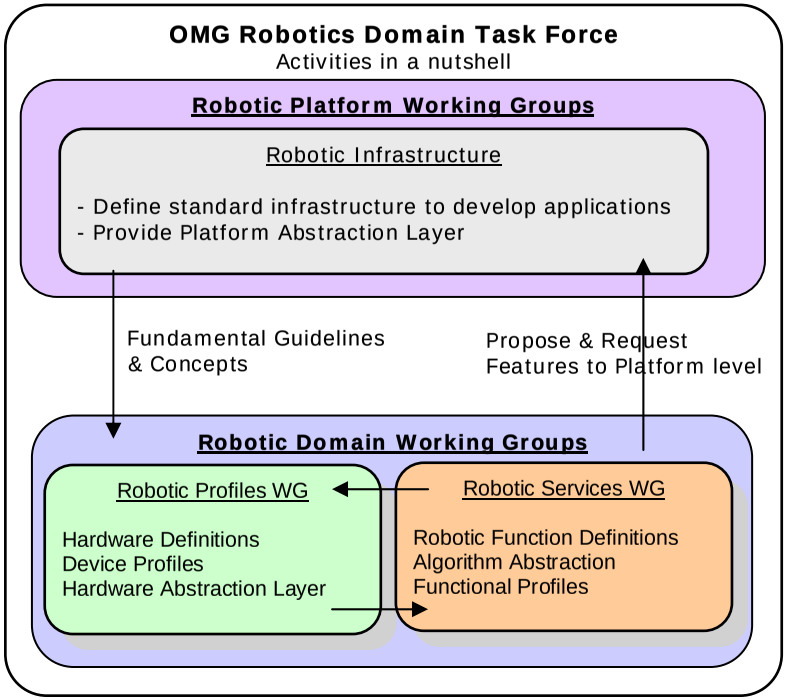
WG activity (optional)

AIST

Next Meeting Agenda

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

We have to post our preliminary Agenda a month before!



More info abt WGs??
News and Events
Timeline and Roadmap (for each WG??)

Feedbacks from Yokomachi-san

- Motivation and Goals
  - Why we need standards
- Proposed Methods
- Targets of the DTF
- Structure of the Working Groups
  - DTF and its Sub TFs
- Mission Statement (must make it short)
  - From the Robotics POV
- Description of the WGs
  - Profile
  - Infrastructure
  - Services
  - Tools ??
- News and Events attended
- Related Organisations
  - ISO, IEEE, OASIS, etc - how to mention them (subtle but clear)
- Weblinks , URL
- Invitation to contribute to the standardisation drive
  - What can we do!

Japan Robot Association (JARA)

java.net

NEDO 技術開発機構

OBJECTIVE INTERFACE

ogy Collaboration

MODEL DRIVEN ARCHITECTURE

UNIFIED MODELING LANGUAGE

CORBA

MOF Meta-Object Facility

XMI

OMG OBJECT MANAGEMENT GROUP

Robotics Domain Task Force

Perhaps some pictures of a few robots

(If it can indicate standards, it would be nice!)

A SLOGAN!! PUNCHLINE!

- **TBD – Homework!**

Join Us!

Membership Information

Websites

Etc etc

Robotics DTF Contacts

Workgroup Contacts

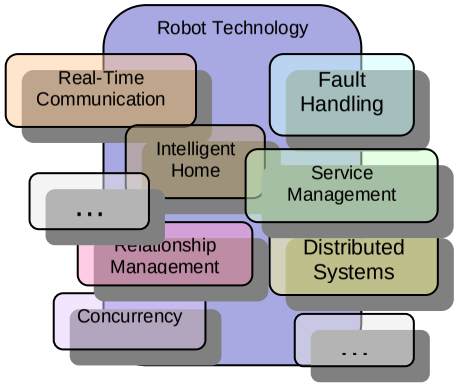
b

About Object Management Group & the Robotics DTF

The Object Management Group (OMG), home to UML, CORBA and other such technologies, is a not for profit consortium targeting the production and maintenance of the computer industry specifications for interoperable enterprise applications. The Robotics Domain Task force aims to establish such standards for the Robotics Industry.

Focus and targets

Robot Technology is a complicated mix of various domain technologies and as a result very complicated to form a common standard. To make things more challenging, key players in the industry today develop their own unique standards which act against inter–operability



The Robotics DTF in OMG addresses these issues by:

- adoption of existing OMG standards to the domain
- extending OMG technologies to robotic applications
- form a bridge between OMG and Robotic communities
- collaborate with other similar organisations like ISO, IEEE, OASIS to encourage interoperability
- coordinate with other task forces in OMG to develop common standards

Established Working Groups & their focus

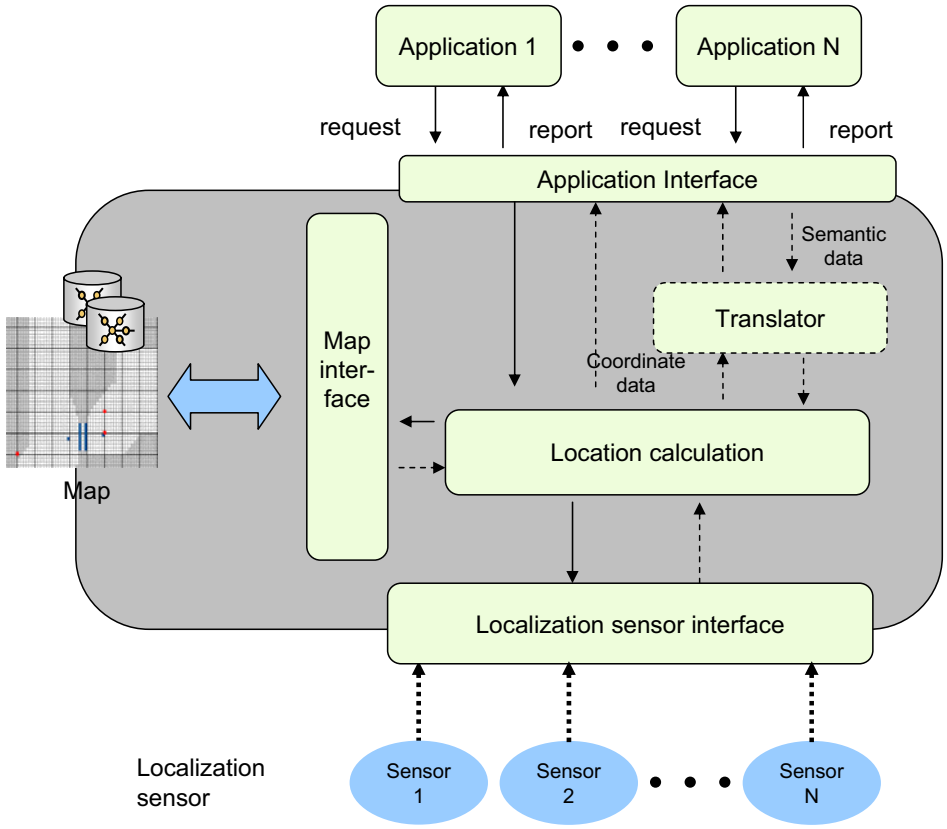
A survey was conducted amongst the DTF members to determine the important aspects within Robotics to be standardised. Resulting from the survey, three workgroups were formed:

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

Working Group Diagram Pending

A definition of localization service

Conceptual structure of a localization service component



OMG Anaheim Robotics DTF Wireless Robot Sensors: SunSPOTs

Bruce Boyes
Technical Director, Systronix Inc
Co-chair, OMG Robotics DTF Profile WG

Eric Arseneau
Principal Investigator, Sun Microsystems

What we'll cover today:

- Small review of why we need standards
- Wireless sensors used with mobile robots
- SunSPOTs – what are they?
- Advantages of Java on sensors and robots
- Several hands-on demonstrations!
- Plans for Oct-Nov and Dec OMG meeting

Why we are all here: (quoting NEC RFI 06-02-02)

- Developing behavior of robot in real application is a huge task. (We once developed a huge program but it last only three weeks. After three weeks user get bored as they enjoy all contents.)
- We want to develop application more efficiently, so that researcher can take a rest.
- There was no appropriate software platform for our robot. So we developed by ourselves.

Review: why robot standards:

- Develop compelling robots easily
- Make practical collaborative robot teams/swarms
- Maximize safety and reliability
- Make robots more accessible to all, less arcane
- Learn from Eclipse IDE vs 100+ custom IDE
- Must be useful in practical applications or they will be largely ignored

The Future Internet of "things"

What if we could:

- Extend the sensing range of robots
- Attach wireless sensors to any robot
- Wireless between sensors and robots?
- Route messages along sensors to robots and base stations
- Sensors have enough CPU to process data
- Sensors have a powerful OO language?

Smart Wireless Sensors

(We already have plenty of dumb sensors with wires)

- Smartness
  - Enough processing power to store, process, analyze and route data. “Real” programming language.
  - Easily add more (wired) sensors to a node
  - Could be a small robot brain
- Wirelessness
  - Ad-hoc networks, interoperate with other sensors, PDAs, HVAC, mobile robots, and the world!

SPOT: Small Programmable Object Technology

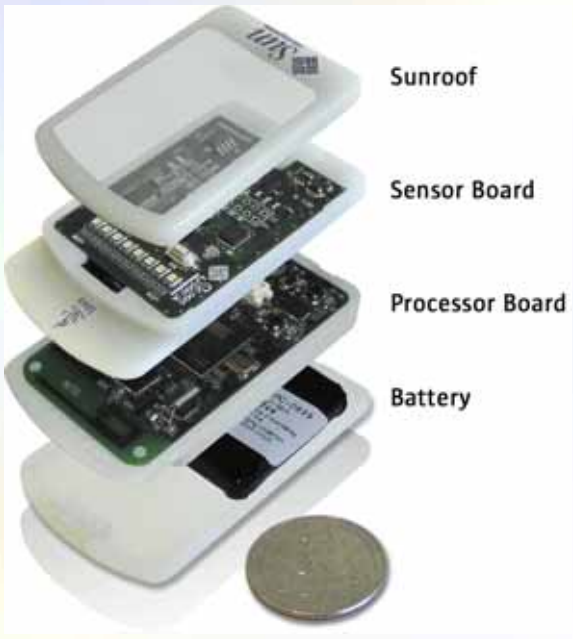
- 180 Mhz ARM 9, 4 MB ROM, 0.5 MB RAM
- J2ME/CLDC 1.1
- Sensor/LED board
- 802.15.4 radio
- USB slave interface
- Rechargeable battery
- Stackable boards 64 x 38 mm

Demo: Remote Reacto-Matic

- Two SPOTs transmit 3-D accelerometer data to each other
- Color = axis
- 8 LEDs = magnitude (2G or 6G full scale)

SPOT Anatomy

- Basic device has three layers
  - Battery
  - Processor Board with Radio
  - Sensor Board (application specific)
- Processor Board alone acts as a base-station
- Program entirely in Java using standard Java tools



Example Sensor Board

- 2G/6G 3-axis accelerometer
- Light sensor
- Temp sensor
- 8 RGB 24 bit LEDS, power/control LED
- 2 push buttons, 6 analog inputs, 5 General Purpose I/O pins and 4 high current output pins
- Easy to interface to servos, speakers and other devices

Demo: Ectoplasmic Ball

- Virtual electronic ball in a virtual tube
- "corks" can be removed from tube ends
- 802.15.4 joins the tubes, actual ball object passes between SPOTs
- Two balls merge if they rest together
- PC simulator and base station can interact with SPOTs!

More than just sensors:

- Robotics
- Security/access control
- HVAC/energy control
- Art
- Toys
- Personal Electronics
- Program the world!

Why *Java* on a *Sensor*?

- Ease of development
- Reliability and re-usability
- Java end to end in your whole project
  - sensor to server
  - Same IDE and same programmers on all
- No special “sensor OS” to learn
- High level features make your life easier

SPOTs offer

- Powerful CPU which lets you
  - Process and reduce data in place
  - Route messages (including mesh networks)
  - Lots of memory for local data storage
- standards compliant OO HLL (Java)
- Standard 802.15.4 radio
- Easily expanded – add wired sensors to SPOTs

Demo: Air Text and Develop/Deploy

- Persistence of vision & LED array
- Accelerometer times display of data
- Text appears to float in the air
- Text is easily changed and app re-deployed

OMG Standards Issues

- OMG robotics standards should encompass mixed robot and wireless sensor systems. Wireless sensors may have limited resources.
- Such sensors can work with autonomous or server-based robots.
- Smart sensor (IEEE-1451) and time synchronization (IEEE-1588) can apply both to wireless sensors and mobile robots.

Dec OMG Goals

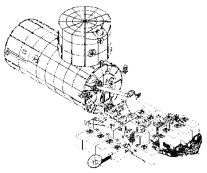
- Major Proof/Demo:
  - Microsoft Robotic Studio, with J# and C#
    - Simulation of platform in real world if possible
    - Code deployment if possible
    - Debugging and control
  - JVex mobile robot platform w/Java and C
  - 802.15.4 radio from PC to robots
  - SunSPOTs with added sonar and PIR sensors

Demo: Visualization

- SPOT broadcasts (802.15.4) accelerometer data
- Base station attached to PC receives the data
- PC displays model of SPOT on screen
- PC graphs all axes of data

References

- http://www.sunspotworld.com
  - The official sunSPOT support website
- http://www.sunspot.systronix.com
  - (including some benchmarks)
- http://robotics.omg.org
- http://community.java.net/robotics/
  - Eventually will have sunSPOT projects



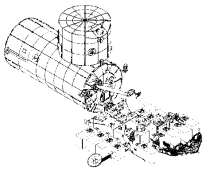
Japanese Experiment Module

Space Robotics in Past, Current and Future

2006/ September /26

Hiroshi Ueno

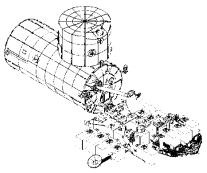
JEM Development Project Team
Japan Aerospace Exploration Agency (JAXA)



Japanese Experiment Module

Presentation Outline

- Teleoperated Robot Experiments on Satellite (ETS-VII)
- Manned Practical Use Robot System on JEM('Kibo') (JEMRMS)
- Future Space Robotics Activities

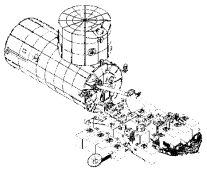


Japanese Experiment Module

ETS-VII Satellite

Main Characteristics

- Launch November 28,1997 by H-II Launch Vehicle
- Orbit Altitude : 550km, Inclination : 35deg.
- Weight 2,860kg, Chaser : 2,540kg, Target : 410kg
- Attitude Control Chaser&Target : Three-axis stabilized
- Life 1.5 years
- Dimensions Box shape with solar paddles

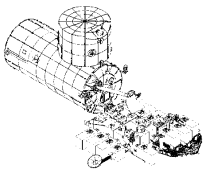


Japanese Experiment Module

ETS-VII Robot Experiments

Robot Experiments

- To acquire the basic technology of a teleoperation space robot and the engineering data for the development of future advanced space robot.
- The following experiments are carried out.
  - The co-operative control between the space robot arm motion and the satellite attitude.
  - The teleoperation of the space robot from the ground.
  - The exchange of equipment in orbit using the space robot.

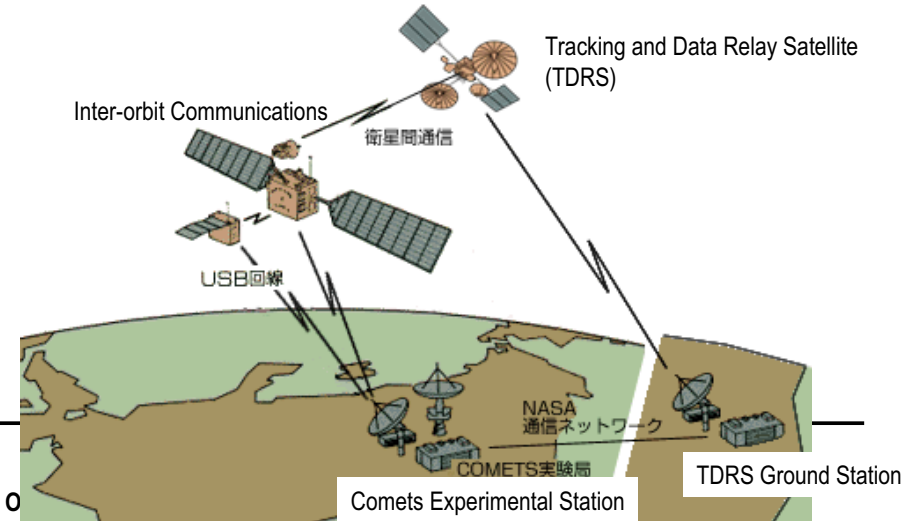


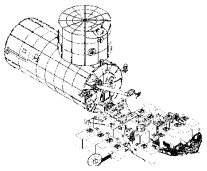
Japanese Experiment Module

ETS-VII System

Major Changes after Launch of ETS-VII

- Data Relay Satellite is switched from stranded COMETS to TDRS after ETS-VII launch
- Teleoperation commands (isochronous 4Hz commands) are not supported by TDRS.
- The additional teleoperation software such as command buffers are installed to the onboard computer of robot mission





Robot Experiments Results

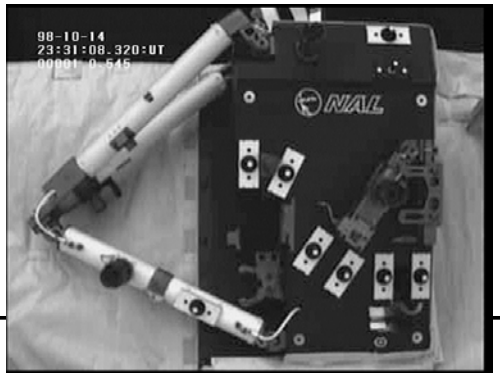
Robot Experiments

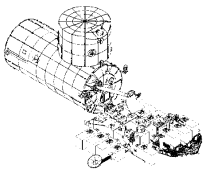
- Tele-operation of onboard robot arm from ground under the time delay
  - The predictive display was introduced to deal with time delay of 6 seconds
  - The compliance control at the tip of the robot arm was implemented

Video

- Satellite attitude control experiments against robot arm's reaction
- Performance evaluation of onboard robot system and its equipment
- Task demonstration: replacement of onboard equipment, handling the target satellite.
- The national research labs (MITI(AIST), CRL(NICT) and NAL(JAXA)) have also conducted the experiments

NAL Truss Teleoperation Experiment



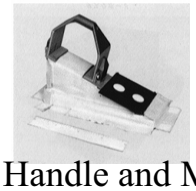


Japanese Experiment Module

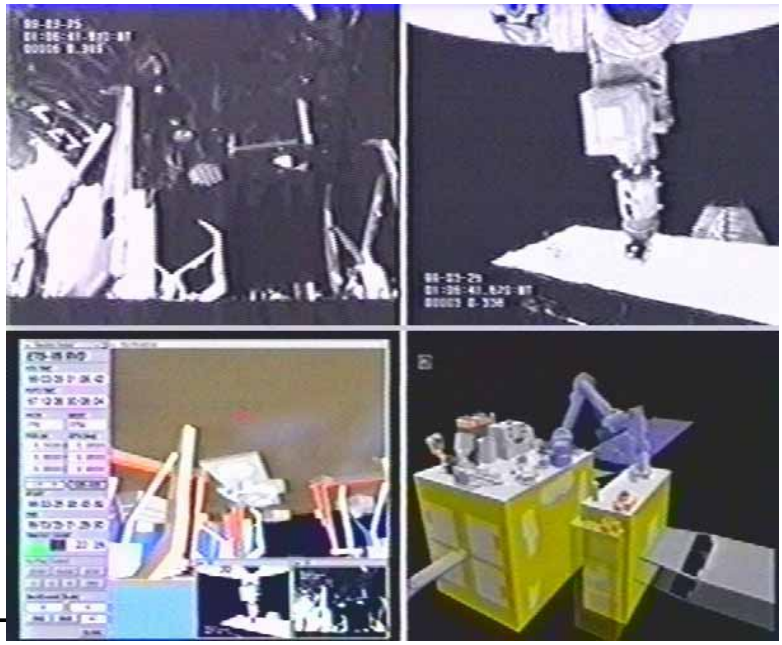
Robot Experiments Results

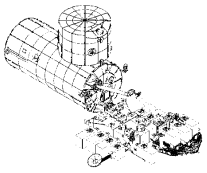
Target Satellite Handling Experiments: Predictive Display is used (Bottom Right)

Capturing Tool



Handle and Marker

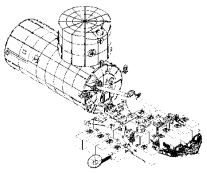




Japanese Experiment Module

Presentation Outline

- Teleoperated Robot Experiments on Satellite (ETS-VII)
- Manned Practical Use Robot System on JEM('Kibo') (JEMRMS)
- Future Space Robotics Activities

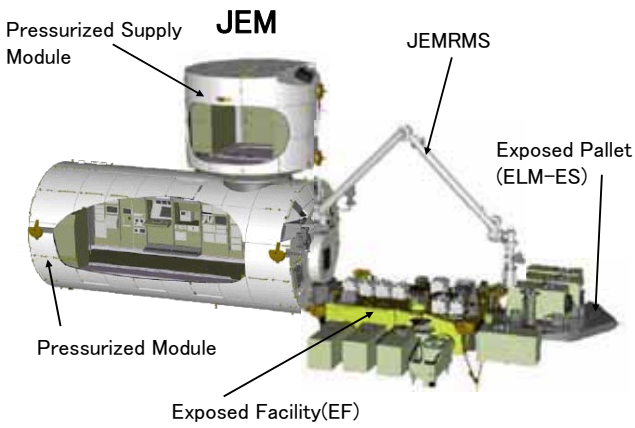


Japanese Experiment Module

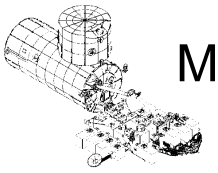
ISS and JEM 'Kibo'

ISS and JEM status

- International space station (ISS) have resumed construction on orbit.
- Japanese Experiment Module (JEM) 'Kibo' will be attached to ISS in 2007.
- ISS assembly will be completed by 2010.

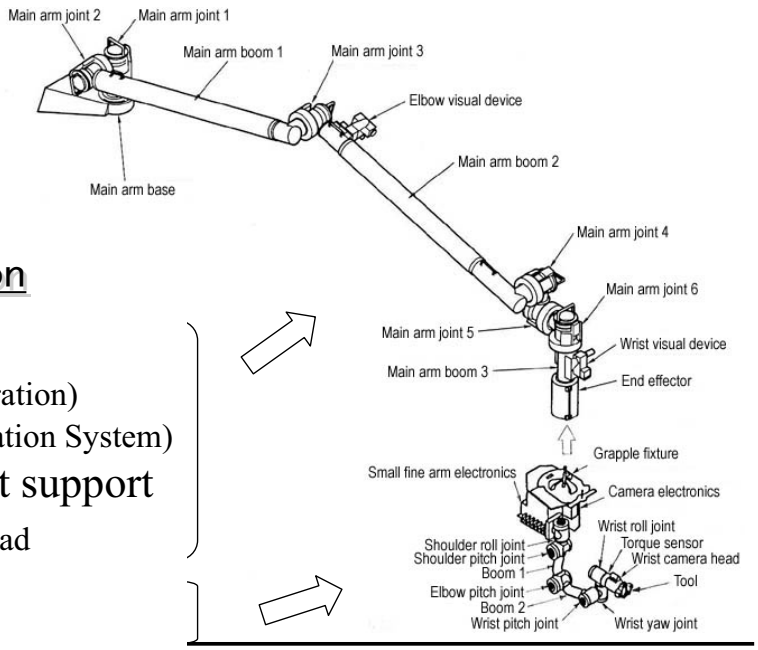


Courtesy of NASA



Japanese Experiment Module

MA(Main Arm) and SFA(Small Fine Arm)



JEMRMS Mission

JEM assembly operation

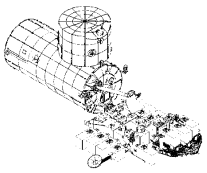
EF, ELM-ES (Backup operation)
ICS(Inter-orbit Communication System)

JEM exposed experiment support

Exposed Experiment Payload

JEM maintenance

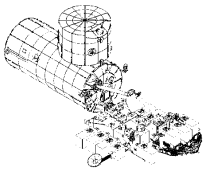
Exchange ORU on EF



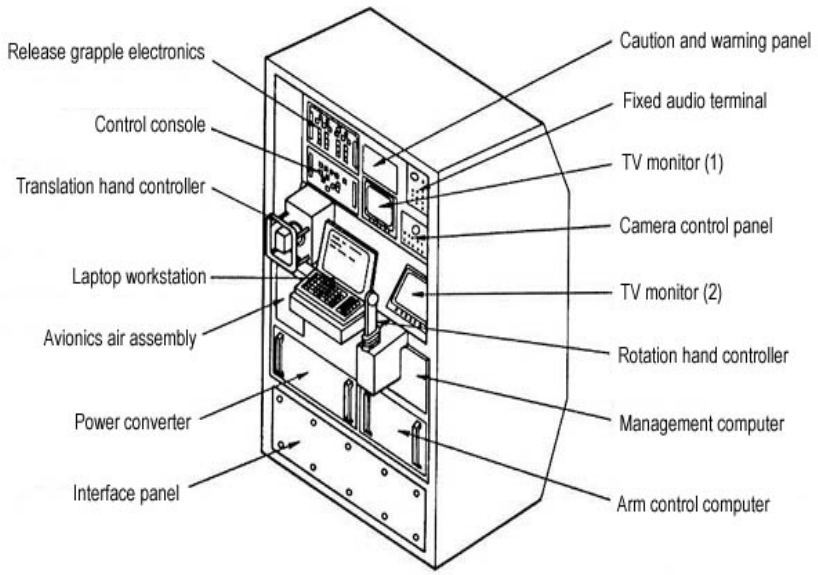
Japanese Experiment Module

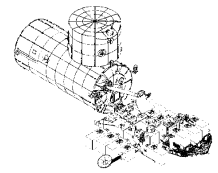
MA and SFA Performance

MA	D.O.F	: 6D.O.F
	Length	: 10m
	Payload	: Max. 7000Kg
	Positioning Accuracy	: ±50mm/±1°
	Tip Speed	: Less than 60mm/sec （with P/L of 600kg or less）
		Less than 30mm/sec (with P/L of 3000kg or less)
		Less than 20mm/sec (with P/L of 7000kg or less)
	Max. Tip Force	: More than 30N
SFA	D.O.F	: 6D.O.F
	Length	: 2m
	Payload	: Max. 300Kg
	Positioning Accuracy	: ±10mm/±1°
	Tip Speed	: Less than 50mm/sec （with P/L of 80kg or less）
		Less than 25mm/sec (with P/L of 300kg or less)
	Max. Tip Force	: More than 30N



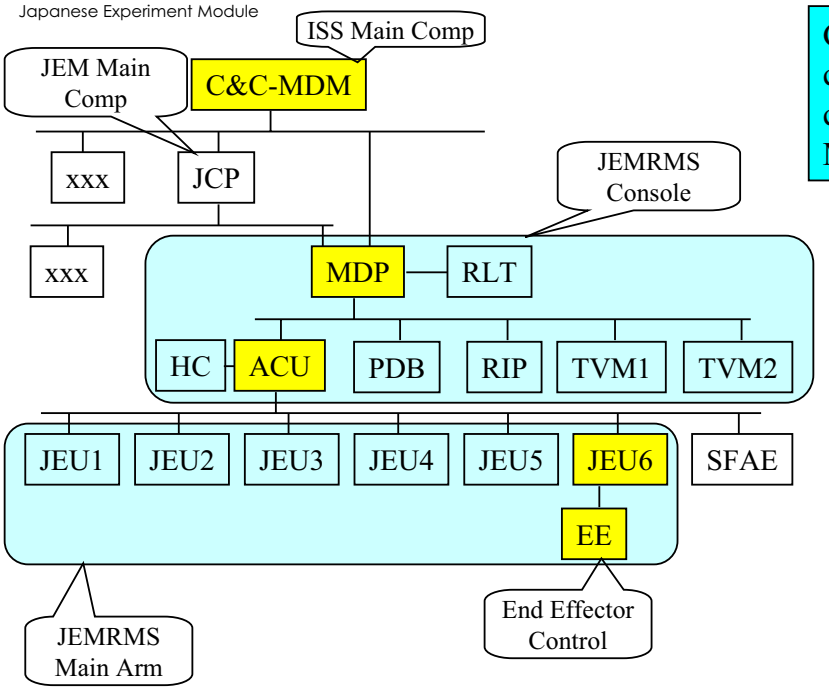
JEMRMS Console





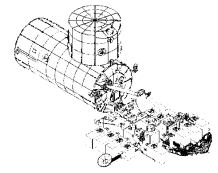
Japanese Experiment Module

Hierarchical Network



Ground Command to EE control through many computers such as C&C-MDM, MDP, ACU.

C&C-MDM: Command & Control Muliplexe/Demultiplexe
JCP: JEM Control Processor
MDP: Management Data Processor
RLT: RMS Laptop Terminal
ACU: Arm Control Unit
HC: Hand Controller
PDB: Power Distribution Box
RIP: Remote Interface Panel
TVM: Television Monitor
JEU: Joint Electronics Unit
SFAE: Small Fine Arm Electronics



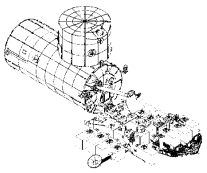
Japanese Experiment Module

JEMRMS Safety Requirement

Two Fault Tolerance (2FT) are required for catastrophic hazard.

- Not to release payload without intention
  - Three independent commands to release EE
  - Berthing mechanism status is confirmed before release EE

- Not to damage structure by collision
  - Collision tolerance design around berthing mechanism even if JEMRMS run away at the worst cases.
  - No collision to other parts by checking ACU/MDP with joint sensor A/B and databases, respectively.
  - JEMRMS needs to sustain position with payload during re-boost of ISS or shuttle docking.



Japanese Experiment Module

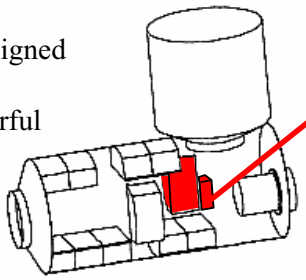
JEMRMS BDS(Backup Drive System)

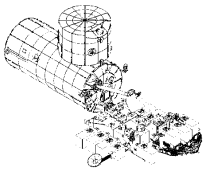
BDS controls and monitors the JEMRMS Main Arm in case of console failure. BDS consists of the following components which are attached on the panel beside the RMS Console in the PM.

- Back-up Controller1(BUC1)
- Back-up Controller2 (BUC2)
- Remote Interface Panel for Back-up (RIP-BU)
- RMS Laptop Terminal for Back-up (RLT-BU)
- Power Distribution Box for Back-up (PDB-BU)
- Solid State External Data Storage Unit (SSEDSU)

BUC is replacement of MDP and ACU. It is designed to modify MDS-1/PCS launched in 2002 where commercial MPUs were demonstrated for powerful fault tolerant parallel computing.

MDS-1/PCS-BBM



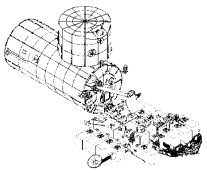


Japanese Experiment Module

RMS Safety Requirement

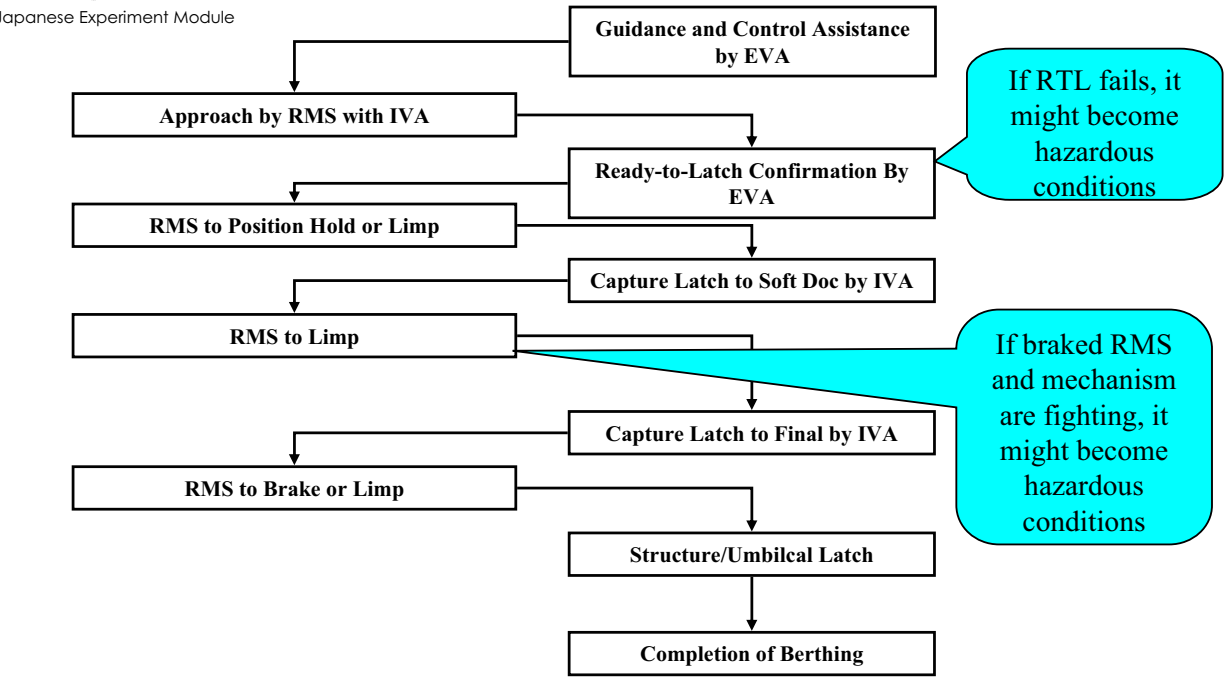
Two Fault Tolerance (2FT) are required for catastrophic hazard.

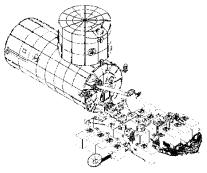
- Just before starting berthing mechanism operation, false of ready to latch indication may fails mechanism broken.
- The force fight happens when RMS is accidentally braked while the mechanism continuously retracts the berthing payload attached to RMS.



Japanese Experiment Module

Berthing Sequence Example



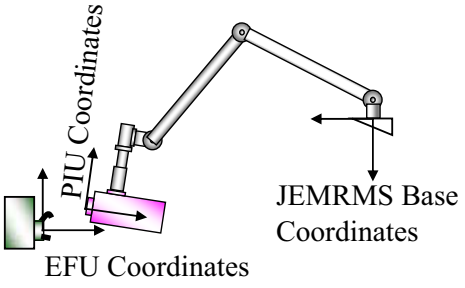


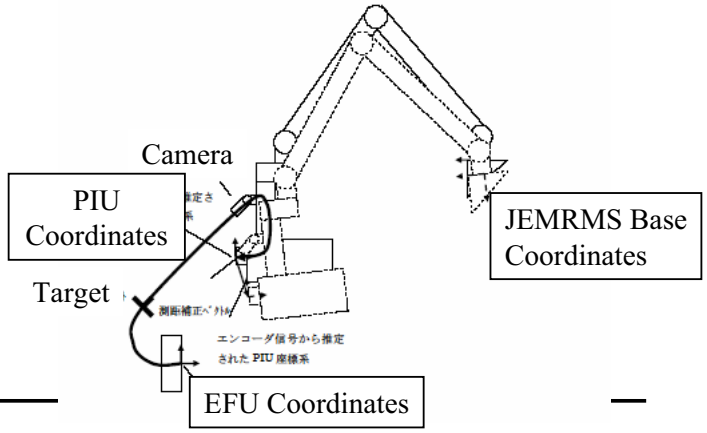
Japanese Experiment Module

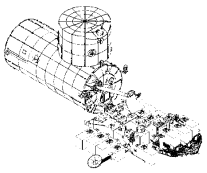
RTL Judgment

The following three conditions must be satisfied in order to 'GO' for RTL

- PIU with respect to EFU based on a joint sensor measurement
- Comparison between two joint sensors
- PIU with respect to EFU based on on-board visual measurement



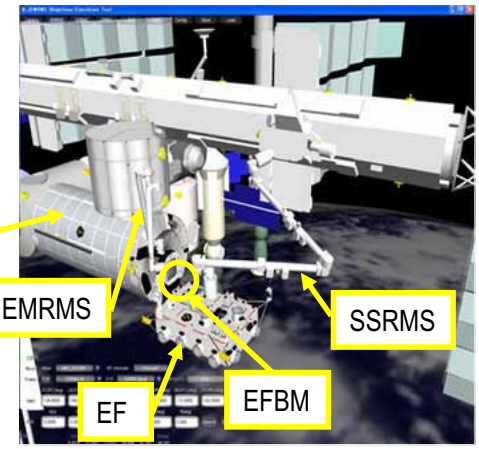


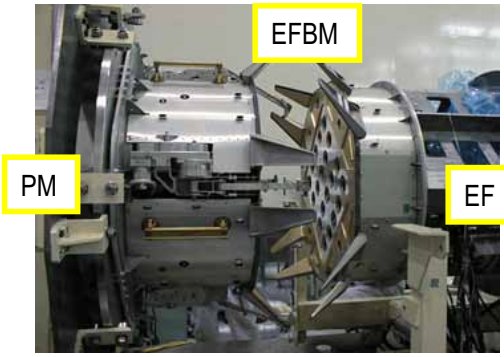


Japanese Experiment Module

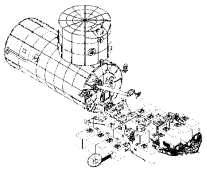
Force Fighting

The force fight happens when the manipulator is accidentally braked while the mechanism continuously retracts the berthing payload attached to the manipulator.



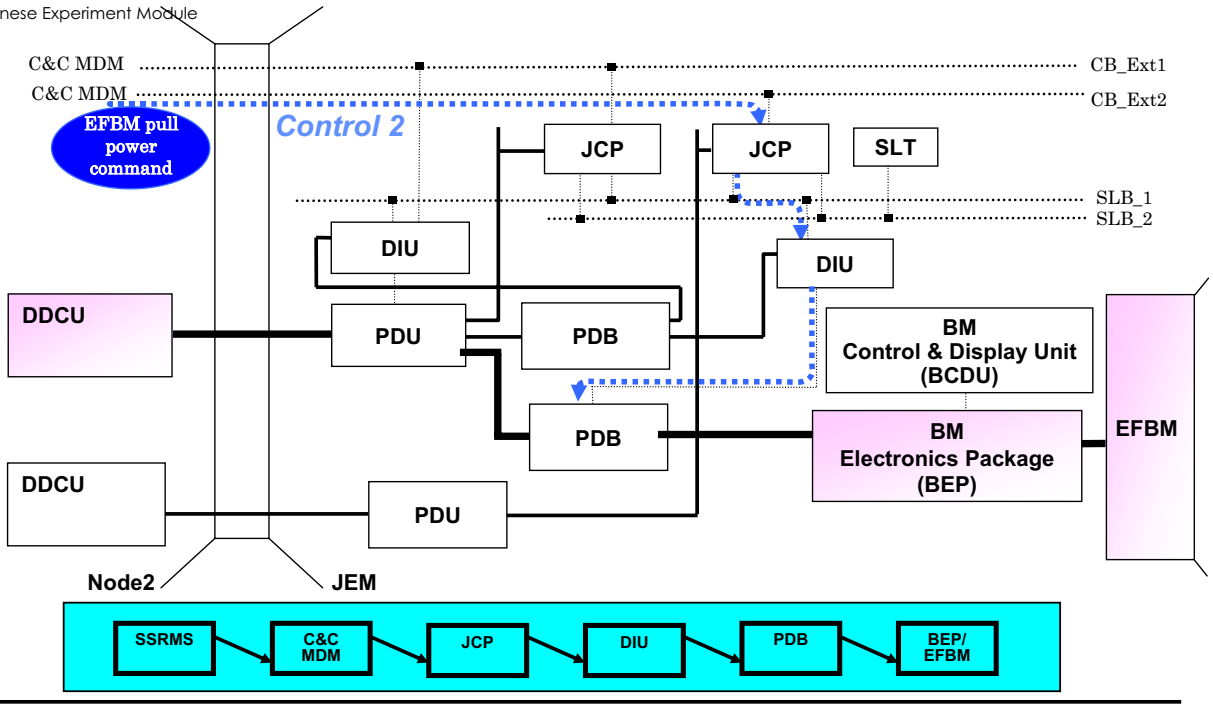


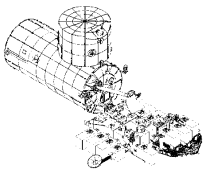
How fast mechanism can be stopped after RMS safing?



Japanese Experiment Module

Force Fighting Mitigation

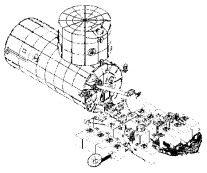




Japanese Experiment Module

Presentation Outline

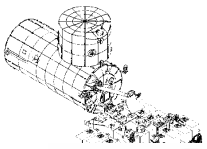
- Teleoperated Robot Experiments on Satellite (ETS-VII)
- Manned Practical Use Robot System on JEM('Kibo') (JEMRMS)
- Future Space Robotics Activities



Japanese Experiment Module

JAXA Vision

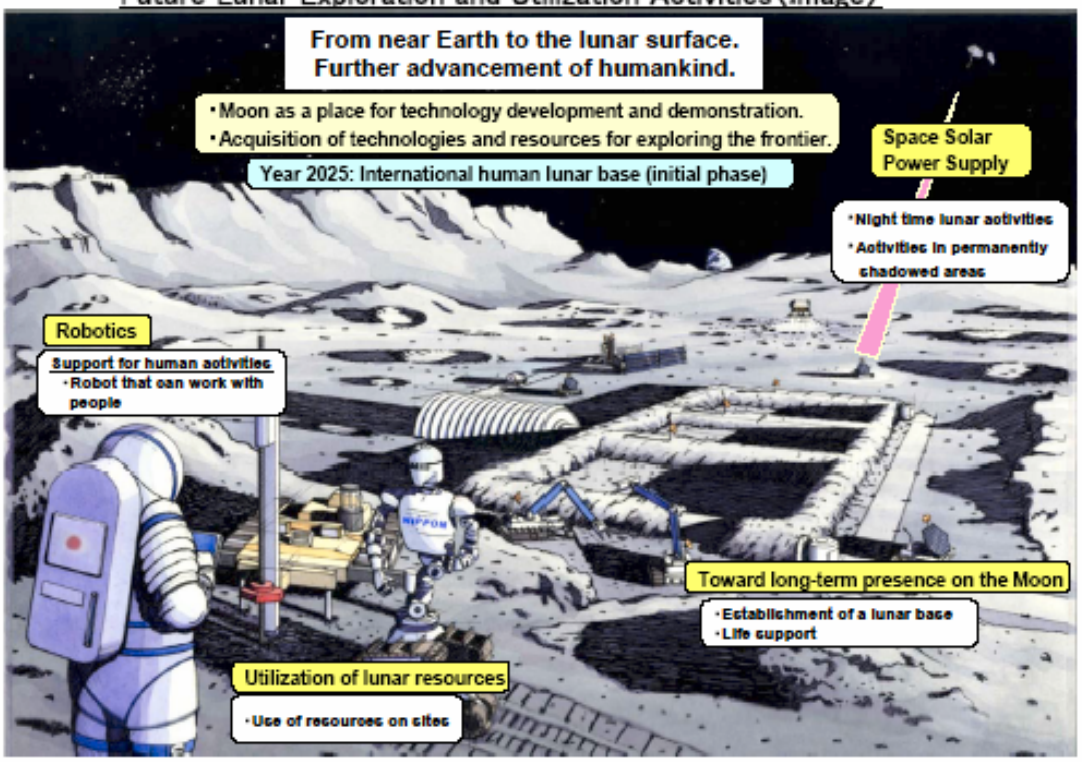
1. **Contribute to building a secure and prosperous society through the utilization of aerospace technologies**
2. **Contribute to advance our knowledge of the universe and broaden the horizon of human activity**
3. **Develop the capability to carry out autonomous space activities through the best technologies in the world**
4. **Facilitate growth of the space industry with self-sustenance and world class sustenance capability**
5. **Facilitate the growth of aviation industry and aim for technological breakthroughs for future air transportation**

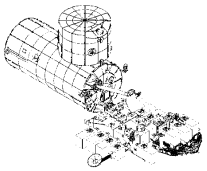


Future Robotics in JAXA Vision

Japan

Future Lunar Exploration and Utilization Activities (Image)



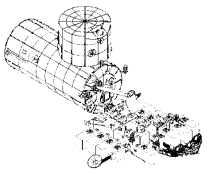


Future Robotics toward Vision

Japanese Experiment Module

Since robotics is not a mission in itself but rather a tool for realizing space missions, we will discuss ways in which space robots will be utilized in realizing the goals proposed in the JAXA vision.

1. Robotics for moon exploration
2. Robots for solar system exploration
3. Robotics for manned missions
4. Robotics for satellite utilization



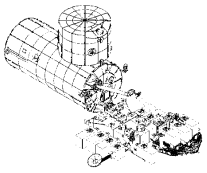
Japanese Experiment Module

Future Robotics Development

When new project is started, the following software issues are always discussed.

- Developing environment and its support
- Operating system including version and Software languages
- Software heritage and its portability, maintenacability
- Device driver availability and practical accomplishments
- Human resources, costs and period of development

But JAXA will not make a decision on how to design and manufacture software!



Japanese Experiment Module

Questions?

OMG Systems Modeling Language (OMG SysML™) Tutorial

11 July 2006

Sanford Friedenthal
Alan Moore
Rick Steiner

Caveat

- This material is based on version 1.0 of the SysML specification (ad-06-03-01)
  - Adopted by OMG in May '06
  - *Going through finalization process*
- OMG SysML Website
  - http://www.omgsysml.org/

Objectives & Intended Audience

At the end of this tutorial, you should understand the:

- Benefits of model driven approaches to systems engineering
- Types of SysML diagrams and their basic constructs
- Cross-cutting principles for relating elements across diagrams
- Relationship between SysML and other Standards
- High-level process for transitioning to SysML

This course is not intended to make you a systems modeler!
You must use the language.

Intended Audience:

- Practicing Systems Engineers interested in system modeling
  - Already familiar with system modeling & tools, or
  - Want to learn about systems modeling
- Software Engineers who want to express systems concepts
- Familiarity with UML is not required, but it will help

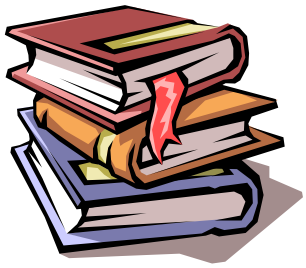
Topics

- Motivation & Background (30)
- Diagram Overview (135)
- SysML Modeling as Part of SE Process (120)
  - Structured Analysis – Distiller Example
  - OOSEM – Enhanced Security System Example
- SysML in a Standards Framework (20)
- Transitioning to SysML (10)
- Summary (15)

Motivation & Background

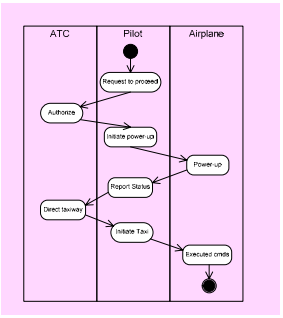
SE Practices for Describing Systems

Past



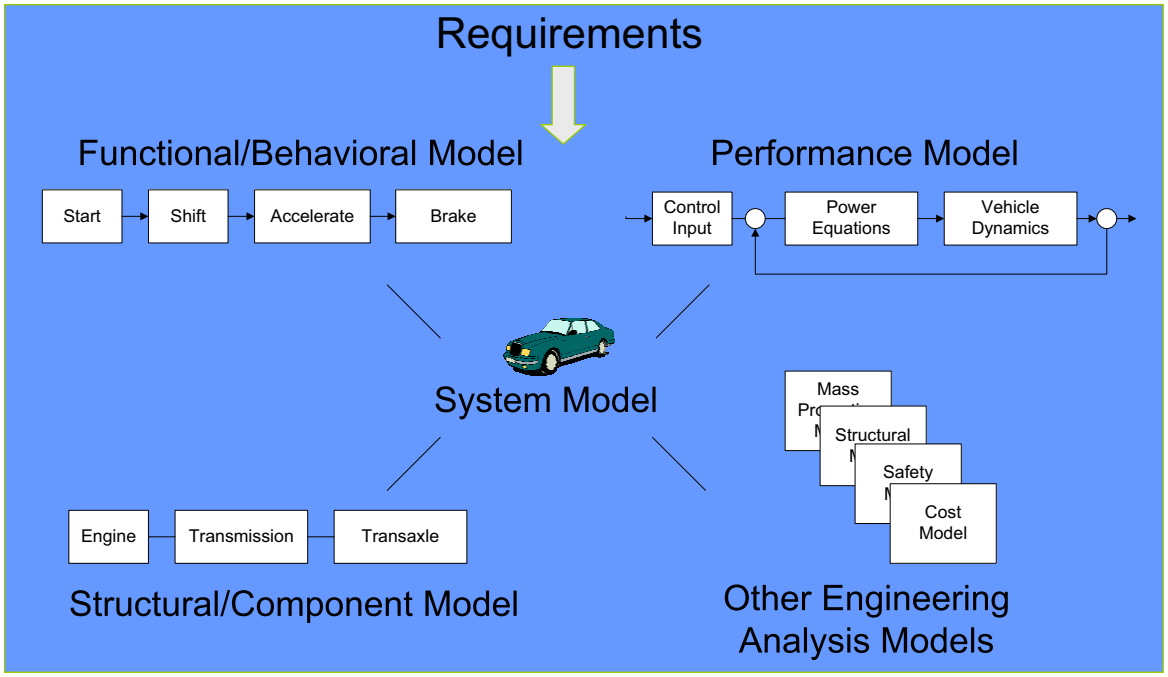
- **Specifications**
- **Interface requirements**
- **System design**
- **Analysis & Trade-off**
- **Test plans**

Future



Moving from Document centric to Model centric

System Modeling

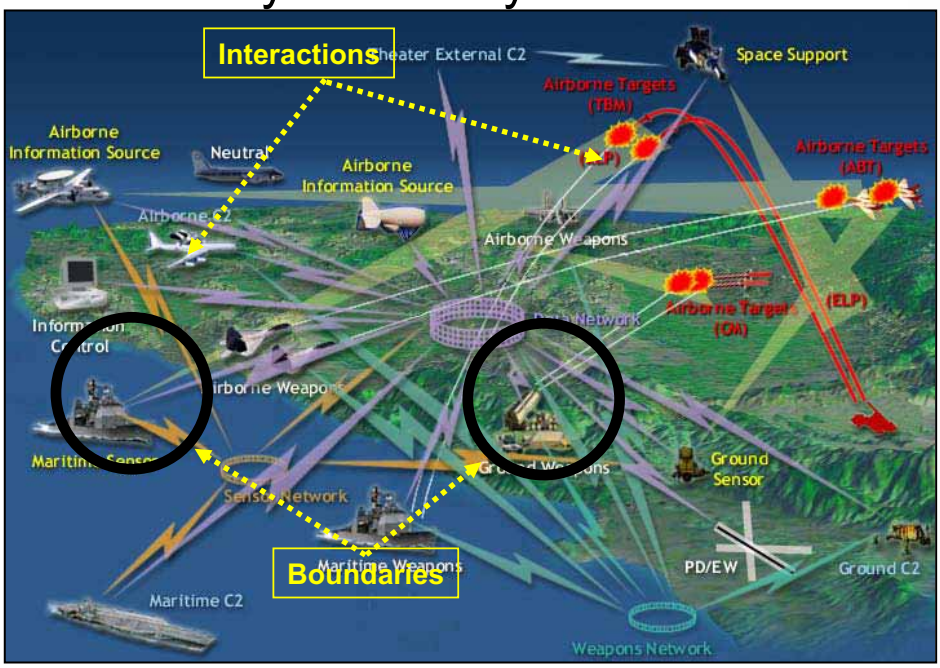


Integrated System Model Must Address Multiple Aspects of a System

Model Based Systems Engineering Benefits

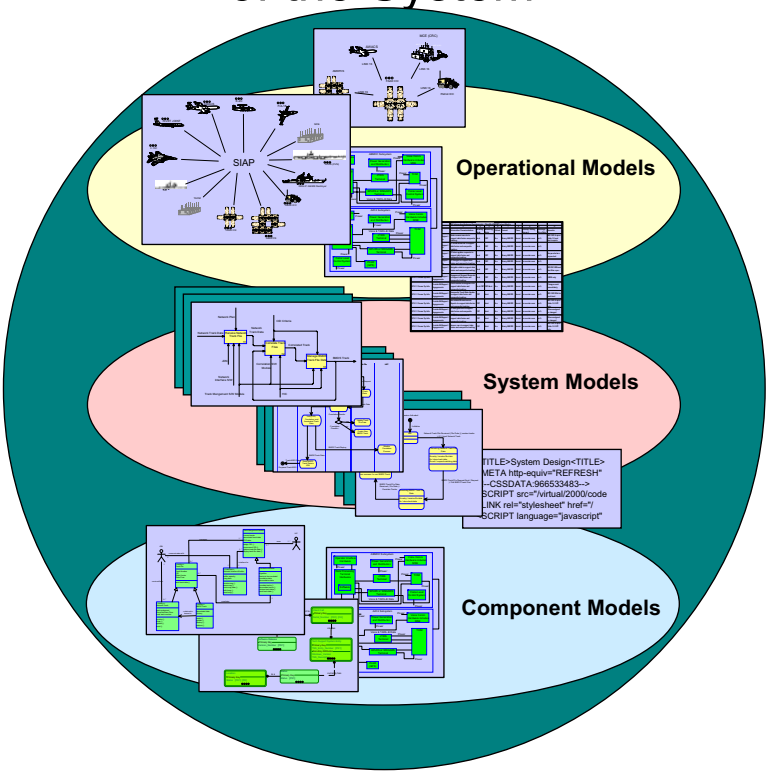
- Improved communications
- Assists in managing complex system development
  - Separation of concerns
  - Hierarchical modeling
  - Facilitates impact analysis of requirements and design changes
  - Supports incremental development & evolutionary acquisition
- Improved design quality
  - Reduced errors and ambiguity
  - More complete representation
- Early and on-going verification & validation to reduce risk
- Other life cycle support (e.g., training)
- Enhanced knowledge capture

System-of-Systems

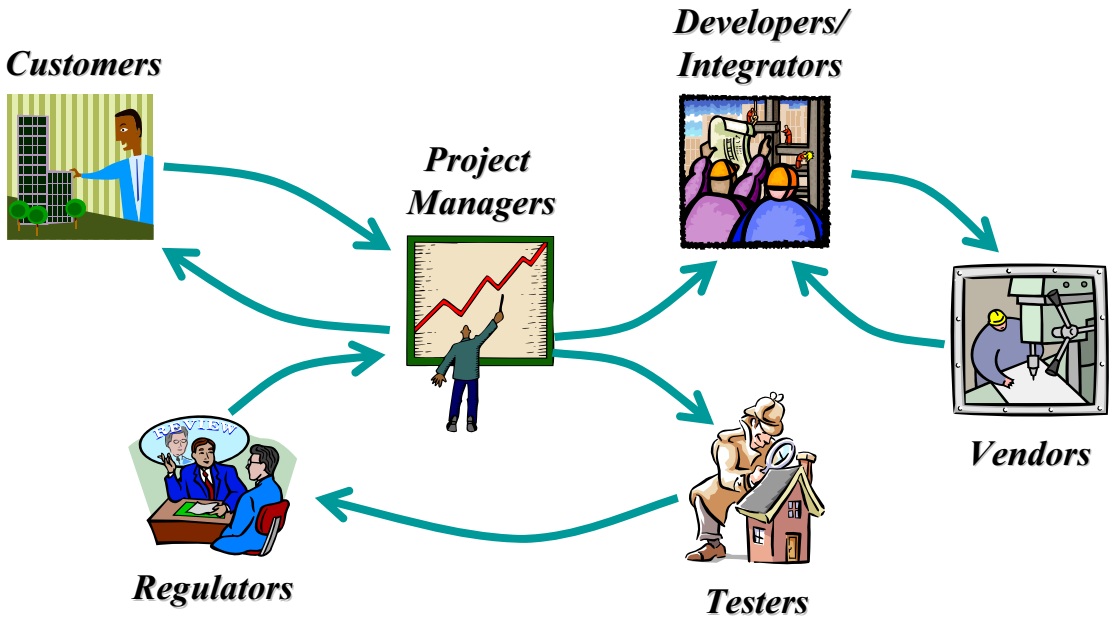


Modeling Needed to Manage System Complexity

Modeling at Multiple Levels of the System



Stakeholders Involved in System Acquisition



Modeling Needed to Improve Communications

What is SysML?

- A graphical modelling language in response to the UML for Systems Engineering RFP developed by the OMG, INCOSE, and AP233
  - a UML Profile that represents a subset of UML 2 with extensions
- Supports the specification, analysis, design, verification, and validation of systems that include hardware, software, data, personnel, procedures, and facilities
- Supports model and data interchange via XMI and the evolving AP233 standard (in-process)

SysML is Critical Enabler for Model Driven SE

What is SysML (cont.)

- ***Is*** a visual modeling language that provides
  - Semantics = meaning
  - Notation = representation of meaning
- ***Is not*** a methodology or a tool
  - SysML is methodology and tool independent

UML/SysML Status

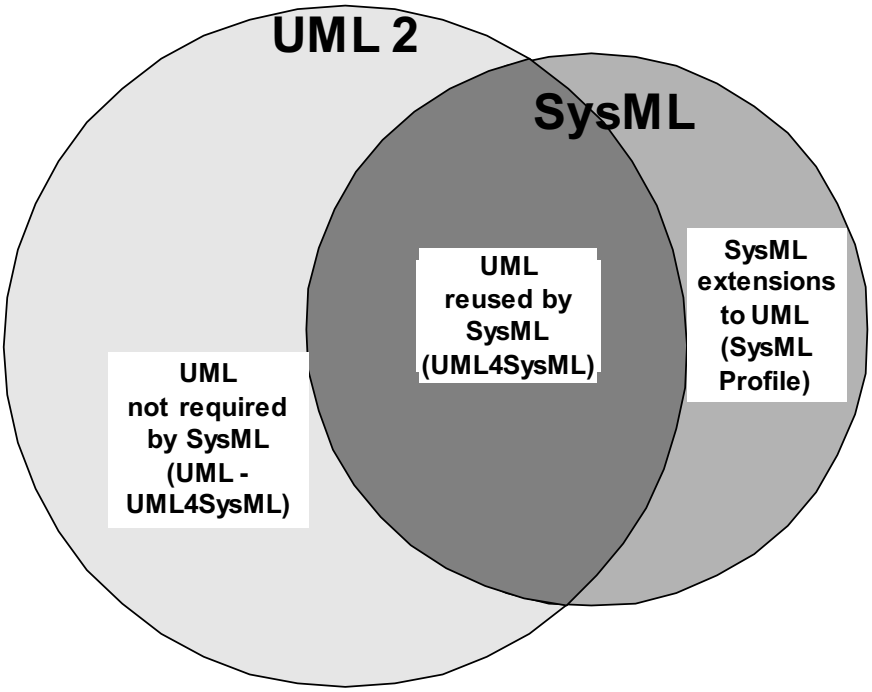
- UML V2.0
  - Updated version of UML that offers significant capability for systems engineering over previous versions
  - Finalized in 2005 (formal/05-07-04)
- UML for Systems Engineering (SE) RFP
  - Established the requirements for a system modeling language
  - Issued by the OMG in March 2003
- SysML
  - Industry Response to the UML for SE RFP
  - Addresses most of the requirements in the RFP
  - Version 1.0 adopted by OMG in May ’06 / In finalization
  - Being implemented by multiple tool vendors

SysML Team Members

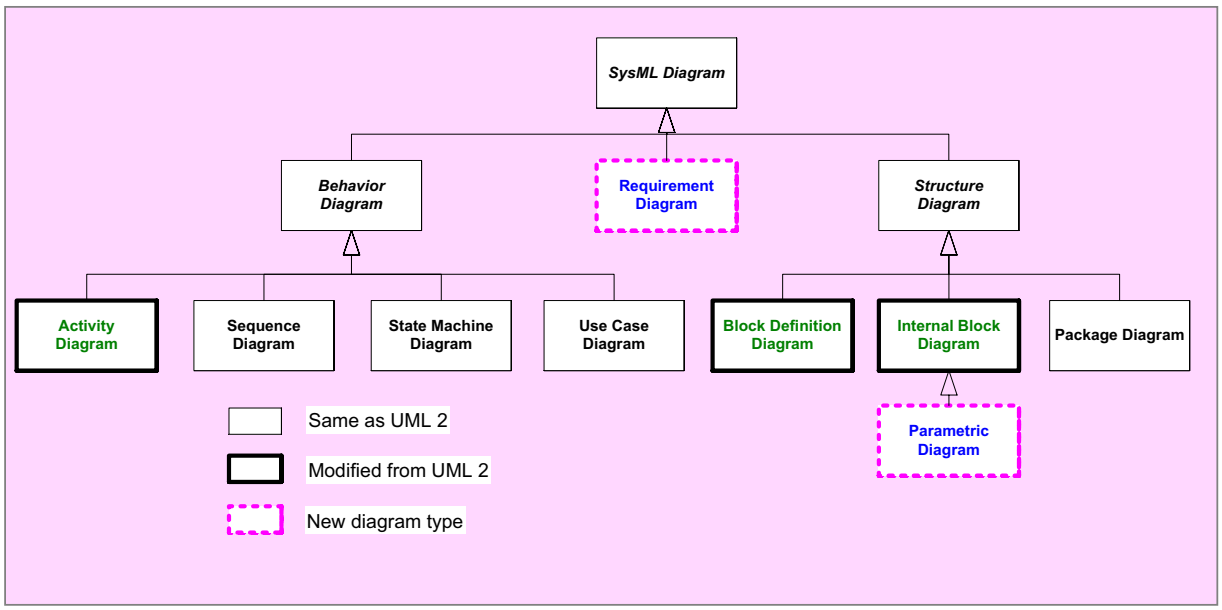
- Industry & Government
  - American Systems, BAE SYSTEMS, Boeing, Deere & Company, EADS-Astrium, Eurostep, Lockheed Martin, Motorola, NIST, Northrop Grumman, oose.de, Raytheon, THALES
- Vendors
  - Artisan, EmbeddedPlus, Gentleware, IBM, I-Logix, Mentor Graphics, PivotPoint Technology, Sparx Systems, Telelogic, Vitech Corp
- Academia
  - Georgia Institute of Technology
- Liaison Organizations
  - INCOSE, ISO AP233 Working Group

Diagram Overview

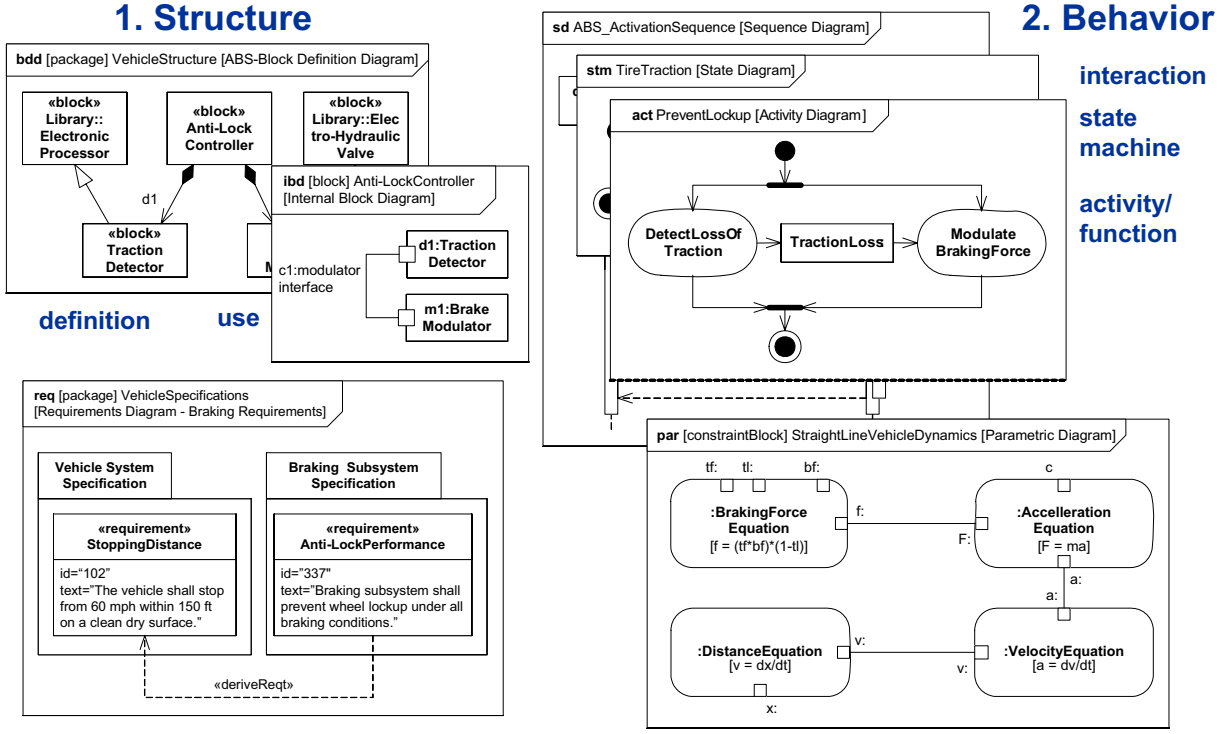
Relationship Between SysML and UML



SysML Diagram Taxonomy

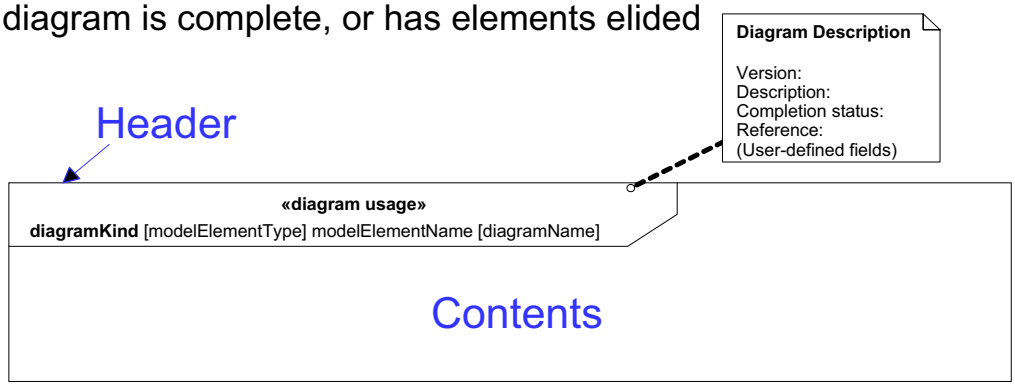


4 Pillars of SysML – ABS Example

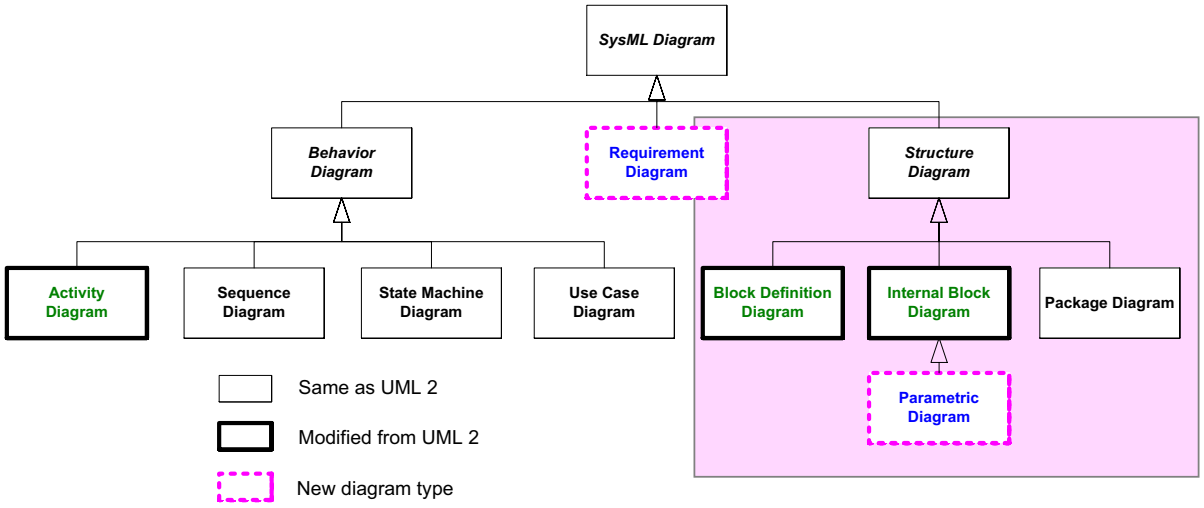


SysML Diagram Frames

- Each SysML diagram represents a model element
- Each SysML Diagram must have a Diagram Frame
- Diagram context is indicated in the header:
  - Diagram kind (act, bdd, ibd, seq, etc.)
  - Model element type (activity, block, interaction, etc.)
  - Model element name
  - Descriptive diagram name or view name
- A separate diagram description block is used to indicate if the diagram is complete, or has elements elided



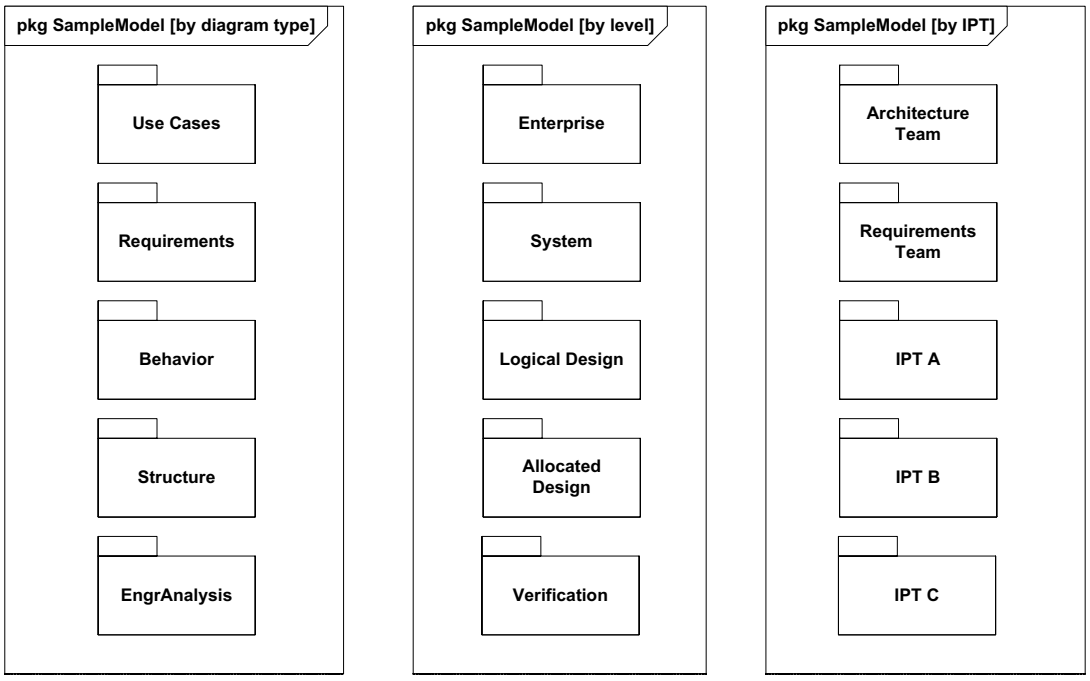
Structural Diagrams



Package Diagram

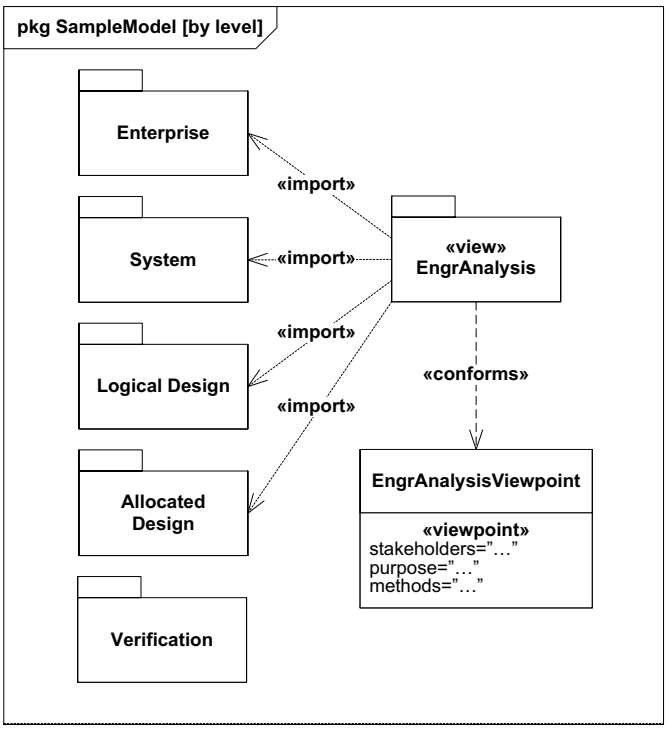
- Package diagram is used to organize the model
  - Groups model elements into a name space
  - Often represented in tool browser
- Model can be organized in multiple ways
  - By System hierarchy (e.g., enterprise, system, component)
  - By domain (e.g., requirements, use cases, behavior)
  - Use viewpoints to augment model organization
- Import relationship reduces need for fully qualified name (package1::class1)

Package Diagram
Organizing the Model



By Diagram Type By Hierarchy By IPT

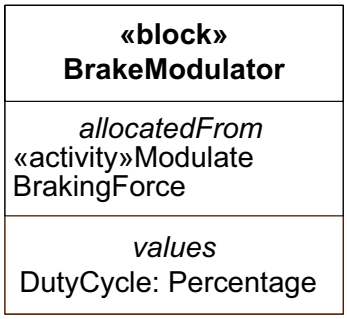
Package Diagram - Views



- Model is organized in one hierarchy
- Viewpoints can provide insight into the model using another principle
  - E.g., analysis view that spans multiple levels of hierarchy
  - Can specify diagram usages, constraints, and filtering rules
  - Consistent with IEEE 1471 definitions

Blocks are Basic Structural Elements

- Provides a unifying concept to describe the structure of an element or system
  - Hardware
  - Software
  - Data
  - Procedure
  - Facility
  - Person



- Multiple compartments can describe the block characteristics
  - Properties (parts, references, values)
  - Operations
  - Constraints
  - Allocations to the block (e.g. activities)
  - Requirements the block satisfies

Block Property Types

- Property is a structural feature of a block
  - **Part property** aka. part (typed by a block)
    - Usage of a block in the context of the enclosing block
    - Example - right-front:wheel
  - **Reference property** (typed by a block)
    - A part that is not owned by the enclosing block (not composition)
    - Example - logical interface between 2 parts
  - **Value property** (typed by value type)
    - Defines a value with units, dimensions, and probability distribution
    - Example
      - Non-distributed value: tirePressure:psi=30
      - Distributed value: «uniform» {min=28,max=32} tirePressure:psi

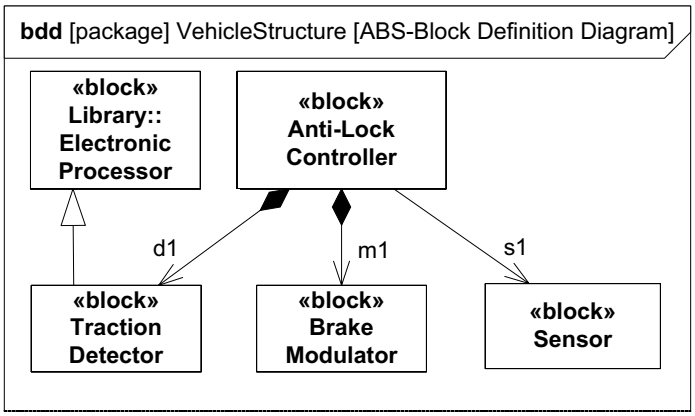
Using Blocks

- Based on UML Class from UML Composite Structure
  - Eliminates association classes, etc.
  - Differentiates value properties from part properties, add nested connector ends, etc.
- Block definition diagram describes the relationship among blocks (e.g., composition, association, classification)
- Internal block diagram describes the internal structure of a block in terms of its properties and connectors
- Behavior can be allocated to blocks

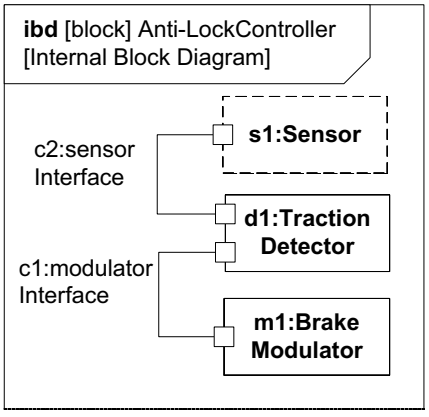
Blocks Used to Specify Hierarchies and Interconnection

Block Definition vs. Usage

Block Definition Diagram



Internal Block Diagram



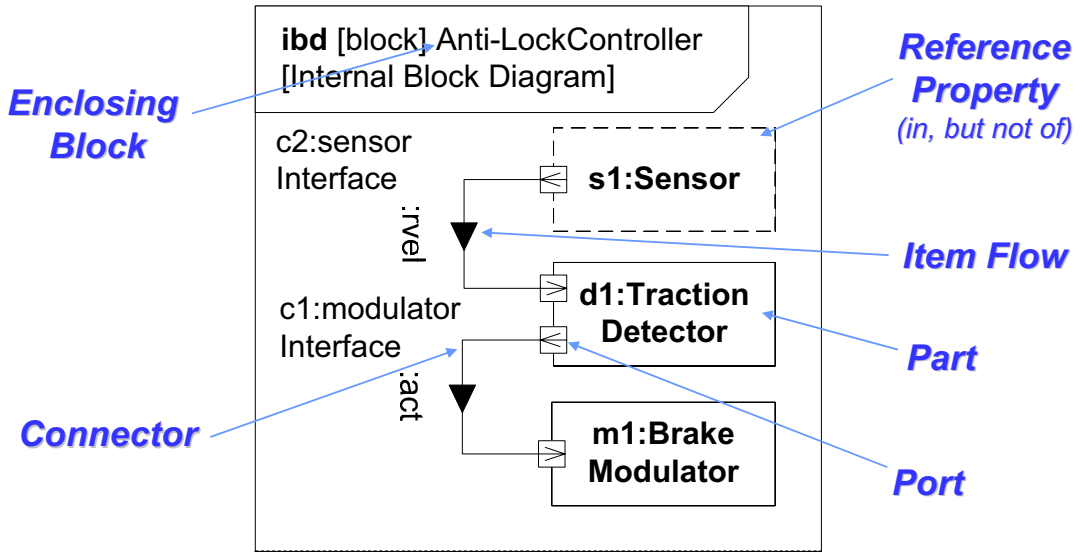
Definition

- Block is a definition/type
- Captures properties, etc.
- Reused in multiple contexts

Usage

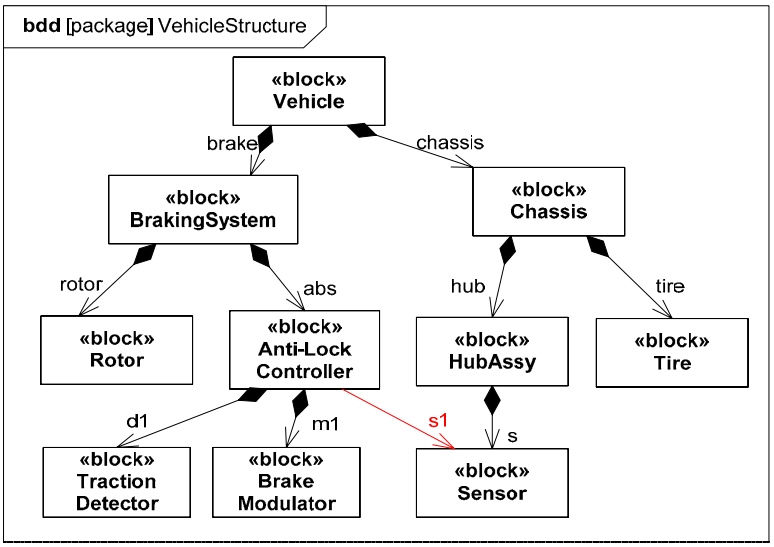
- Part is the usage in a particular context
- Typed by a block
- Also known as a role

Internal Block Diagram (ibd)
Blocks, Parts, Ports, Connectors & Flows

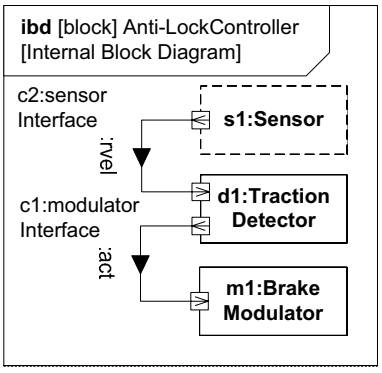


Internal Block Diagram Specifies Interconnection of Parts

Reference Property Explained



S1 is a reference part in ibd shown in dashed outline box

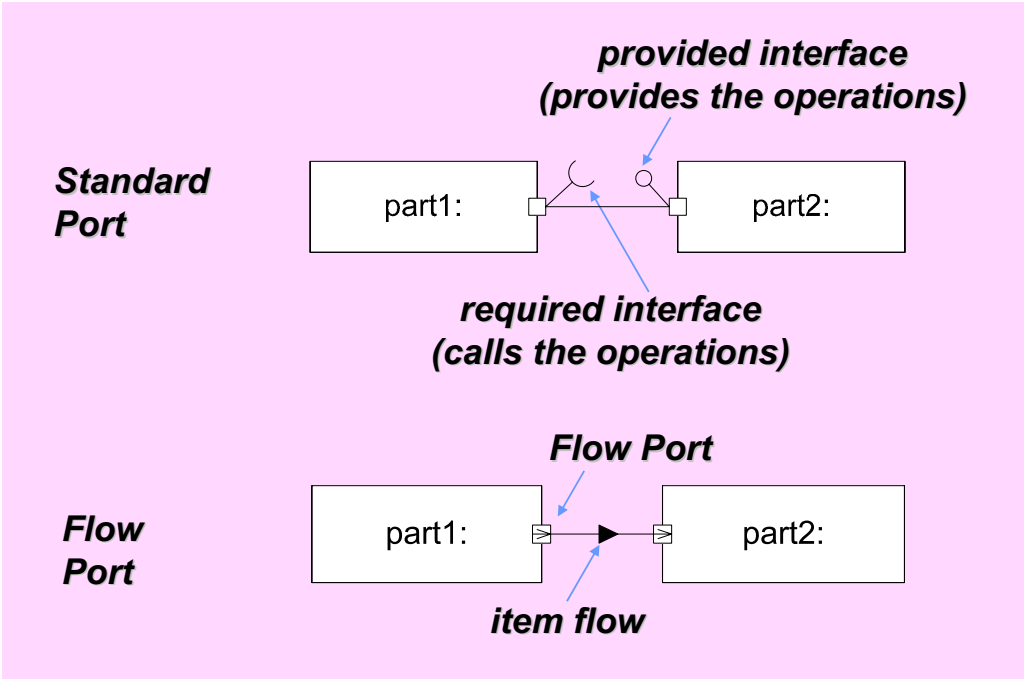


SysML Port

- Specifies interaction points on blocks and parts
  - Supports integration of behavior and structure
- Port types
  - Standard (UML) Port
    - Specifies a set of operations and/or signals
    - Typed by a UML interface
  - Flow Port
    - Specifies what can flow in or out of block/part
    - Typed by a flow specification

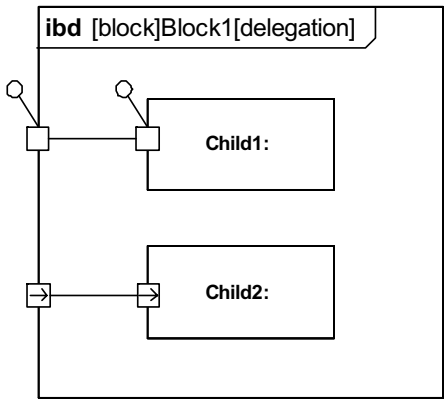
2 Port Types Support Different Interface Concepts

Port Notation



Delegation Through Ports

- Delegation can be used to preserve encapsulation of block
- Interactions at outer ports of Block1 are delegated to ports of child parts
- Ports must match (same kind, types, direction etc.)
- (Deep-nested) Connectors can break encapsulation if required (e.g. in physical system modeling)

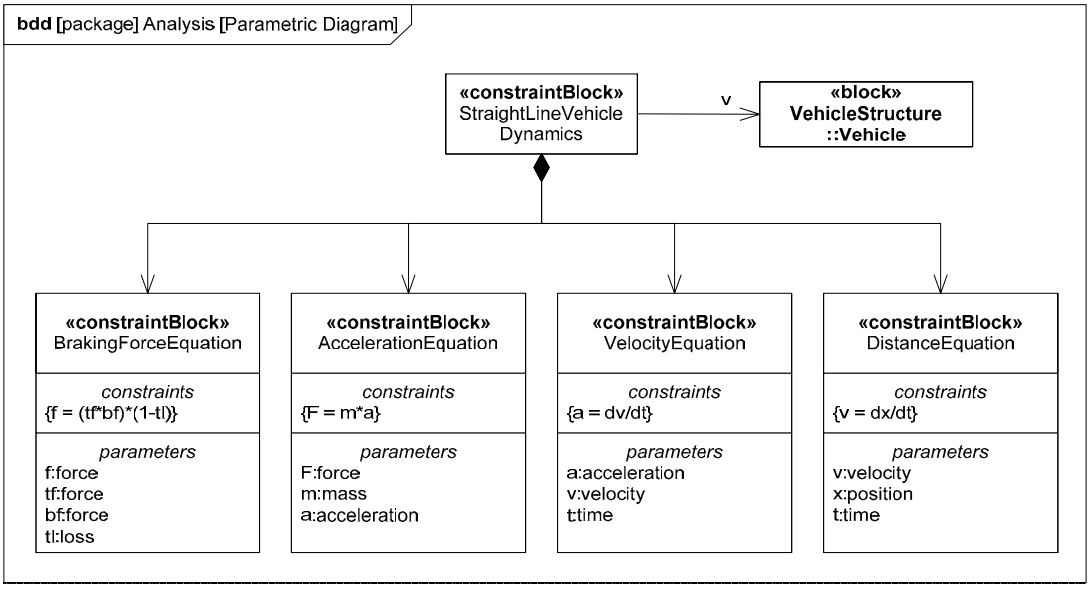


Parametrics

- Used to express constraints (equations) between value properties
  - Provides support for engineering analysis (e.g., performance, reliability)
- Constraint block captures equations
  - Expression language can be formal (e.g., MathML, OCL) or informal
  - Computational engine is defined by applicable analysis tool and not by SysML
- Parametric diagram represents the usage of the constraints in an analysis context
  - Binding of constraint usage to value properties of blocks (e.g., vehicle mass bound to F= m × a)

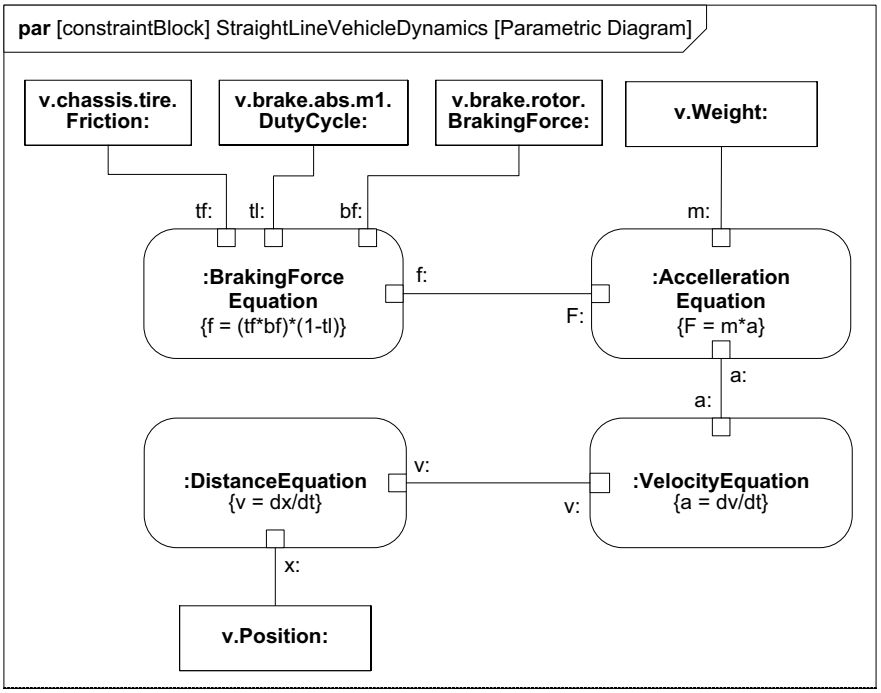
Parametrics Enable Integration of Engineering Analysis with Design Models

Defining Vehicle Dynamics



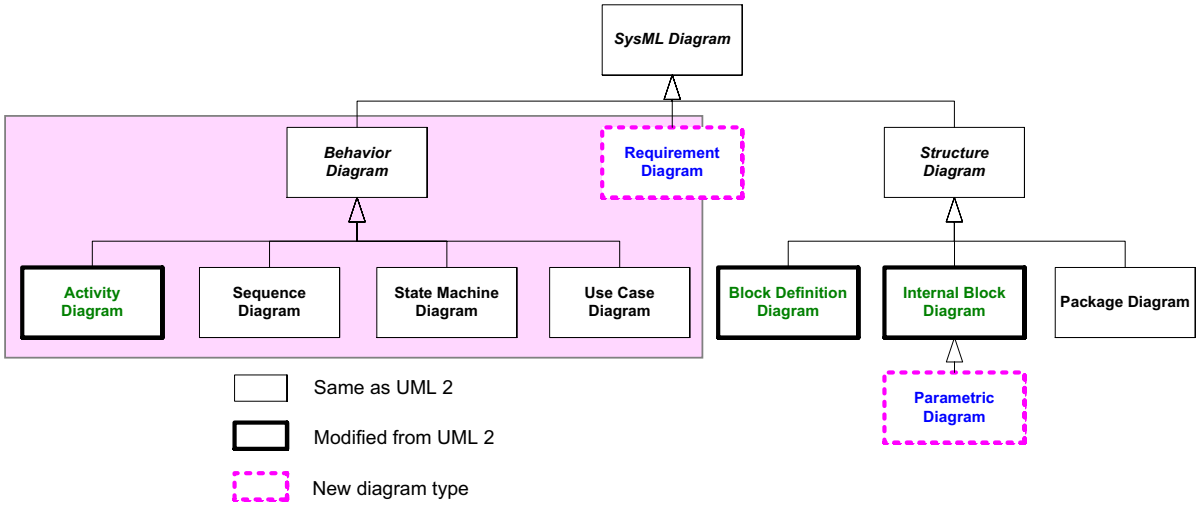
Defining Reusable Equations for Parametrics

Vehicle Dynamics Analysis



Using the Equations in a Parametric Diagram to Constrain Value Properties

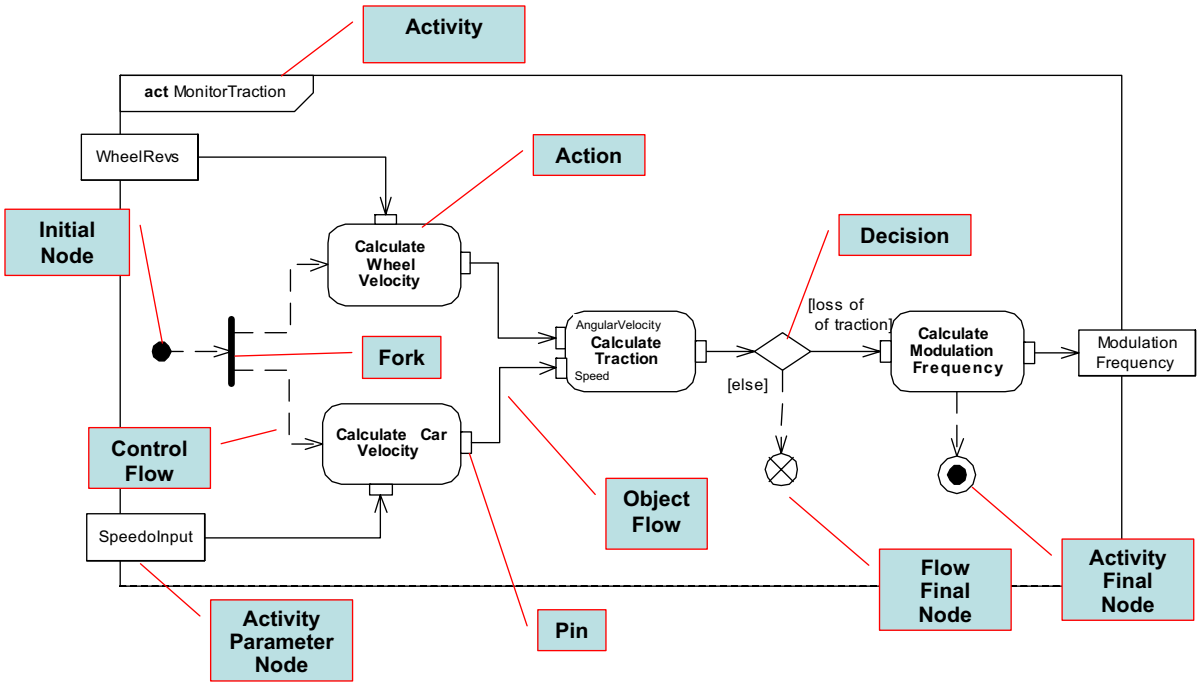
Behavioral Diagrams



Activities

- Activity used to specify the flow of inputs/outputs and control, including sequence and conditions for coordinating activities
- Secondary constructs show responsibilities for the activities using swim lanes
- SysML extensions to Activities
  - Support for continuous flow modeling
  - Alignment of activities with Enhanced Functional Flow Block Diagram (EFFBD)

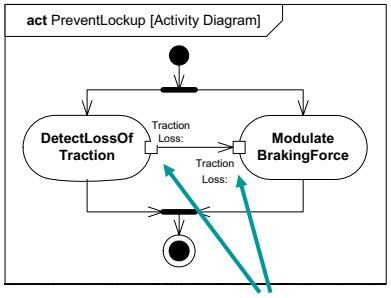
Activity Diagram Notation



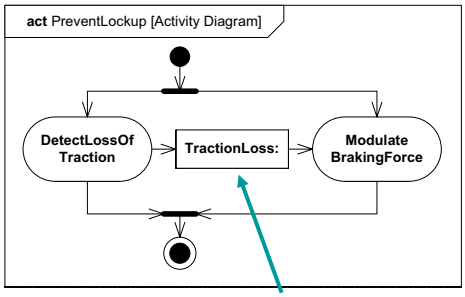
- Join and Merge symbols not included
- Activity Parameter Nodes on frame boundary correspond to activity parameters

Activity Diagrams
Pin vs. Object Node Notation

- Pins are kinds of Object Nodes
  - Used to specify inputs and outputs of actions
  - Typed by a block or value type
  - Object flows connect object nodes
- Object flows between pins have two diagrammatic forms
  - Pins shown with object flow between them
  - Pins elided and object node shown with flow arrows in and out



Pins

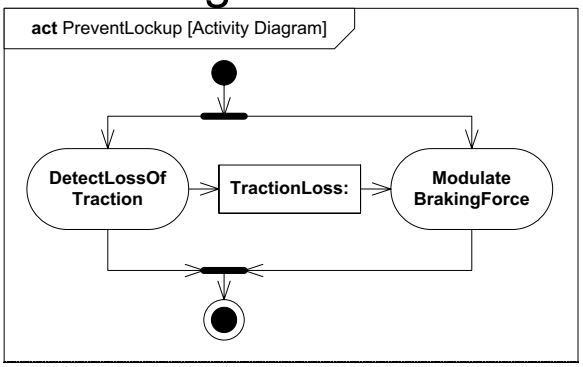


ObjectNode

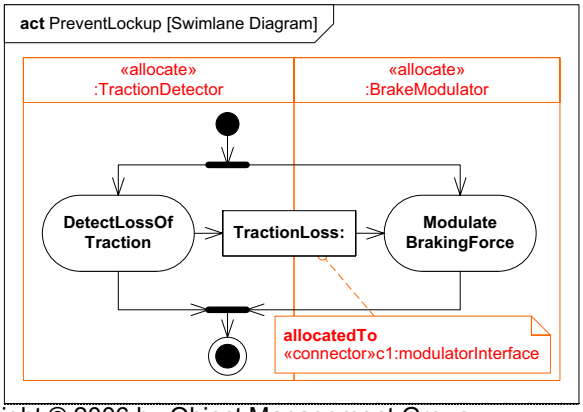
Pins must have same characteristics (name, type etc.)

Explicit Allocation of Behavior to Structure Using Swimlanes

Activity Diagram (without Swimlanes)

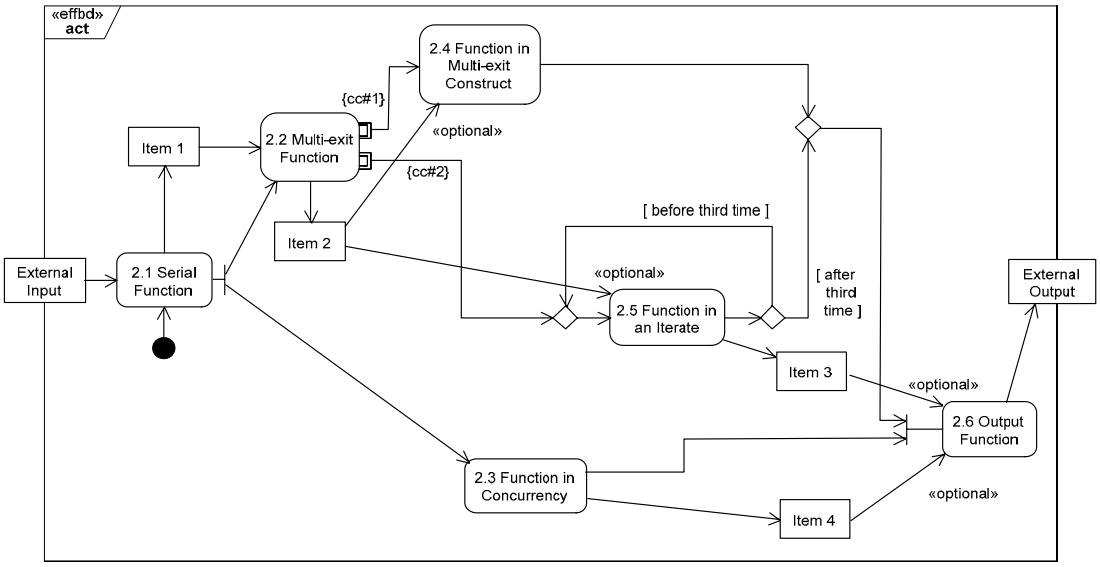


Activity Diagram (with Swimlanes)



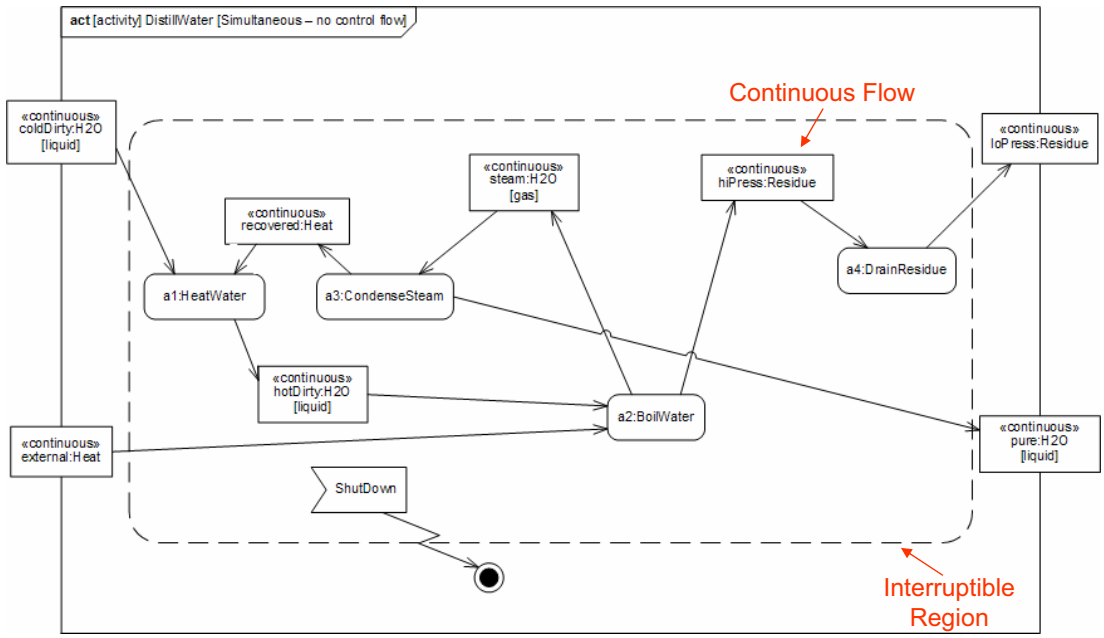
SysML EFFBD Profile

EFFBD - Enhanced Functional Flow Block Diagram



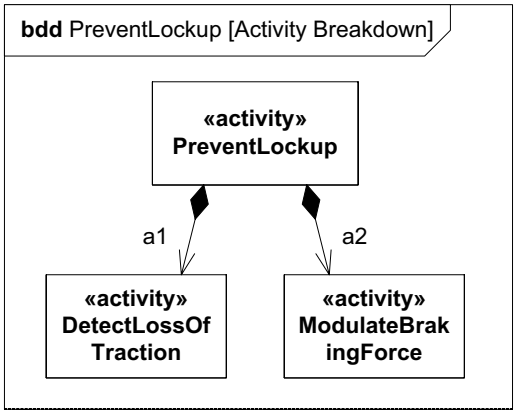
Aligning SysML with Classical Systems Engineering Techniques

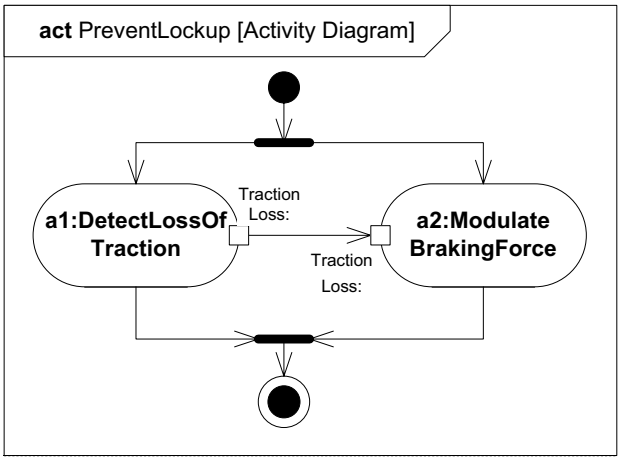
Distill Water Activity Diagram (Continuous Flow Modeling)



Representing Distiller Example in SysML Using Continuous Flow Modeling

Activity Decomposition





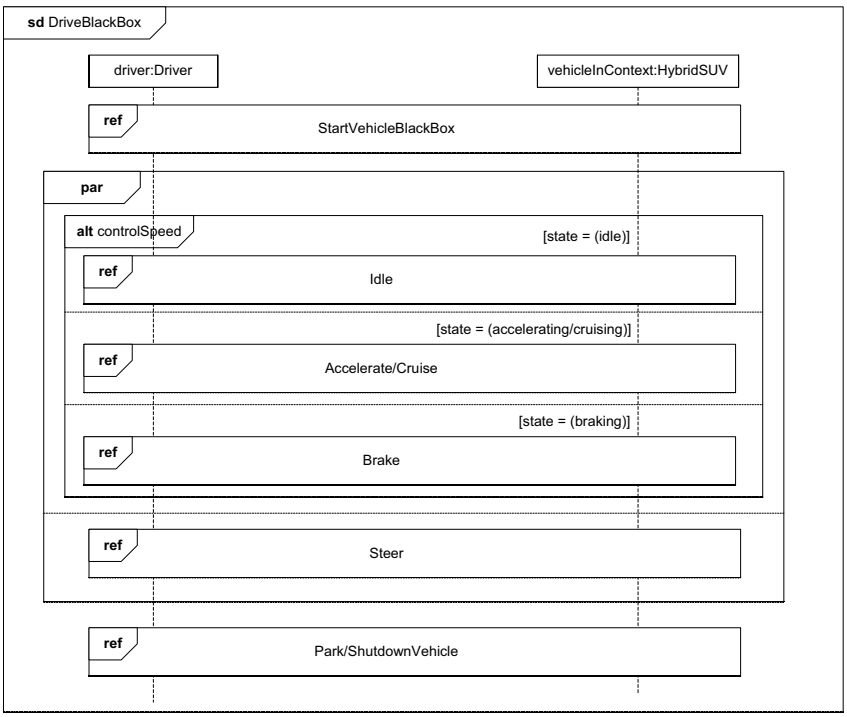
Definition

Use

Interactions

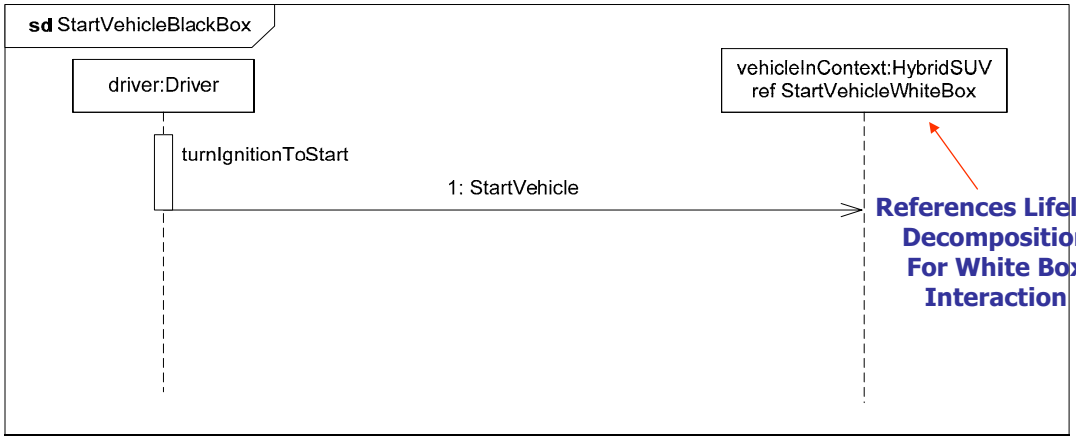
- Sequence diagrams provide representations of message based behavior
  - represent flow of control
  - describe interactions
- Sequence diagrams provide mechanisms for representing complex scenarios
  - reference sequences
  - control logic
  - lifeline decomposition
- SysML does not include timing, interaction overview, and communications diagram

Black Box Interaction (Drive)



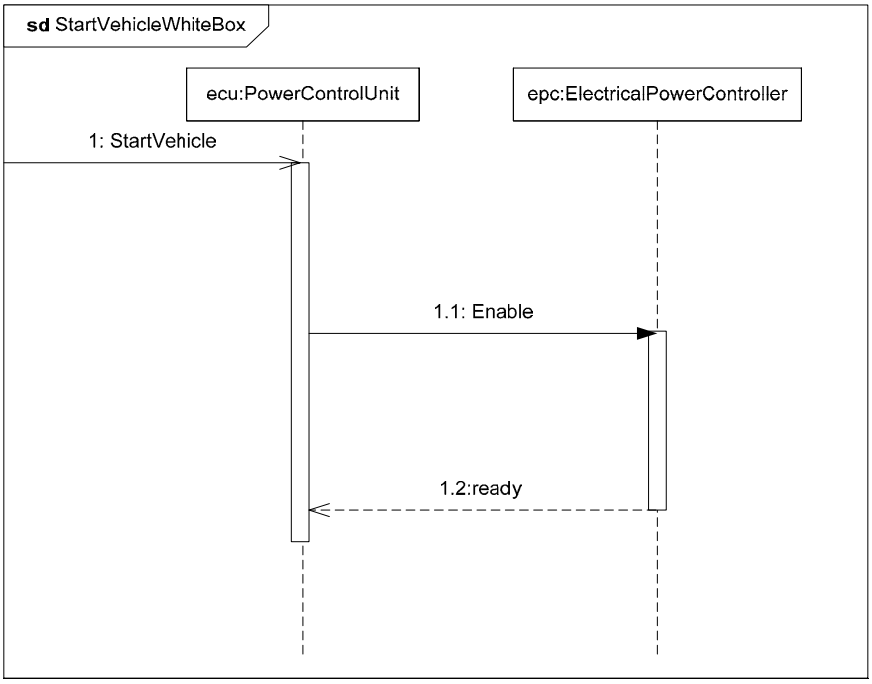
UML 2 Sequence Diagram Scales by Supporting Control Logic and Reference Sequences

Black Box Sequence (StartVehicle)



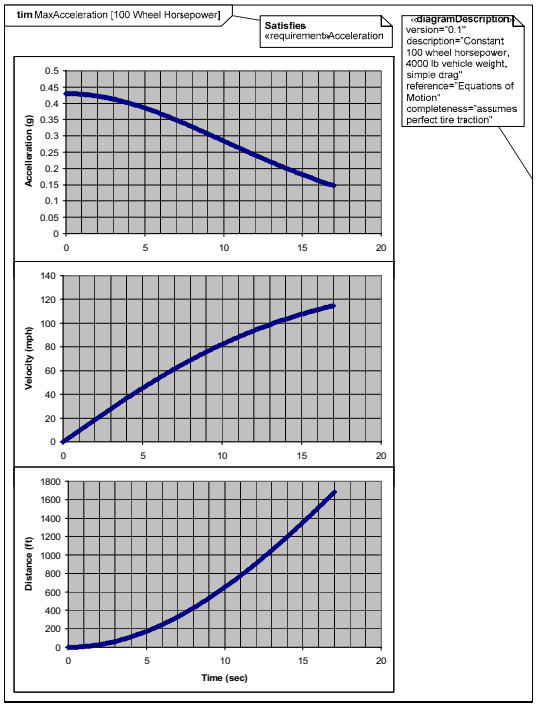
Simple Black Box Interaction

White Box Sequence (StartVehicle)



Decomposition of Black Box Into White Box Interaction

Trial Result of Vehicle Dynamics



Lifeline are value properties

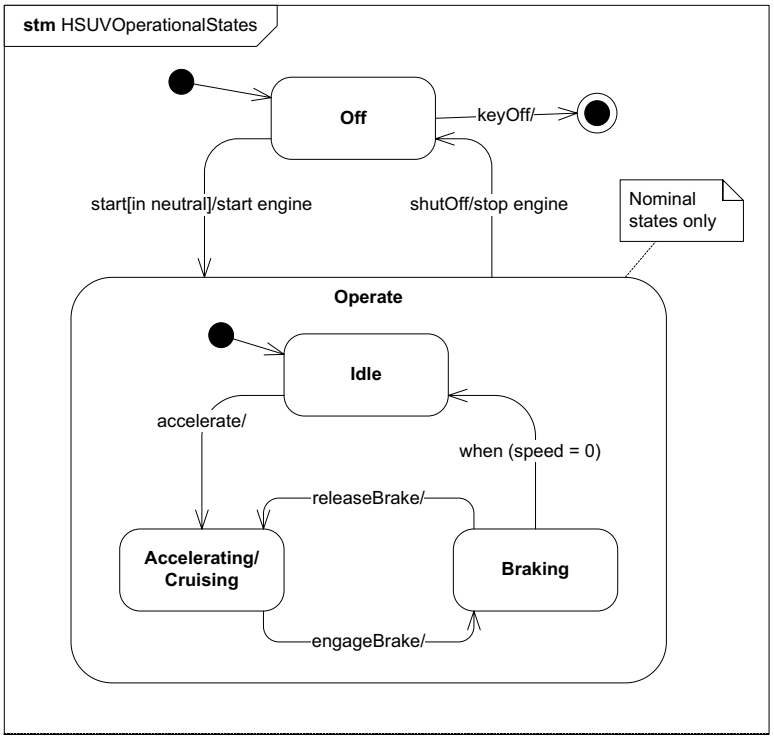
Timing Diagram Not Part of SysML

Typical Example of a Timing Diagram

State Machines

- Typically used to represent the life cycle of a block
- Support event-based behavior (generally asynchronous)
  - Transition with trigger, guard, action
  - State with entry, exit, and do-activity
  - Can include nested sequential or concurrent states
  - Can send/receive signals to communicate between blocks during state transitions, etc.

Operational States (Drive)

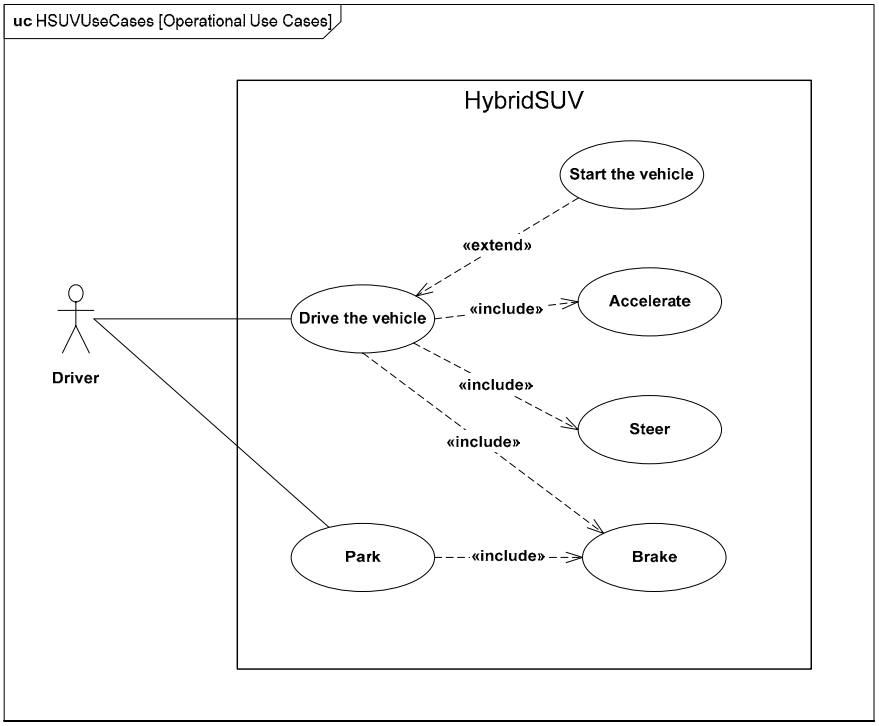


Transition notation:
trigger[guard]/action

Use Cases

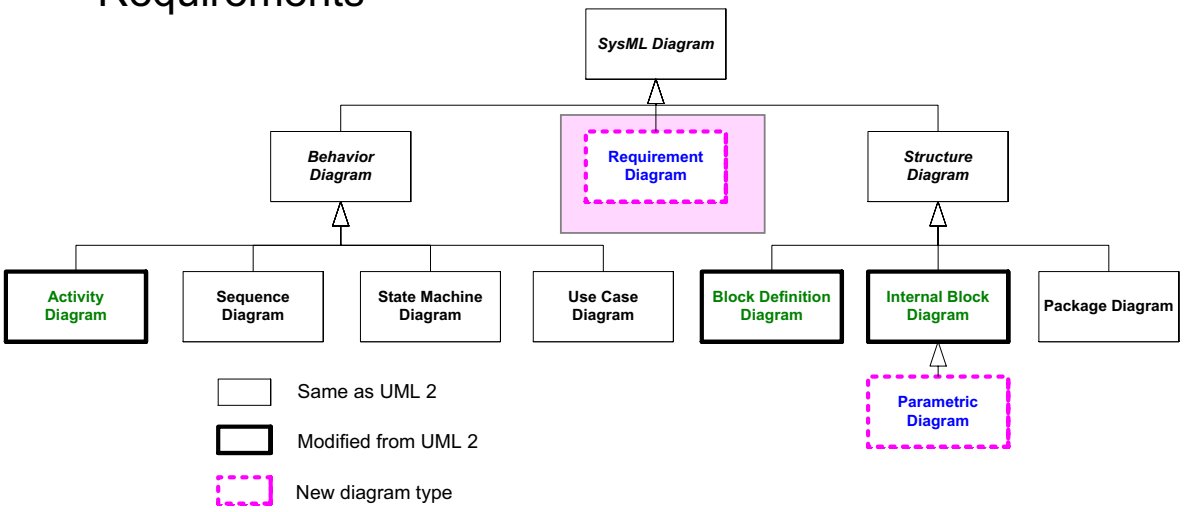
- Provide means for describing basic functionality in terms of usages/goals of the system by actors
- Common functionality can be factored out via include and extend relationships
- Generally elaborated via other behavioral representations to describe detailed scenarios
- No change to UML

Operational Use Cases



Cross-cutting Constructs

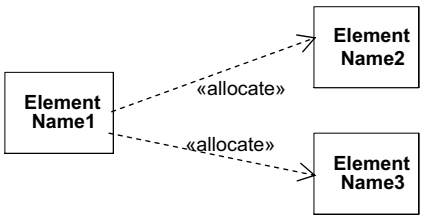
- Allocations
- Requirements



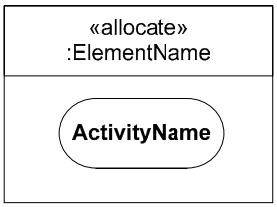
Allocations

- Represent general relationships that map one model element to another
- Different types of allocation are:
  - Behavioral (i.e., function to component)
  - Structural (i.e., logical to physical)
  - Software to Hardware
  - ….
- Explicit allocation of activities to structure via swim lanes (i.e., activity partitions)
- Both graphical and tabular representations are specified

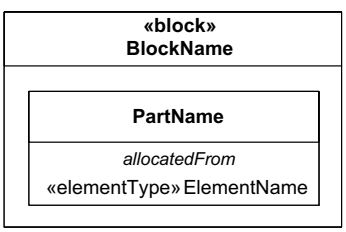
Different Allocation Representations (Tabular Representation Not Shown)



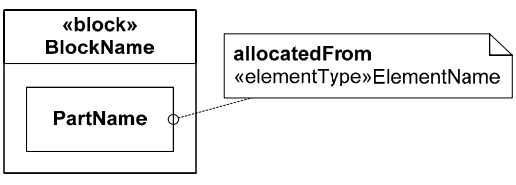
Allocate Relationship



Explicit Allocation of Activity to Swim Lane



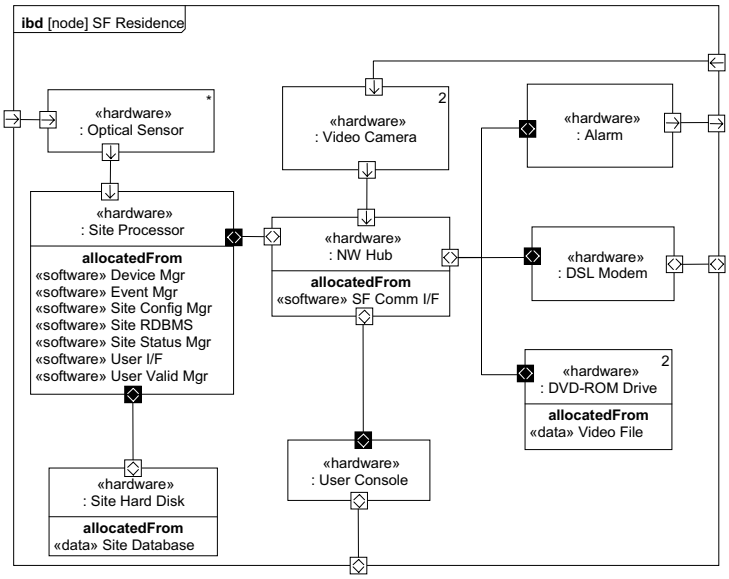
Compartment Notation



Callout Notation

SysML Allocation of SW to HW

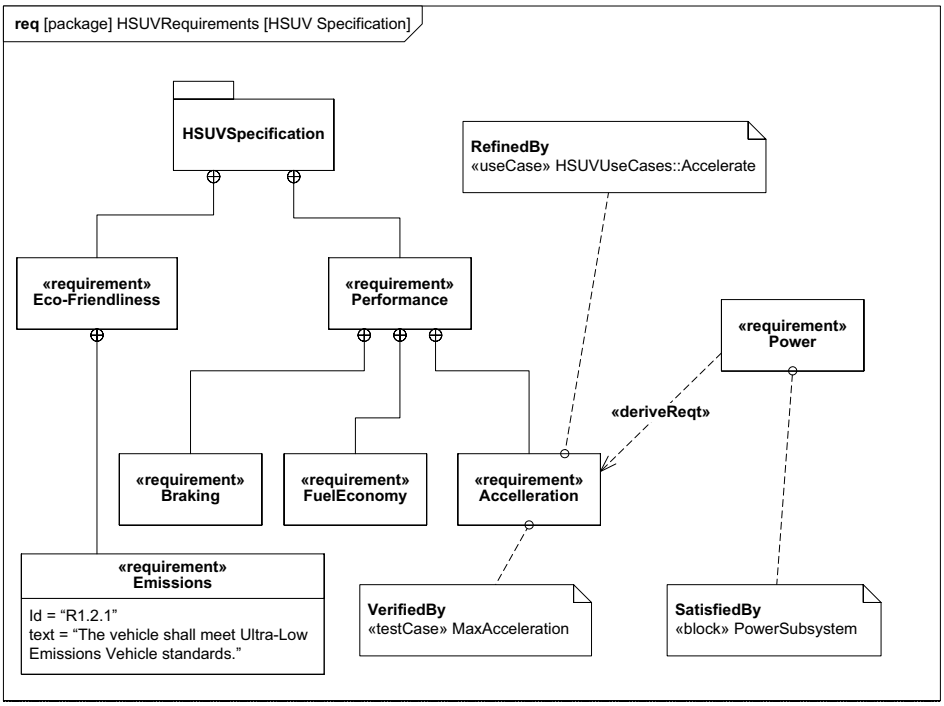
- In UML the deployment diagram is used to deploy artifacts to nodes
- In SysML allocation on ibd and bdd is used to deploy software/data to hardware



Requirements

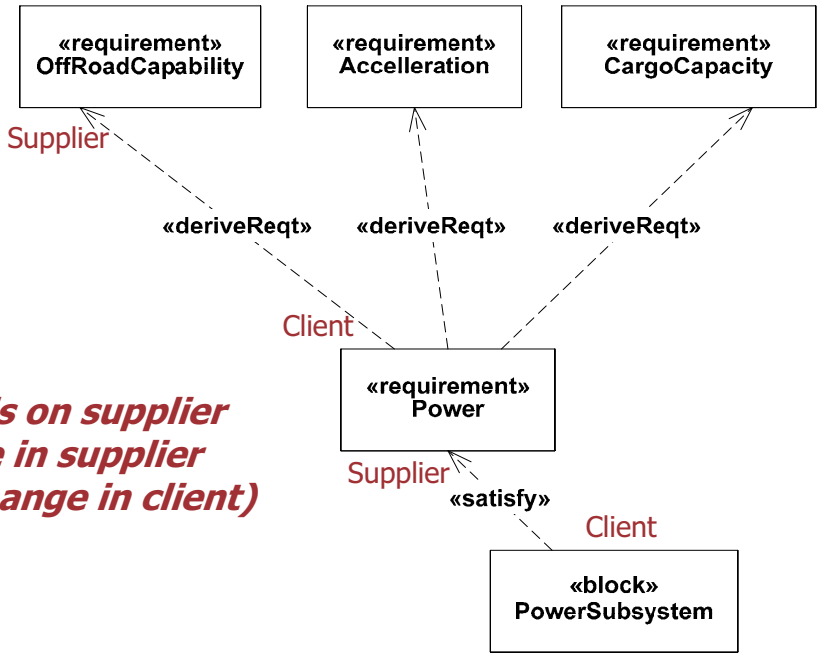
- The «requirement» stereotype represents a text based requirement
  - Includes id and text properties
  - Can add user defined properties such as verification method
  - Can add user defined requirements categories (e.g., functional, interface, performance)
- Requirements hierarchy describes requirements contained in a specification
- Requirements relationships include DeriveReqt, Satisfy, Verify, Refine, Trace, Copy

Requirements Breakdown



Requirement Relationships Model the Content of a Specification

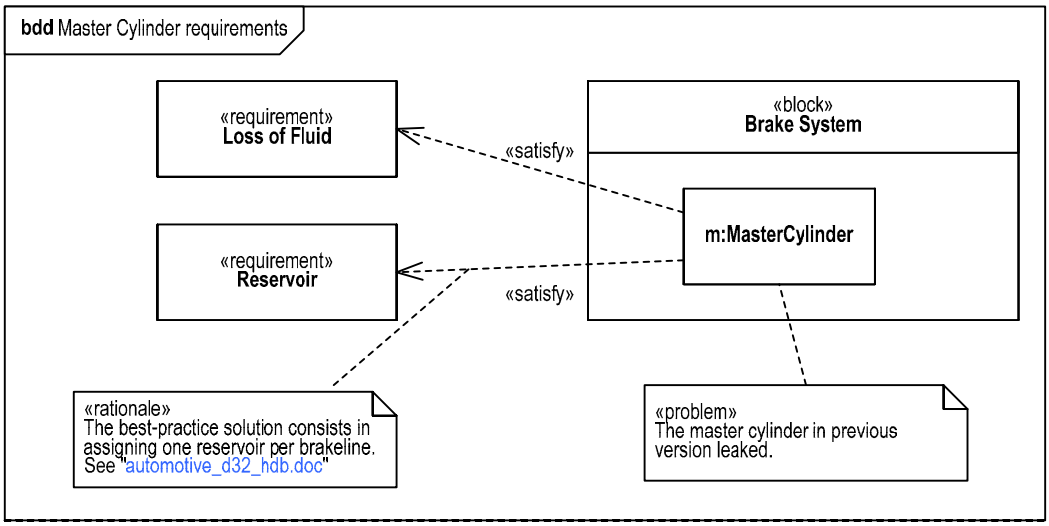
Example of Derive/Satisfy Requirement Dependencies



Client depends on supplier (i.e., a change in supplier results in a change in client)

Arrow Direction Opposite Typical Requirements Flow-Down

Problem and Rationale

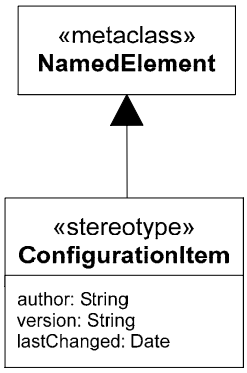


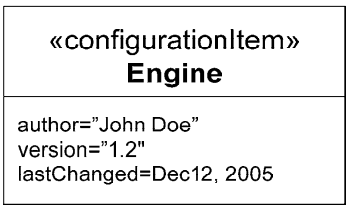
Problem and Rationale can be attached to any Model Element to Capture Issues and Decisions

Stereotypes & Model Libraries

- Mechanisms for further customizing SysML
- Profiles represent extensions to the language
  - Stereotypes extend meta-classes with properties and constraints
    - Stereotype properties capture metadata about the model element
  - Profile is applied to user model
  - Profile can also restrict the subset of the meta-model used when the profile is applied
- Model Libraries represent reusable libraries of model elements

Stereotypes

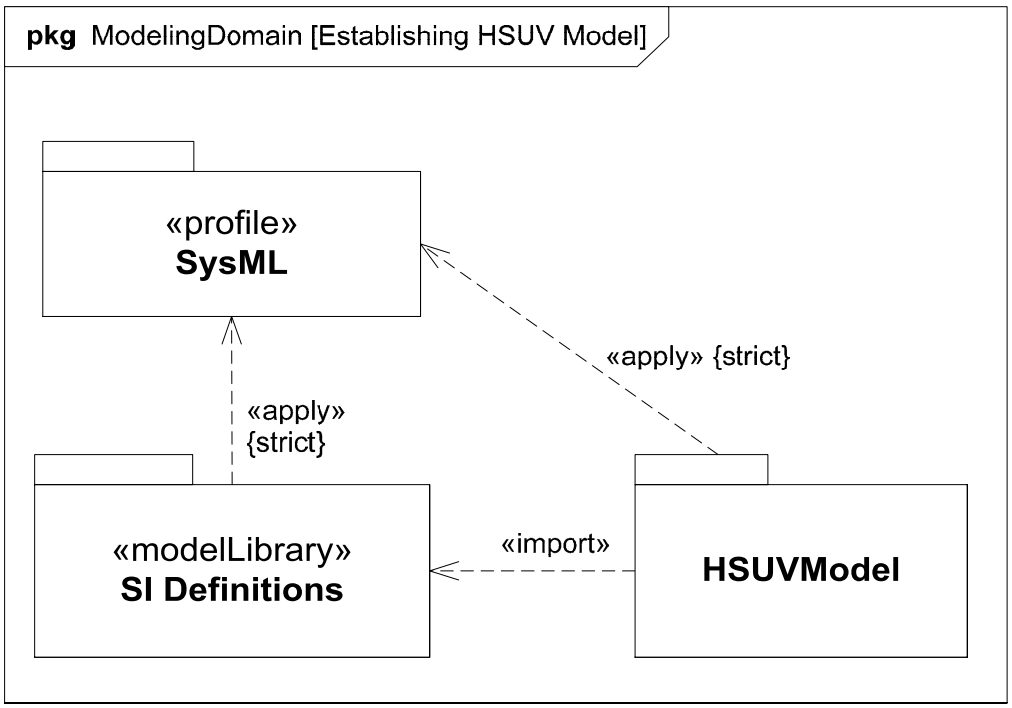




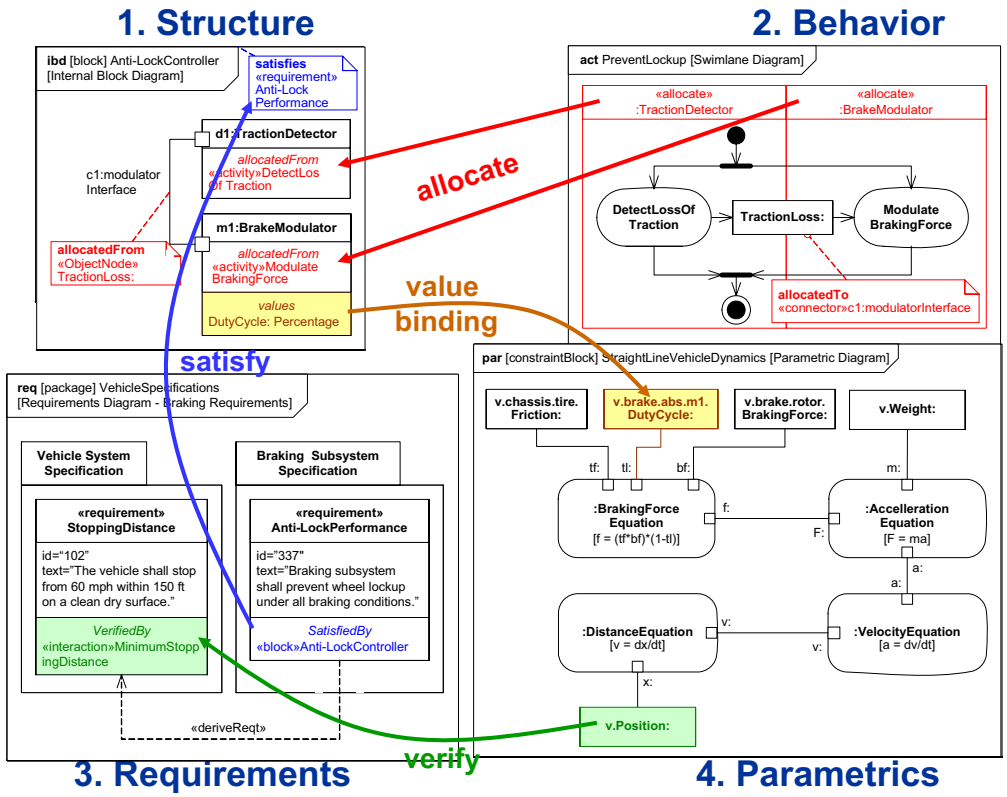
Defining the Stereotype

Applying the Stereotype

Applying a Profile and Importing a Model Library



Cross Connecting Model Elements

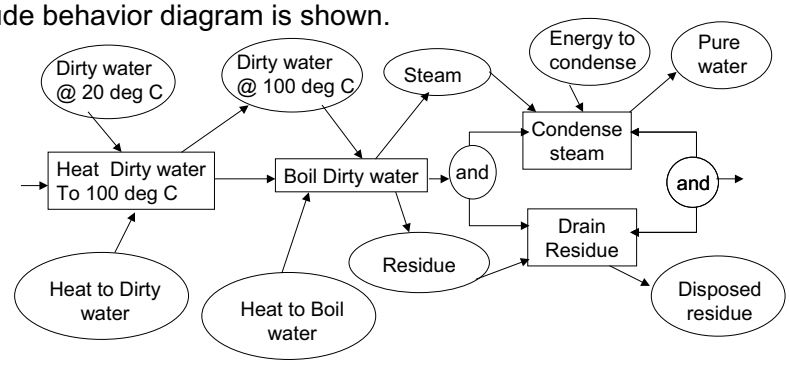


SysML Modeling
as Part of the SE Process

Distiller Sample Problem

Distiller Problem Statement

- The following problem was posed to the SysMLteam in Dec '05 by D. Oliver:
- Describe a system for purifying dirty water.
  - Heat dirty water and condense steam are performed by a Counter Flow Heat Exchanger
  - Boil dirty water is performed by a Boiler
  - Drain residue is performed by a Drain
  - The water has properties: vol = 1 liter, density 1 gm/cm3, temp 20 deg C, specific heat 1cal/gm deg C, heat of vaporization 540 cal/gm.
- A crude behavior diagram is shown.

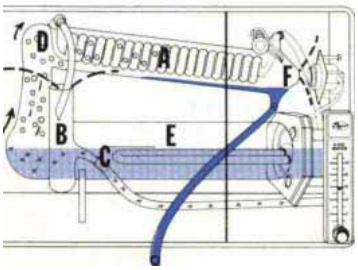


What are the real requirements?
How do we design the system?

Distiller Types

Batch Distiller

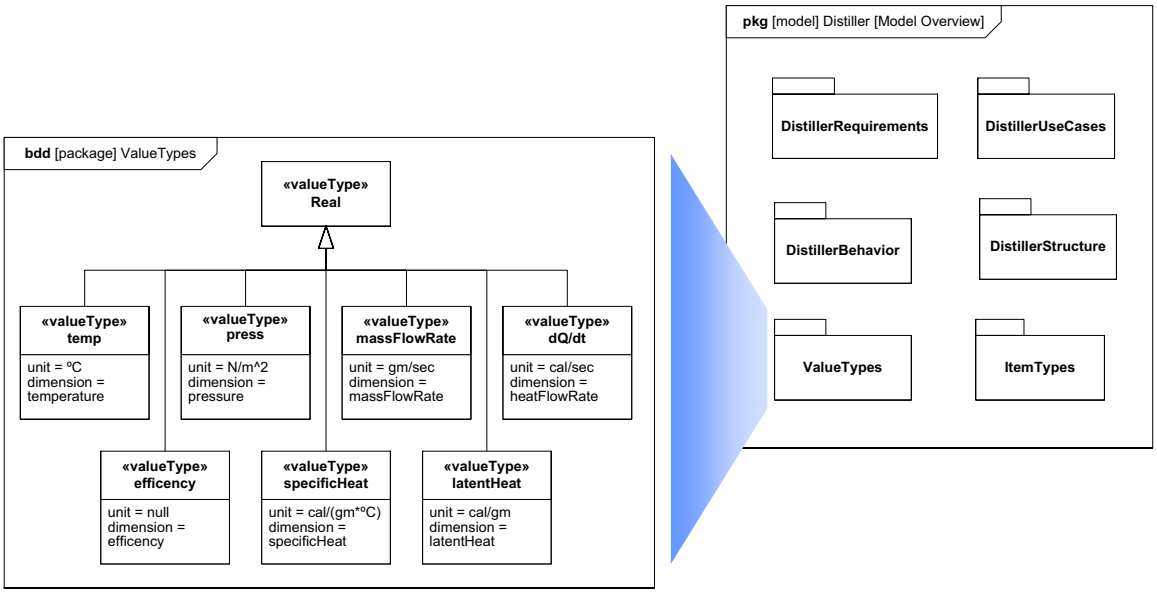
Continuous Distiller



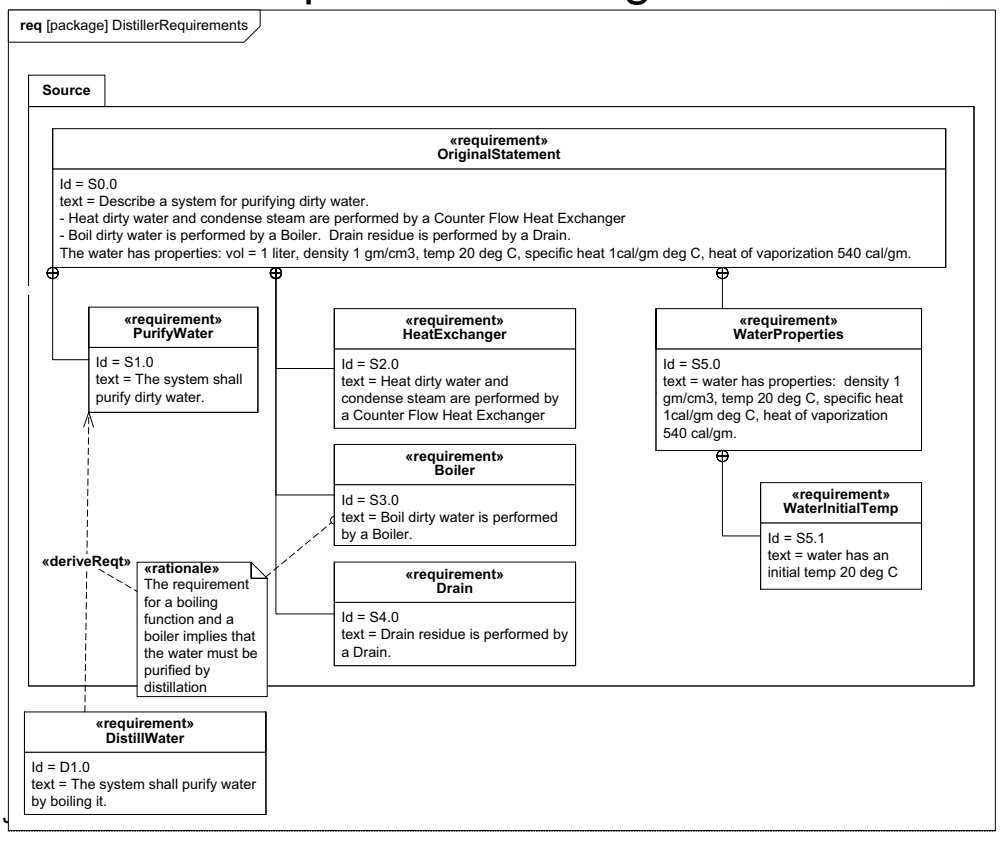
Distiller Problem – Process Used

- Organize the model, identify libraries needed
- List requirements and assumptions
- Model behavior
  - In similar form to problem statement
  - Elaborate as necessary
- Model structure
  - Capture implied inputs and outputs
    - segregate I/O from behavioral flows
  - Allocate behavior onto structure, flow onto I/O
- Capture and evaluate parametric constraints
  - Heat balance equation
- Modify design as required to meet constraints

Distiller Problem – Package Diagram: Model Structure and Libraries



Distiller Example Requirements Diagram



Distiller Example: Requirements Tables

table [requirement] OriginalStatement [Decomposition of OriginalStatement]

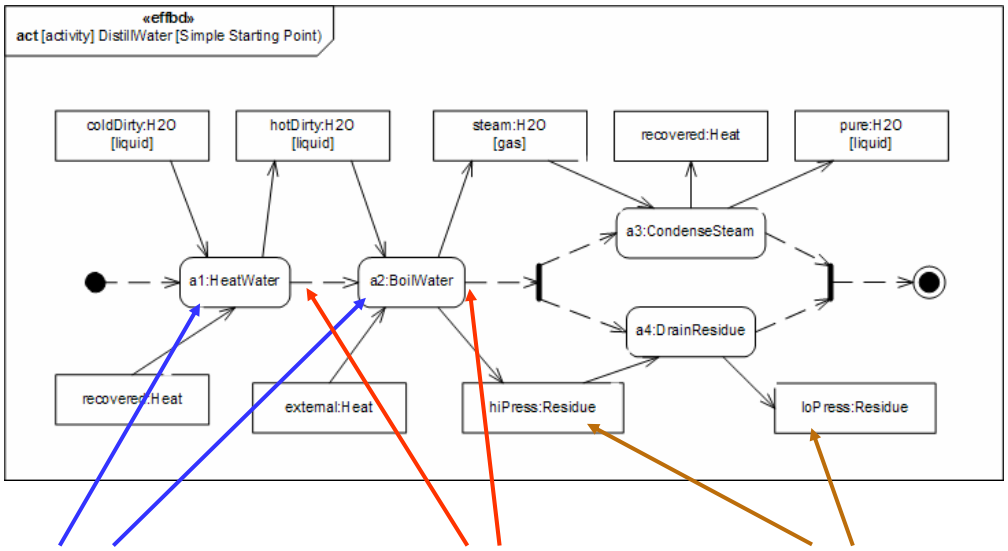
id	name	text
S0.0	OriginalStatement	Describe a system for purifying dirty water. …
S1.0	PurifyWater	The system shall purify dirty water.
S2.0	HeatExchanger	Heat dirty water and condense steam are performed by a …
S3.0	Boiler	Boil dirty water is performed by a Boiler.
S4.0	Drain	Drain residue is performed by a Drain.
S5.0	WaterProperties	water has properties: density 1 gm/cm3, temp 20 deg C, …
S5.1	WaterInitialTemp	water has an initial temp 20 deg C

table [requirement] PurifyWater [Requirements Tree]

id	name	relation	id	name	Rationale
S1.0	PurifyWater	deriveReqt	D1.0	DistillWater	The requirement for a boiling function and a boiler implies that the water must be purified by distillation

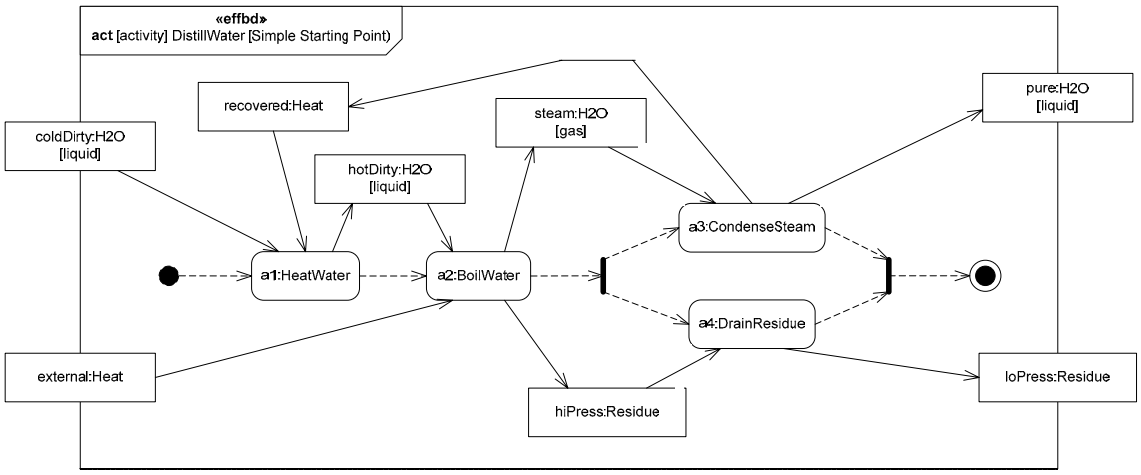
Distiller Example – Activity Diagram: Initial Diagram for DistillWater

- This activity diagram applies the SysML EFFBD profile, and formalizes the diagram in the problem statement.



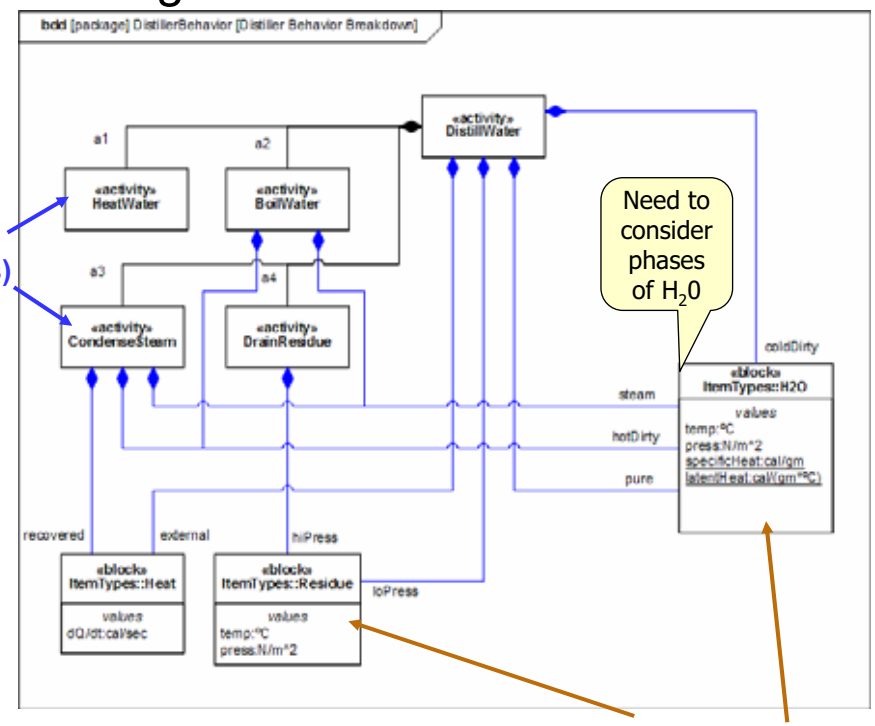
Activities (Functions) **Control (Sequence)** **Things that flow (ObjectNodes)**

Distiller Example – Activity Diagram: Control-Driven: Serial Behavior



Batch Distiller

Distiller Example – Block Definition Diagram: DistillerBehavior

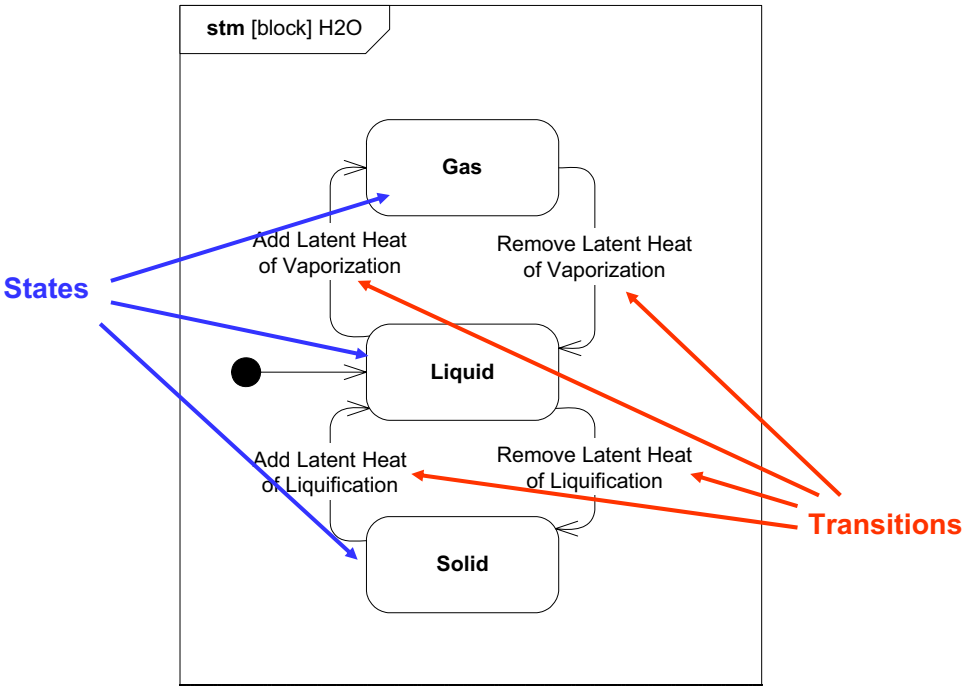


Activities (Functions)

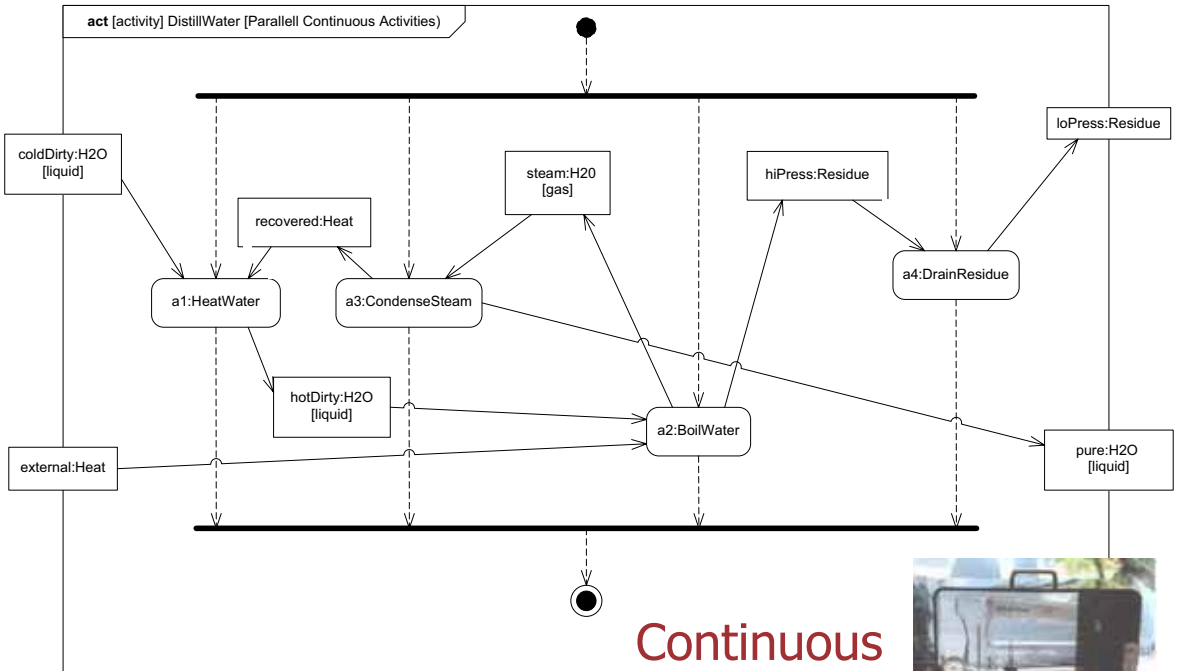
Control (not shown on BDD)

Things that flow (ObjectNodes)

Distiller Example – State Machine Diagram: States of H2O

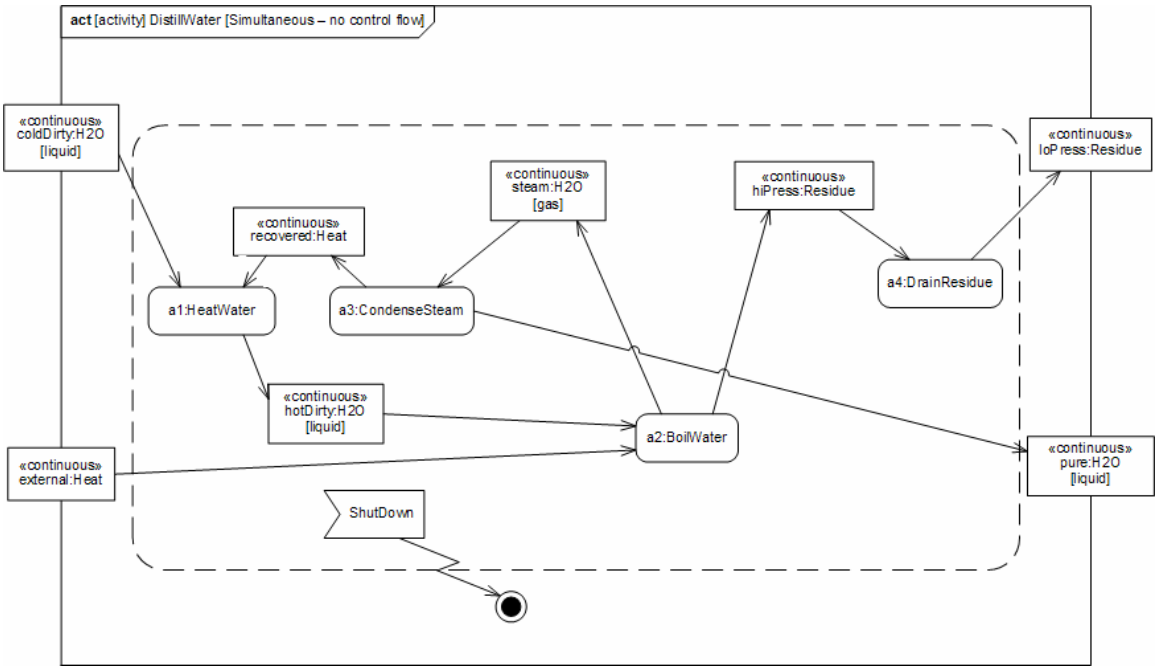


Distiller Example – Activity Diagram: I/O Driven: Continuous Parallel Behavior

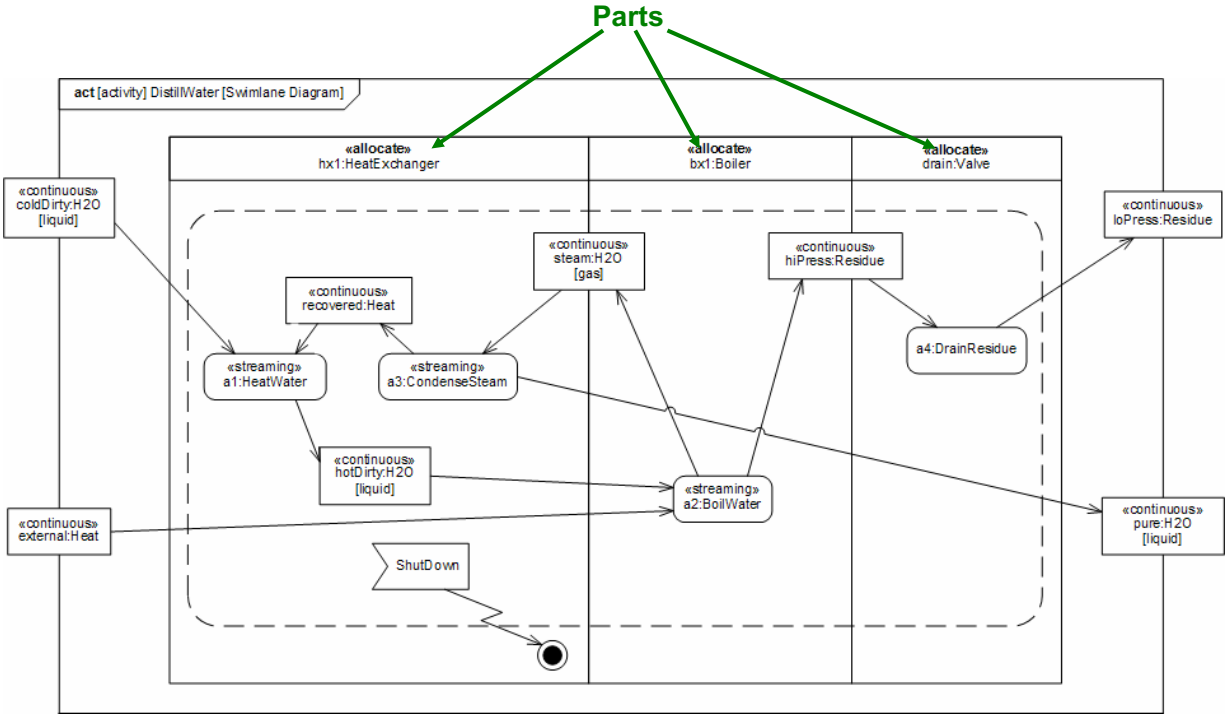


Continuous Distiller

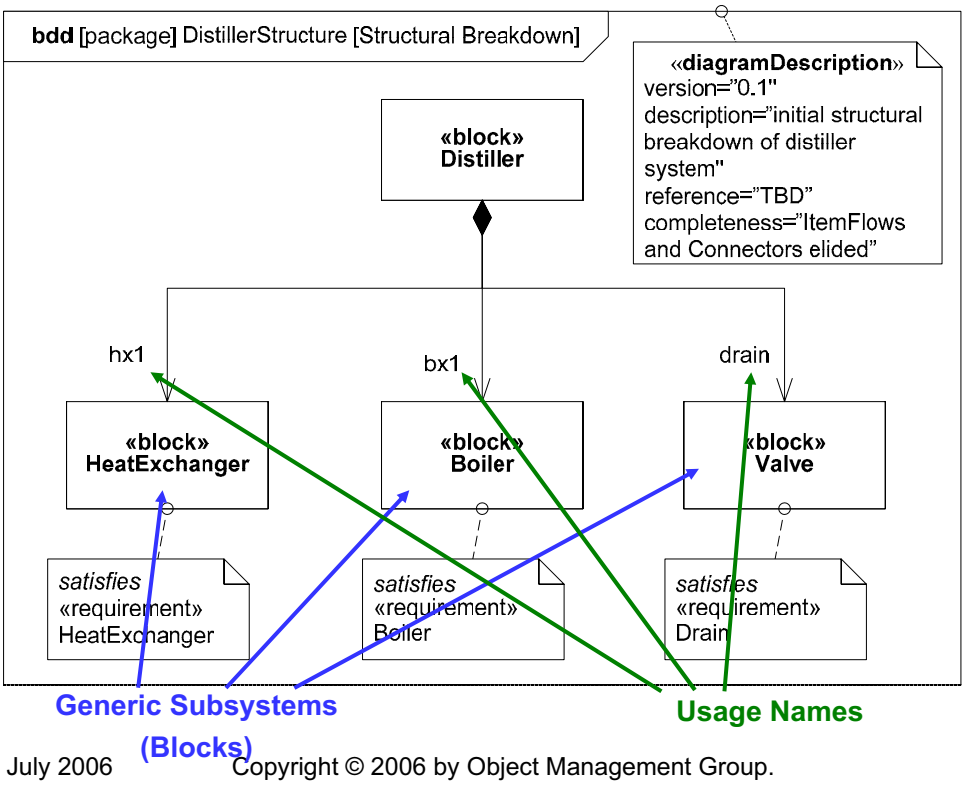
Distiller Example – Activity Diagram: No Control Flow – Simultaneous Behavior



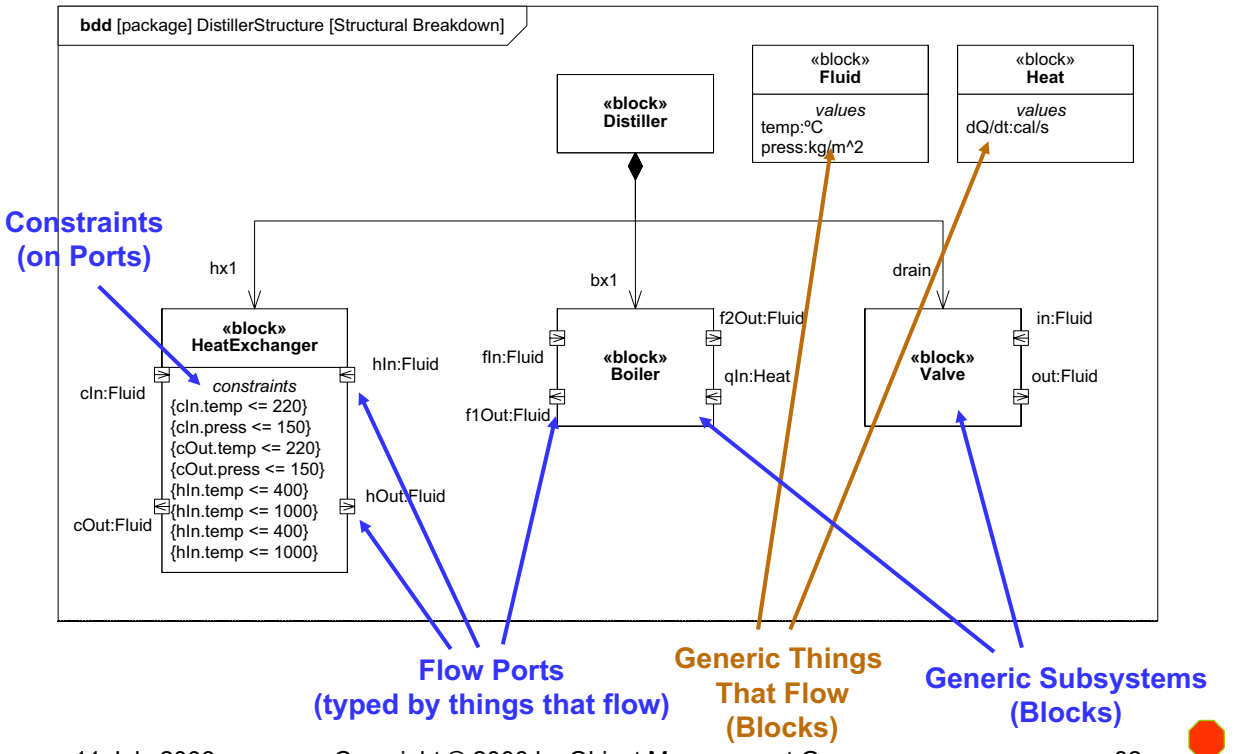
Distiller Example – Activity Diagram (with Swimlanes): DistillWater



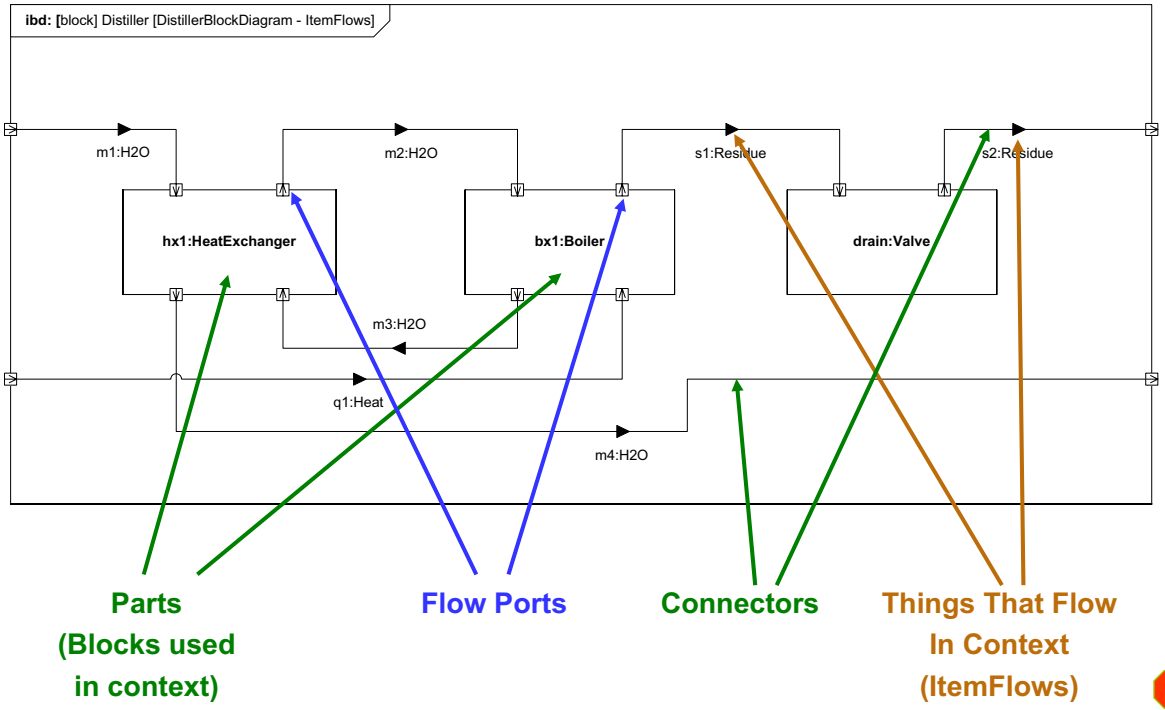
Distiller Example – Block Definition Diagram: DistillerStructure



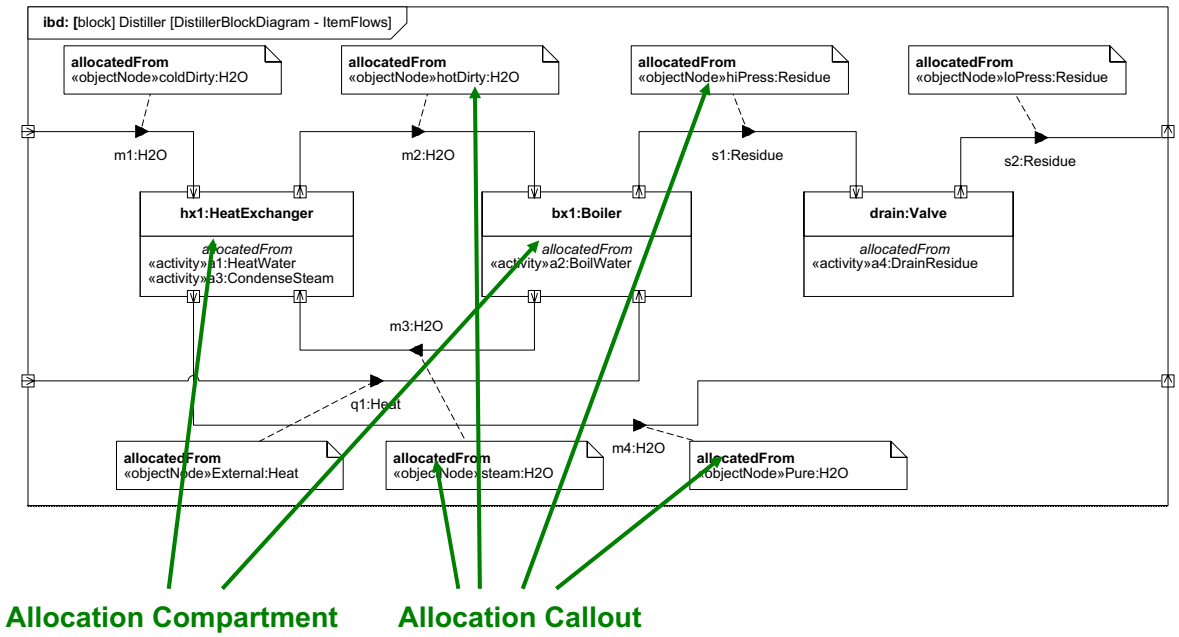
Distiller Example – Block Definition Diagram: Heat Exchanger Flow Ports



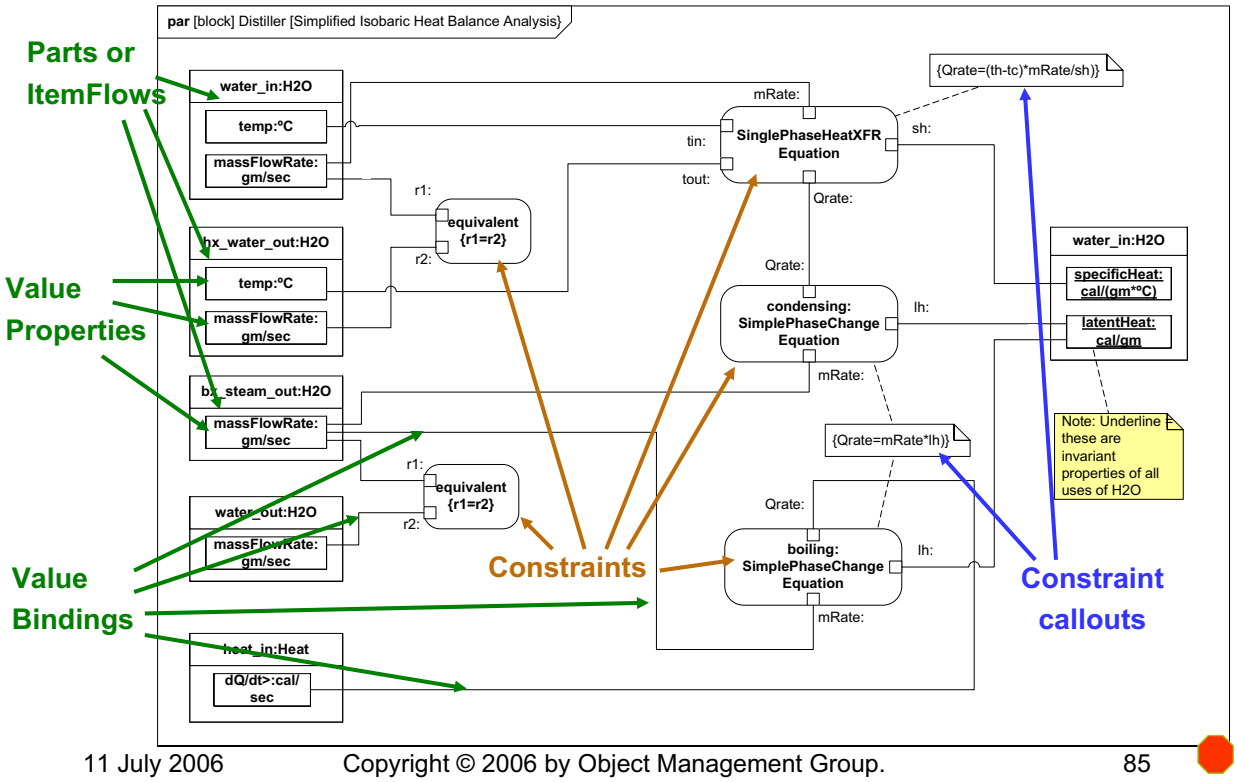
Distiller Example – Internal Block Diagram: Distiller Initial Design



Distiller Example –Internal Block Diagram: Distiller with Allocation



Distiller Example – Parametric Diagram: Heat Balance Equations



Distiller Example – Heat Balance Results

table IsobaricHeatBalance1 [Results of Isobaric Heat Balance]

specific heat cal/gm-°C	1
latent heat cal/cm	540

Satisfies «requirement» WaterSpecificHeat

Satisfies «requirement» WaterHeatOfVaporization

	water_in	hx_water_out	bx_water_in	bx_steam_out	water_out
mass flow rate gm/sec	6.75	6.75	1	1	1
temp °C	20	100	100	100	100

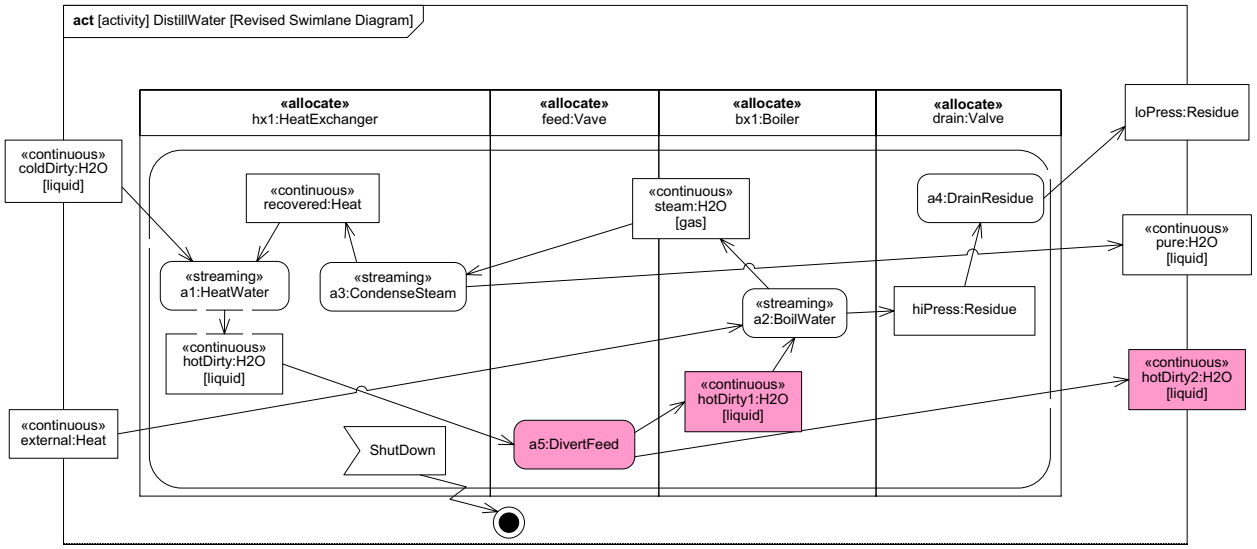
Satisfies «requirement» WaterInitialTemp

dQ/dt cooling water cal/sec	540
dQ/dt steam-condensate cal/sec	540
condenser efficency	1
heat deficit	0

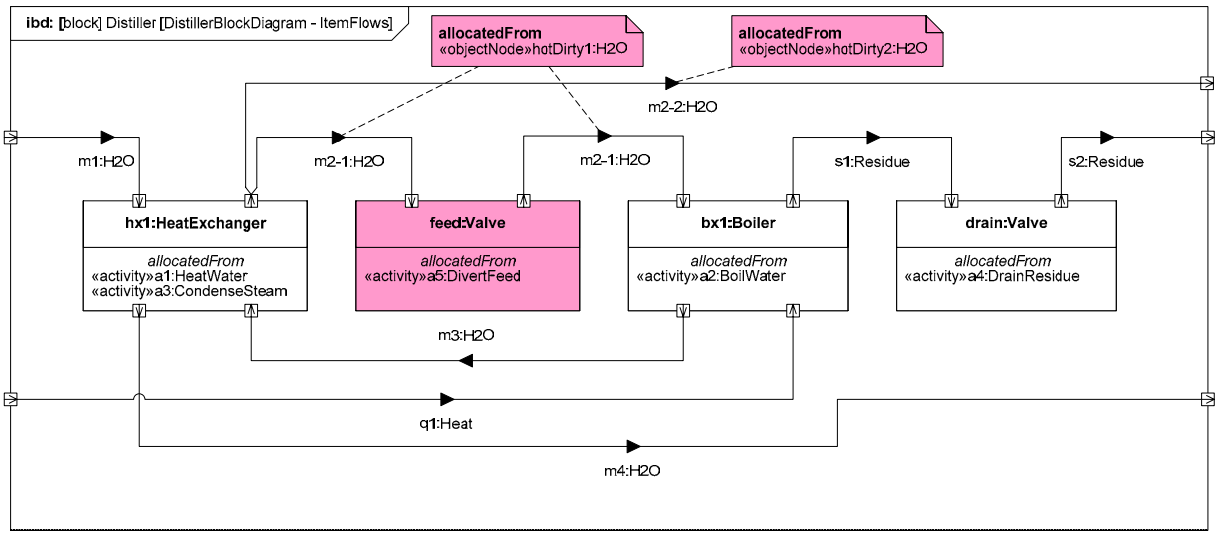
dQ/dt condensate-steam cal/sec	540
boiler efficiency	1
dQ/dt in boiler cal/sec	540

Note: Cooling water needs to have 6x flow of steam!
Need bypass between hx_water_out and bx_water_in!

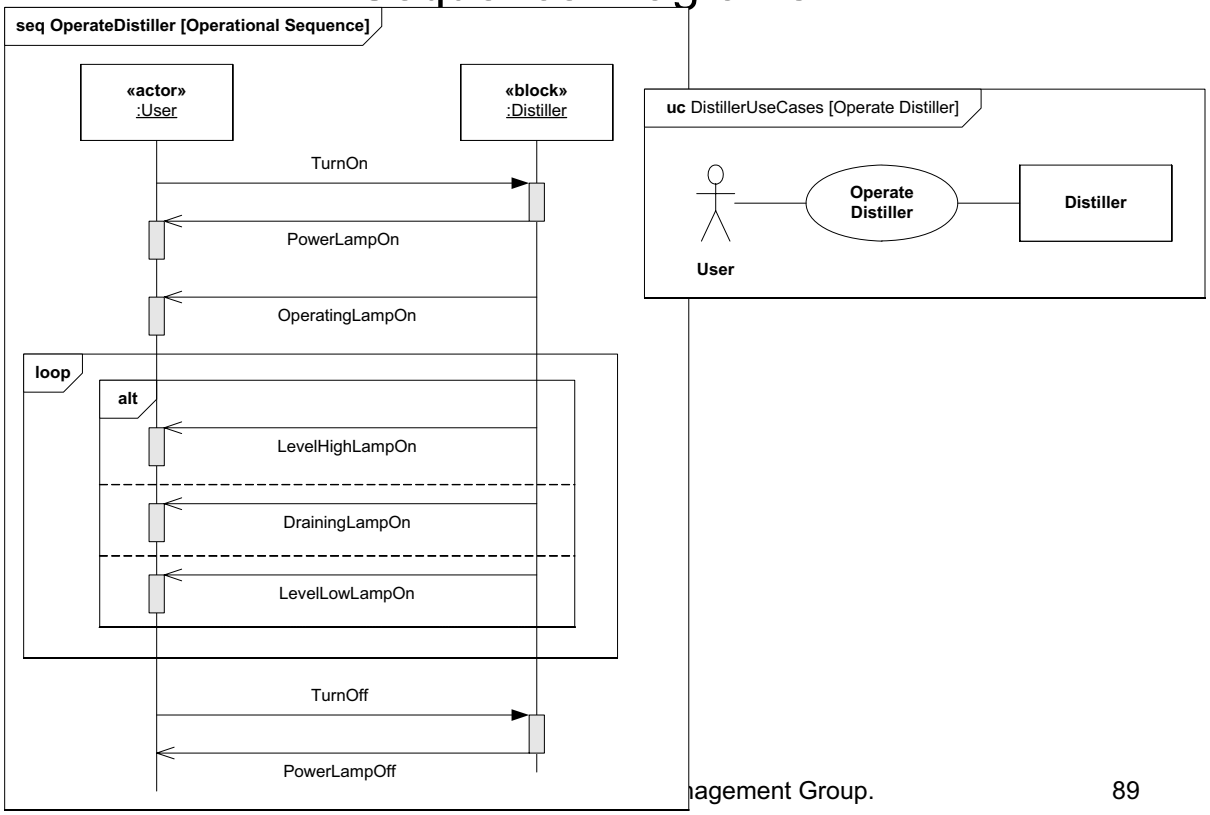
Distiller Example – Activity Diagram: Updated DistillWater



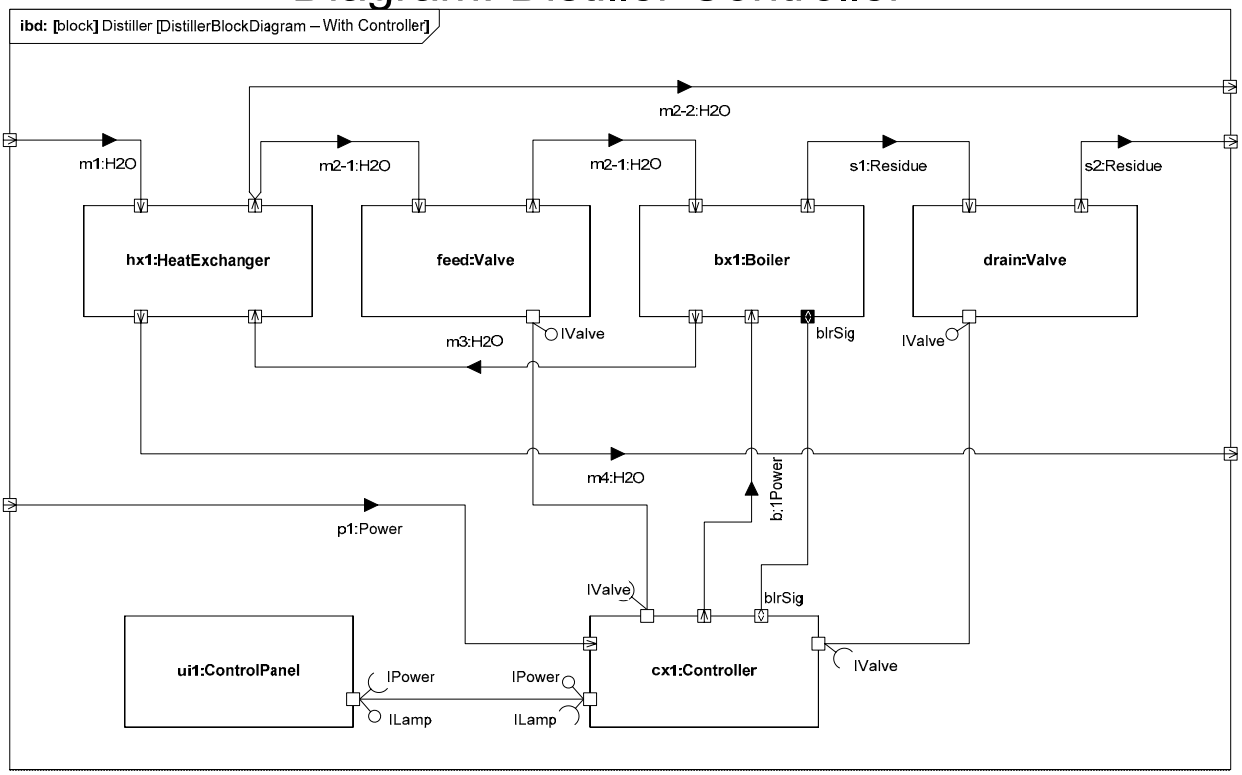
Distiller Example – Internal Block Diagram: Updated Distiller



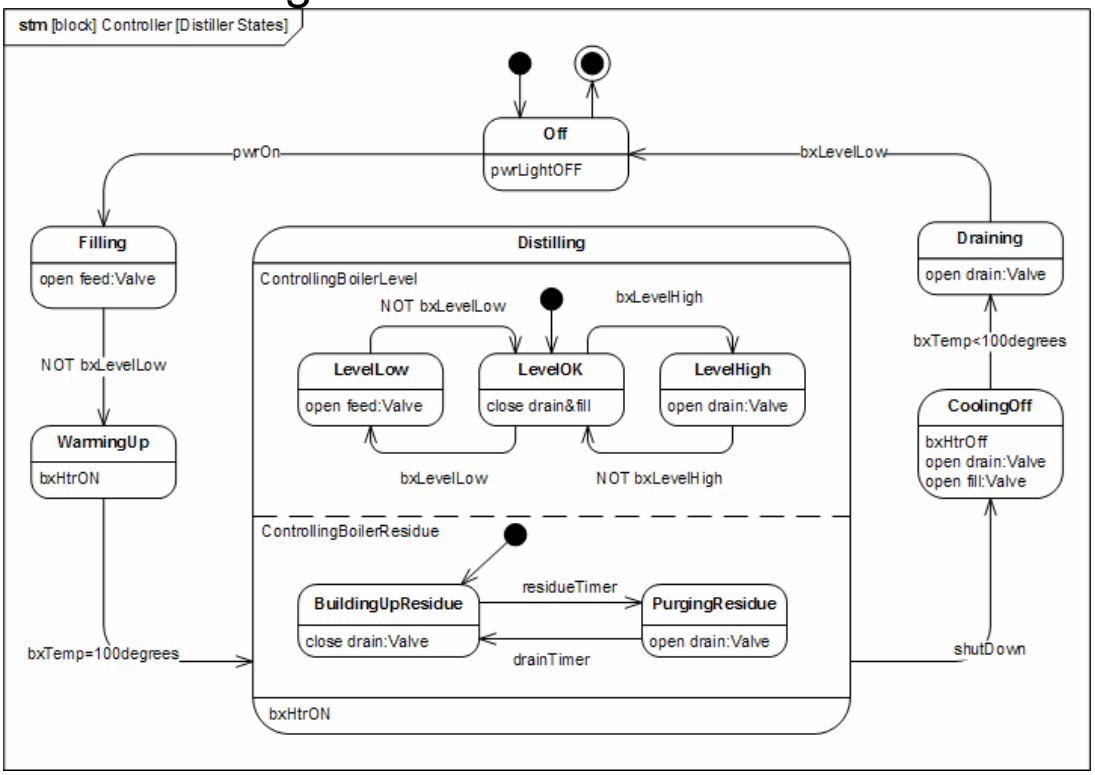
Distiller Example – Use Case and Sequence Diagrams

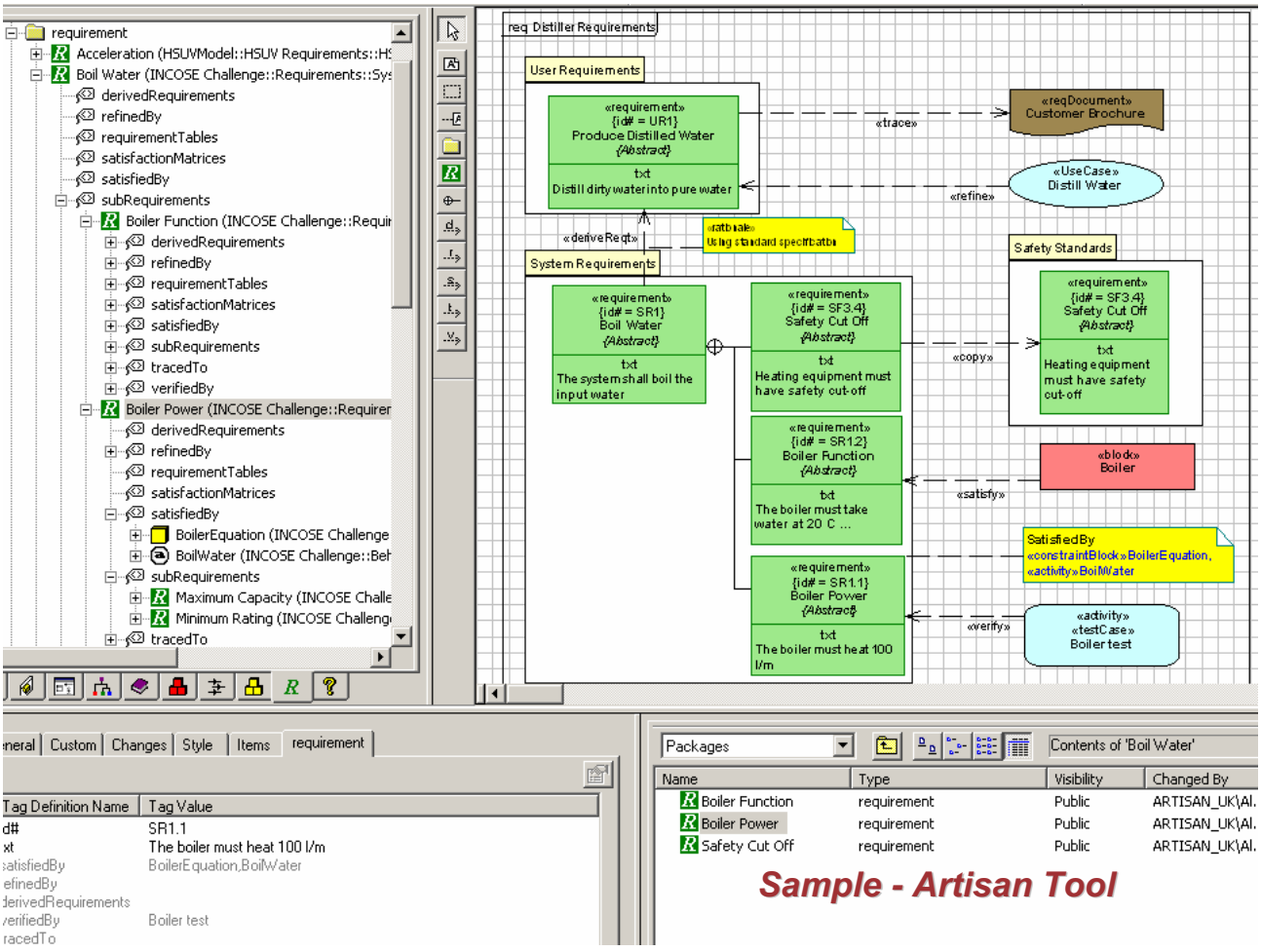


Distiller Example – Internal Block Diagram: Distiller Controller



Distiller Example – State Machine Diagram: Distiller Controller

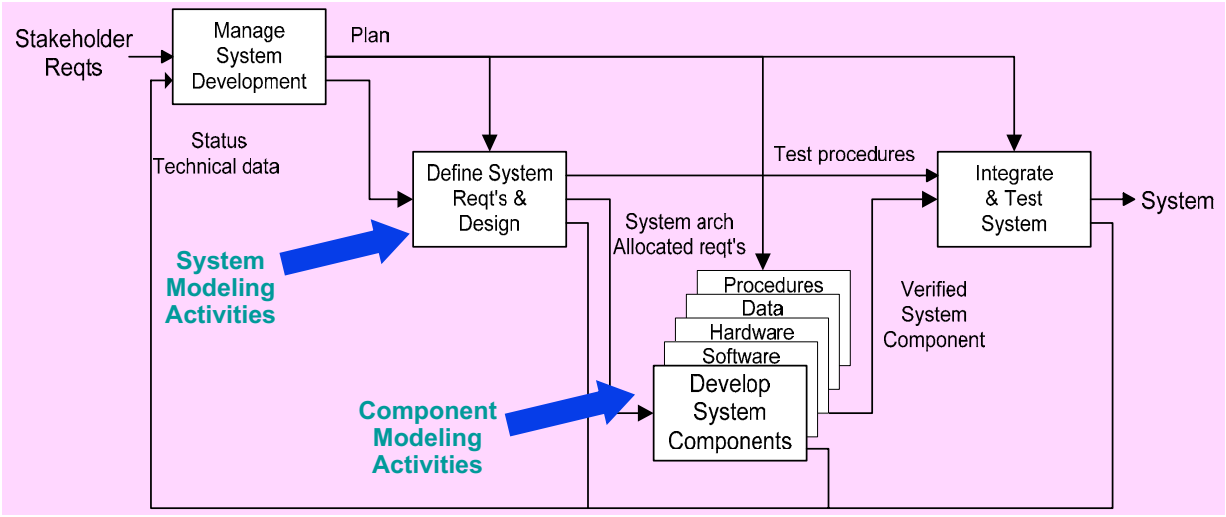




Sample - Artisan Tool

OOSEM – ESS Example

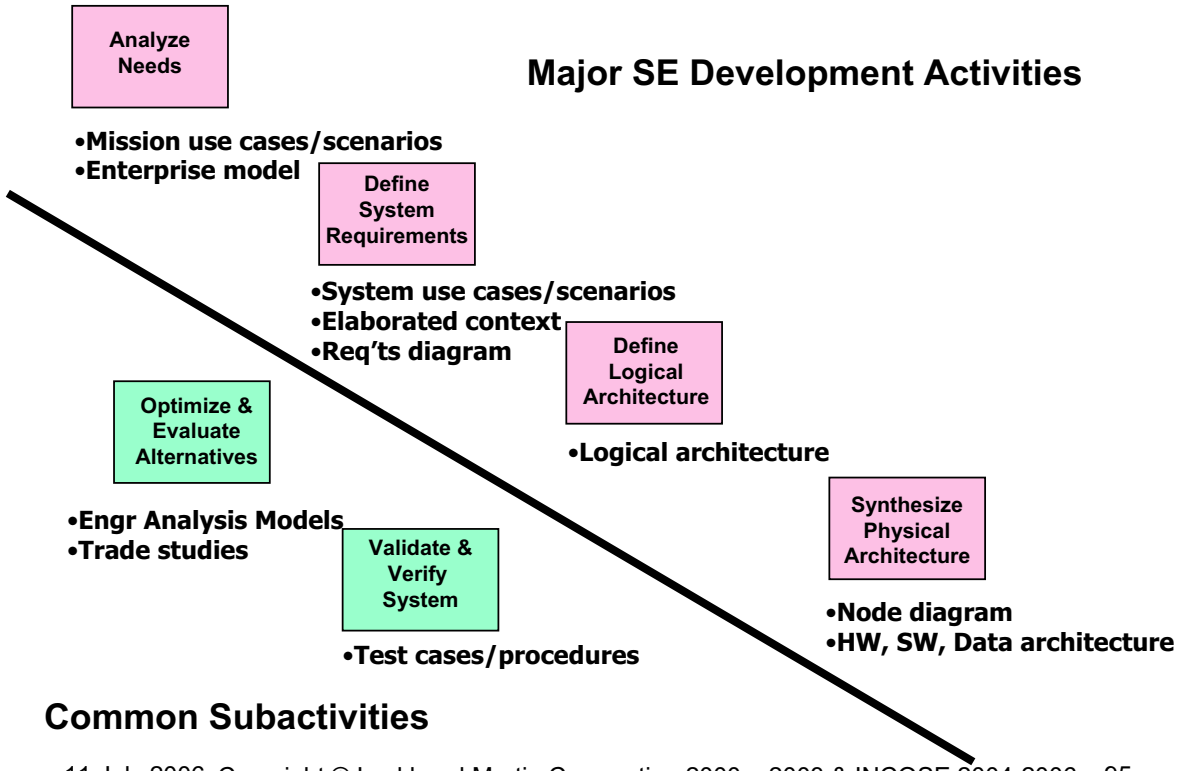
System Development Process



Integrated Product Development (IPD) is essential to improve communications

A Recursive V process that can be applied to multiple levels of the system hierarchy

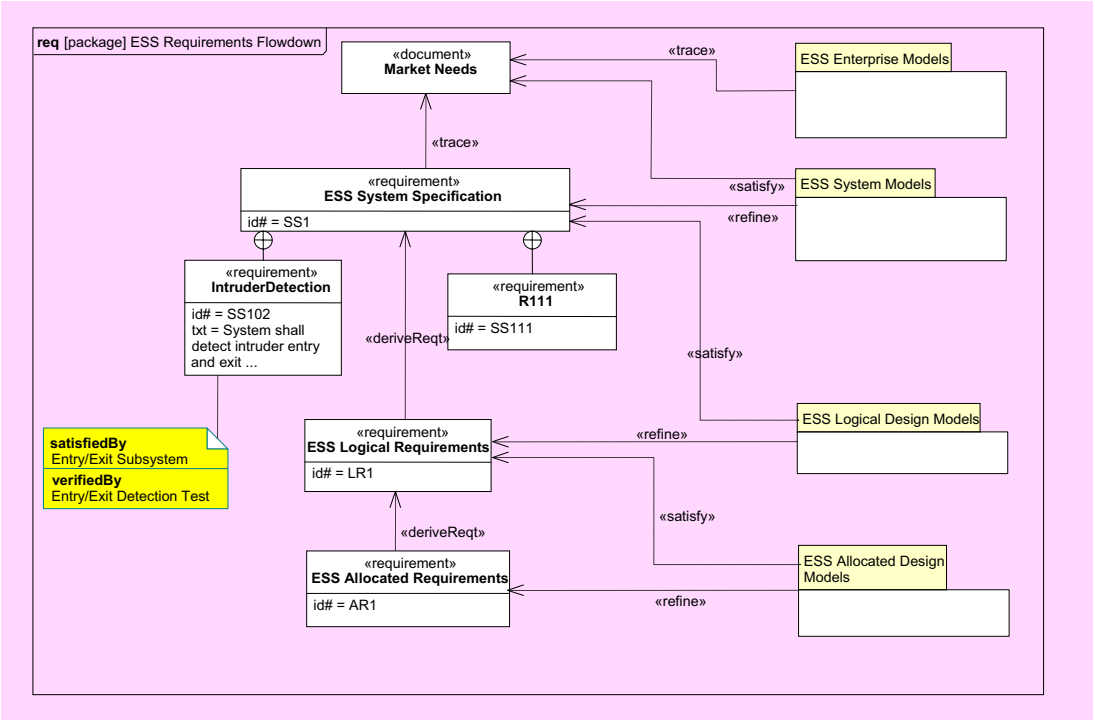
Systems Modeling Activities - OOSEM



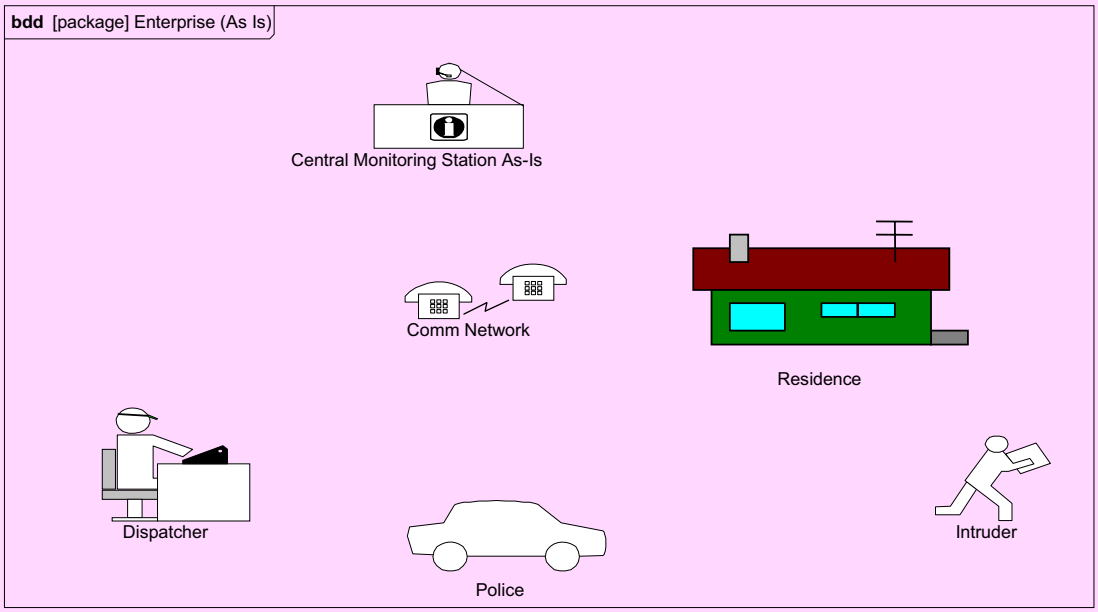
Enhanced Security System Example

- The Enhanced Security System is the example for the OOSEM material
  - Problem fragments used to demonstrate principles
  - Utilizes Artisan RTS™ Tool for the SysML artifacts

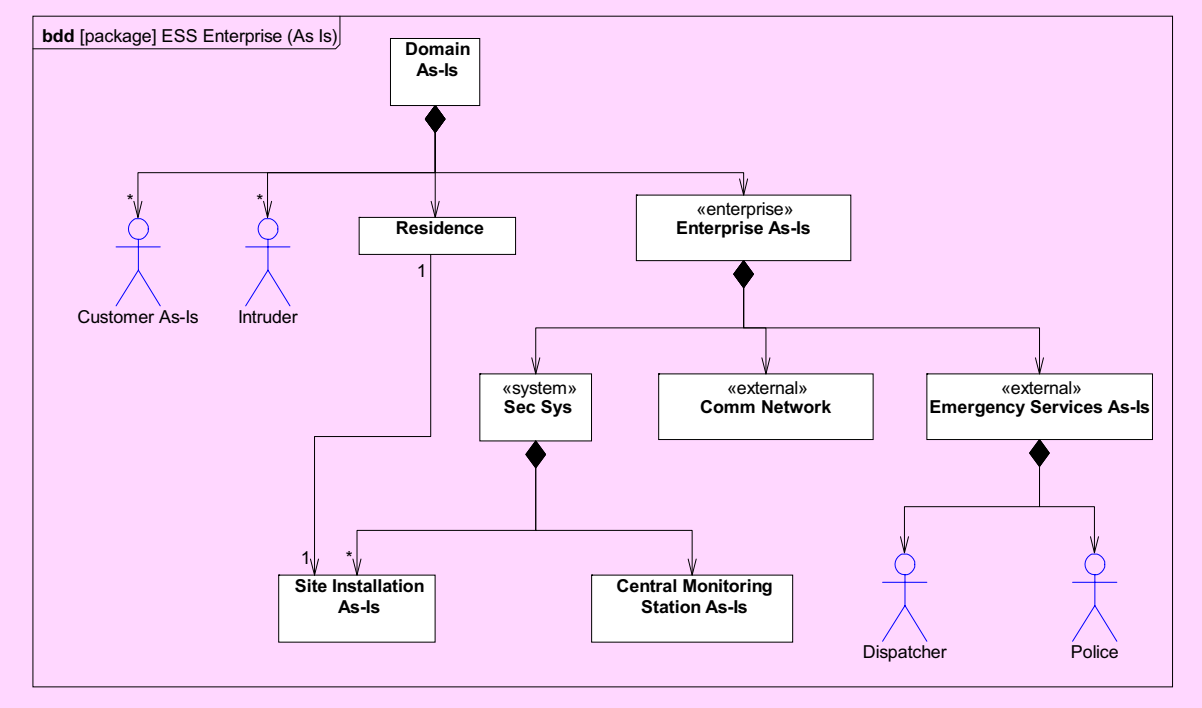
ESS Requirements Flowdown



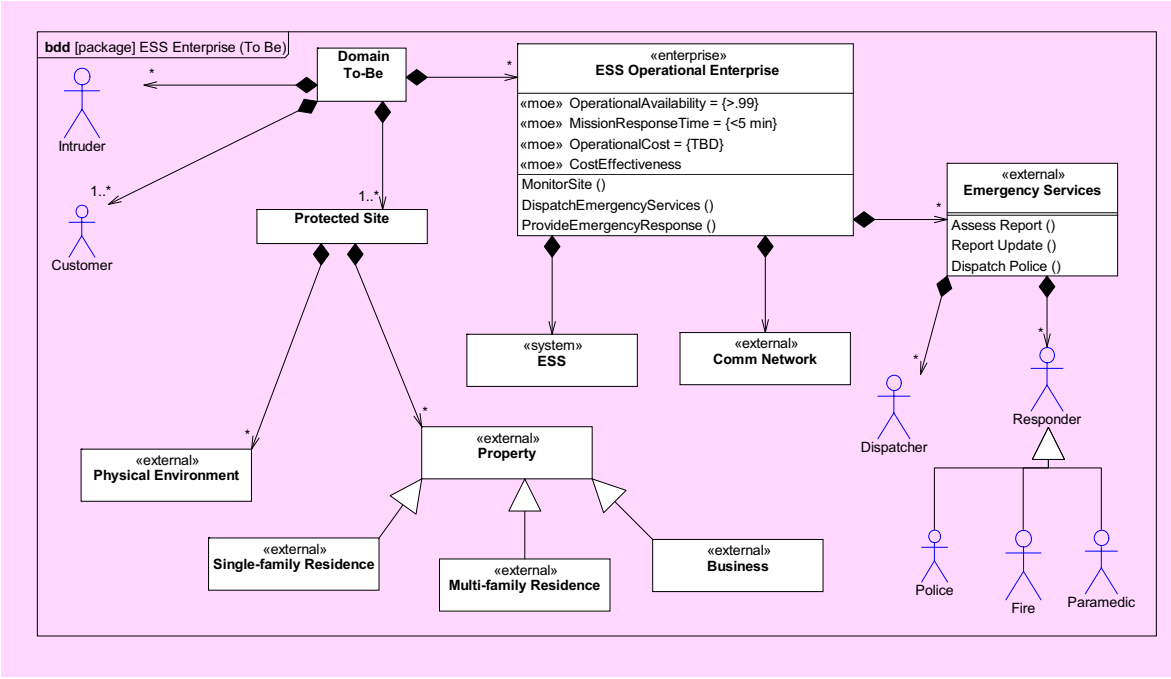
Operational View Depiction



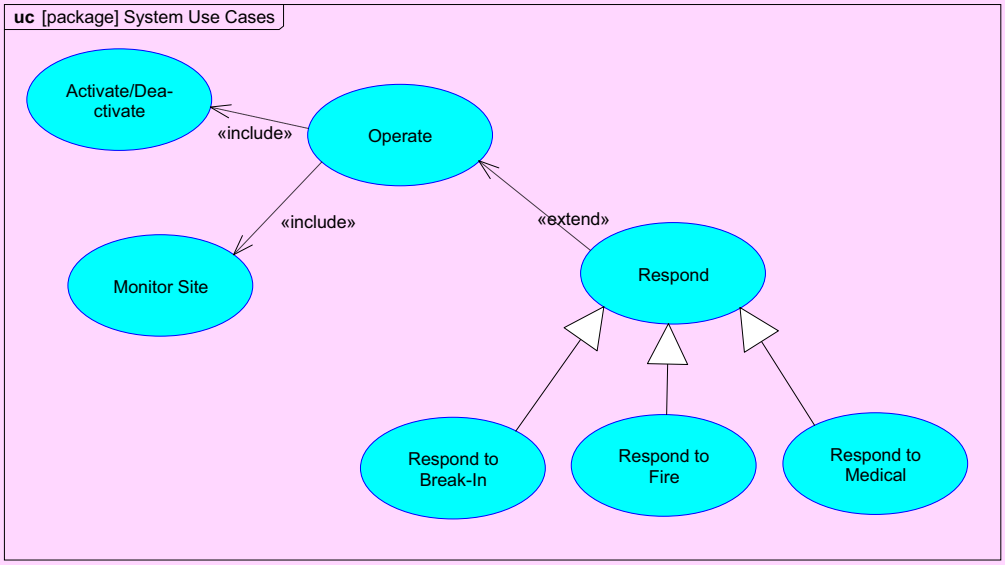
ESS Enterprise As-Is Model



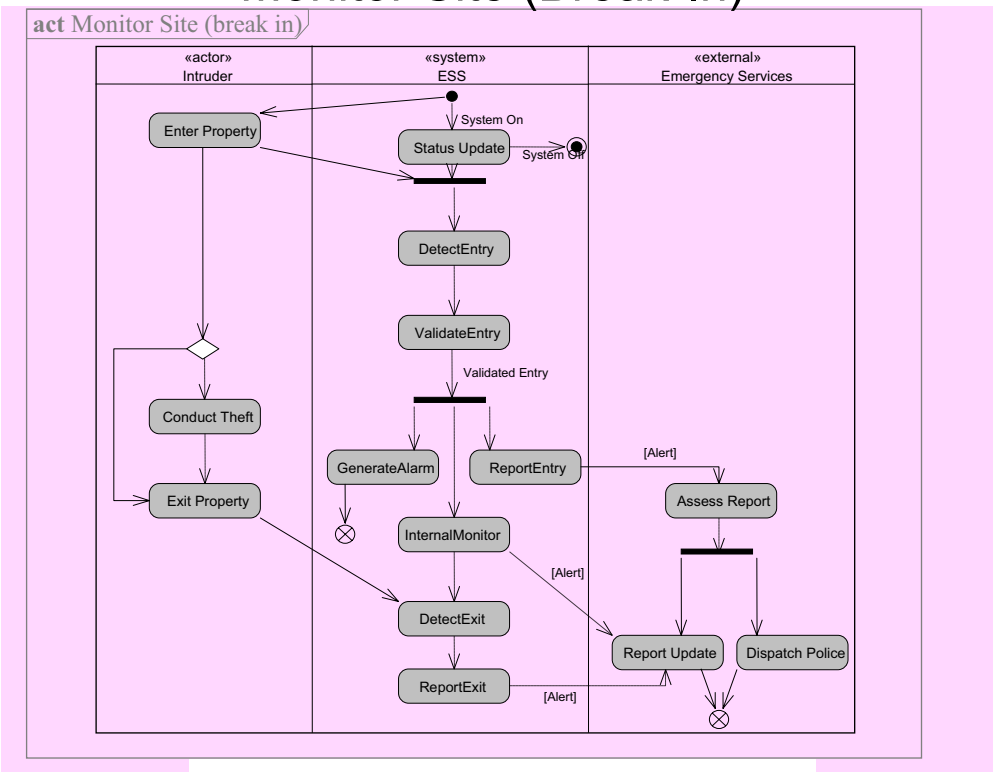
ESS Operational Enterprise To-Be Model



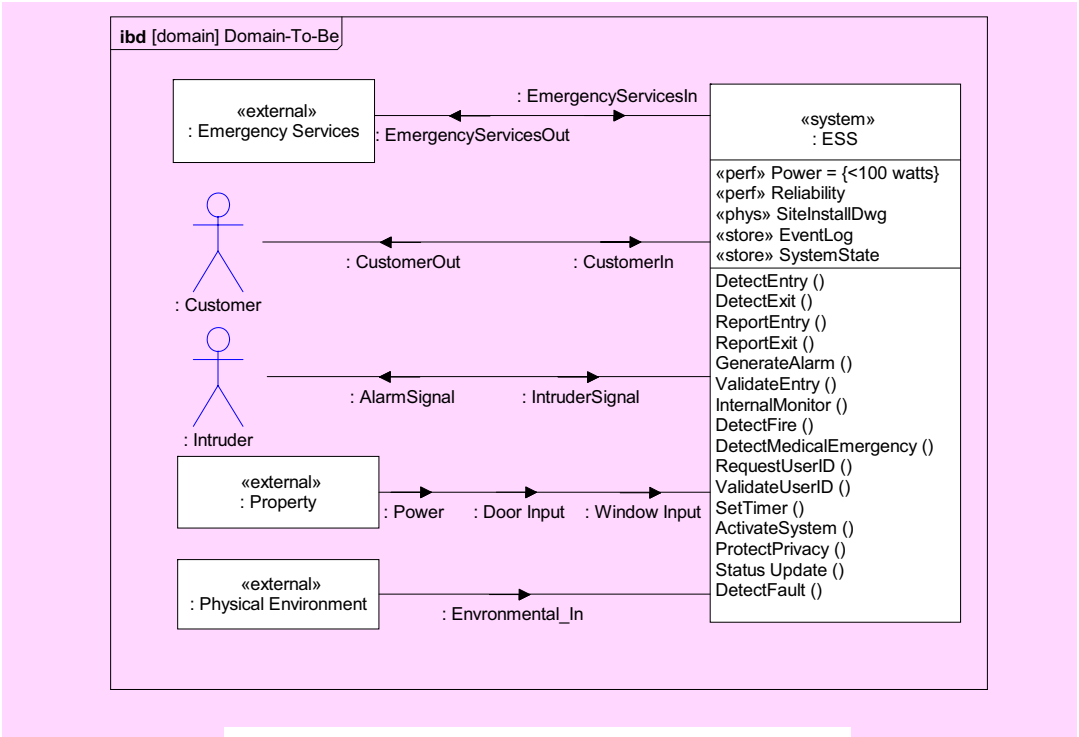
System Use Cases - Operate



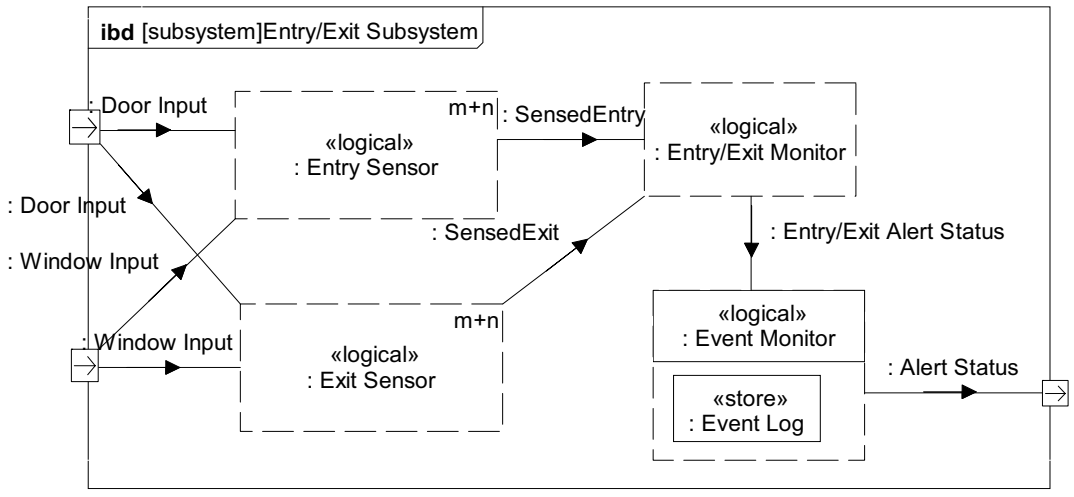
System Scenario: Activity Diagram Monitor Site (Break-In)



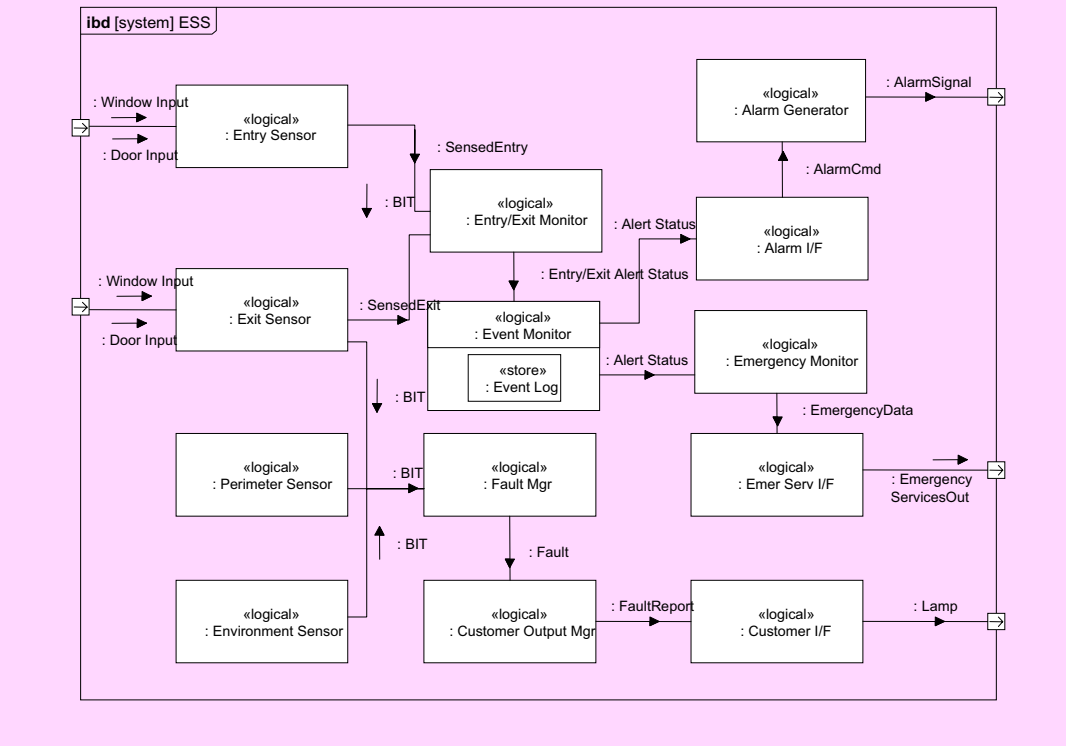
ESS Elaborated Context Diagram



ESS Logical Design – Example Subsystem



ESS Logical Design (Partial)

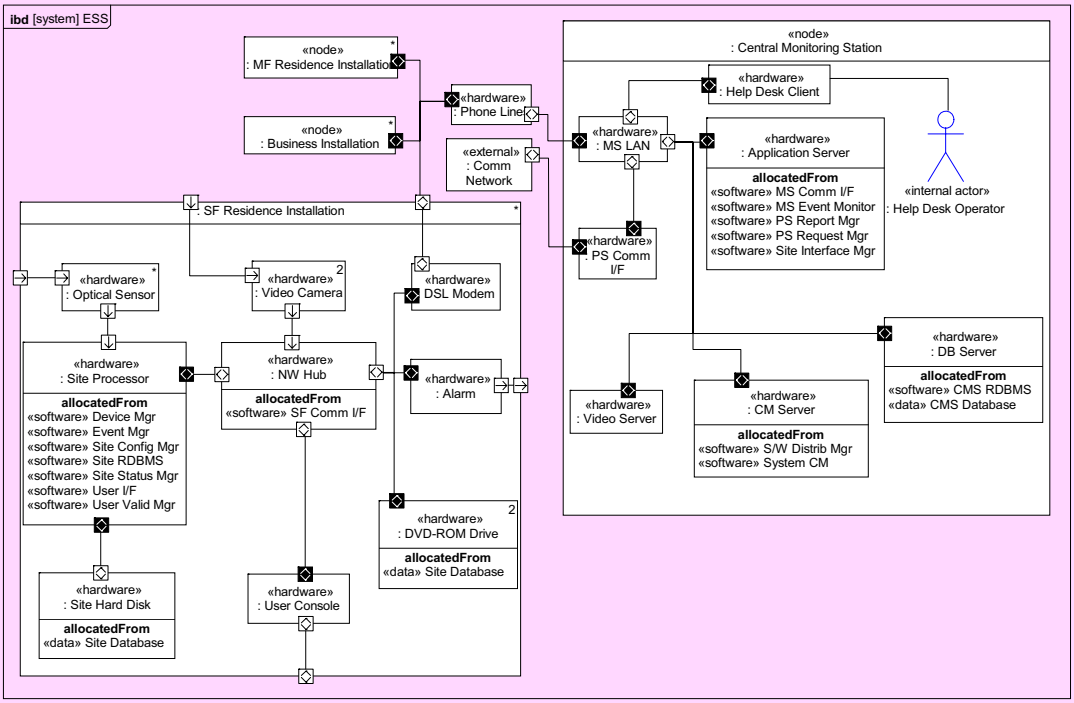


ESS Allocation Table (partial)

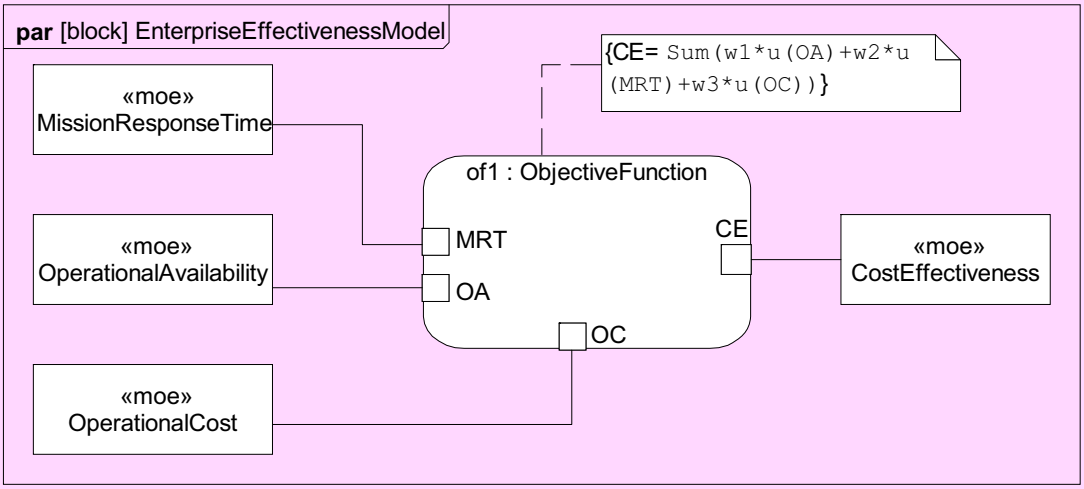
- Allocating Logical Components to HW, SW, Data, and Procedures components

Physical Components	Type		Logical Components: Entry Sensor	Exit Sensor	Perimeter Sensor	Entry/Exit Monitor	Event Monitor	Site Comms I/F	Event Log	Customer I/F	Customer Output Mgr	System Status	Fault Mgr	Alarm Generator	Alarm I/F
	«software»	Device Mgr													X
		SF Comm I/F						X							
		User I/F									X				
		Event Mgr				X	X								
		Site Status Mgr											X		
		Site RDBMS							X			X			
		CMS RDBMS							X						
	«data»	Video File							X						
		CMS Database							X						
		Site Database							X			X			
	«hardware»	Optical Sensor	X	X											
		DSL Modem						X							
		User Console								X					
		Video Camera			X										
		Alarm												X	

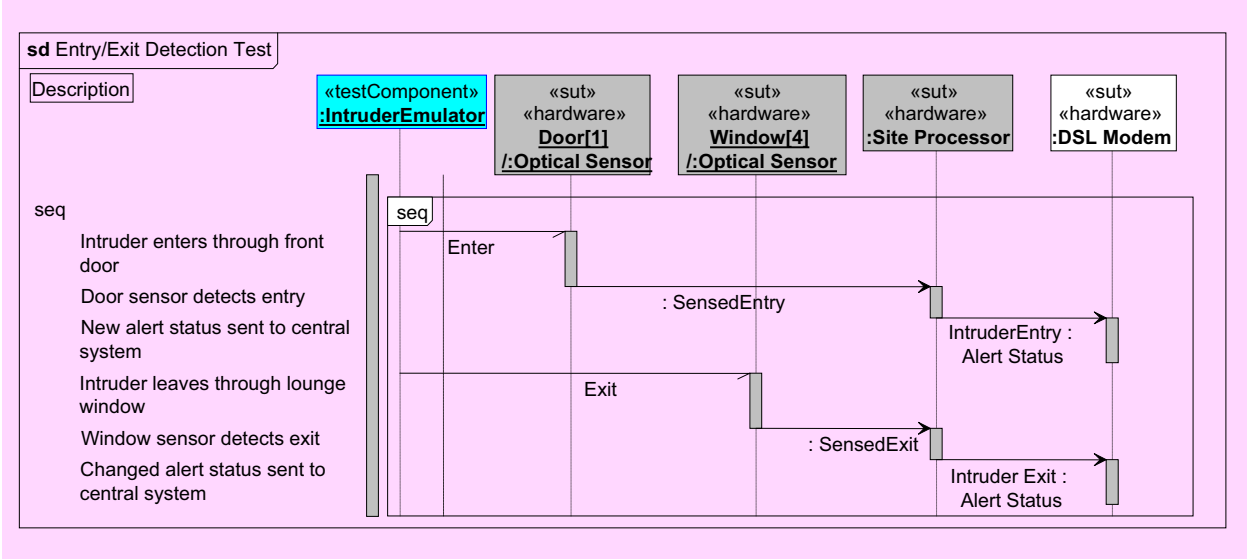
ESS Deployment View



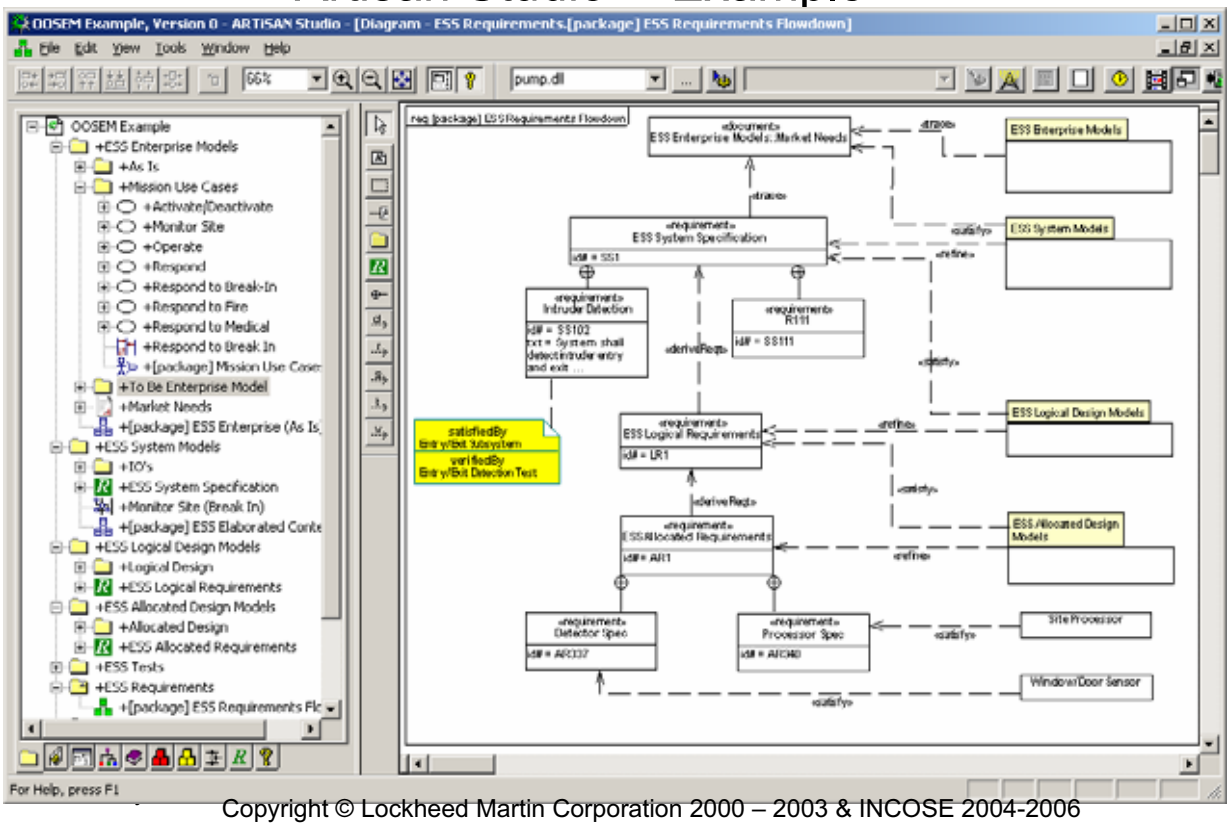
ESS Parametric Diagram
To Support Trade-off Analysis



Entry/Exit Test Case

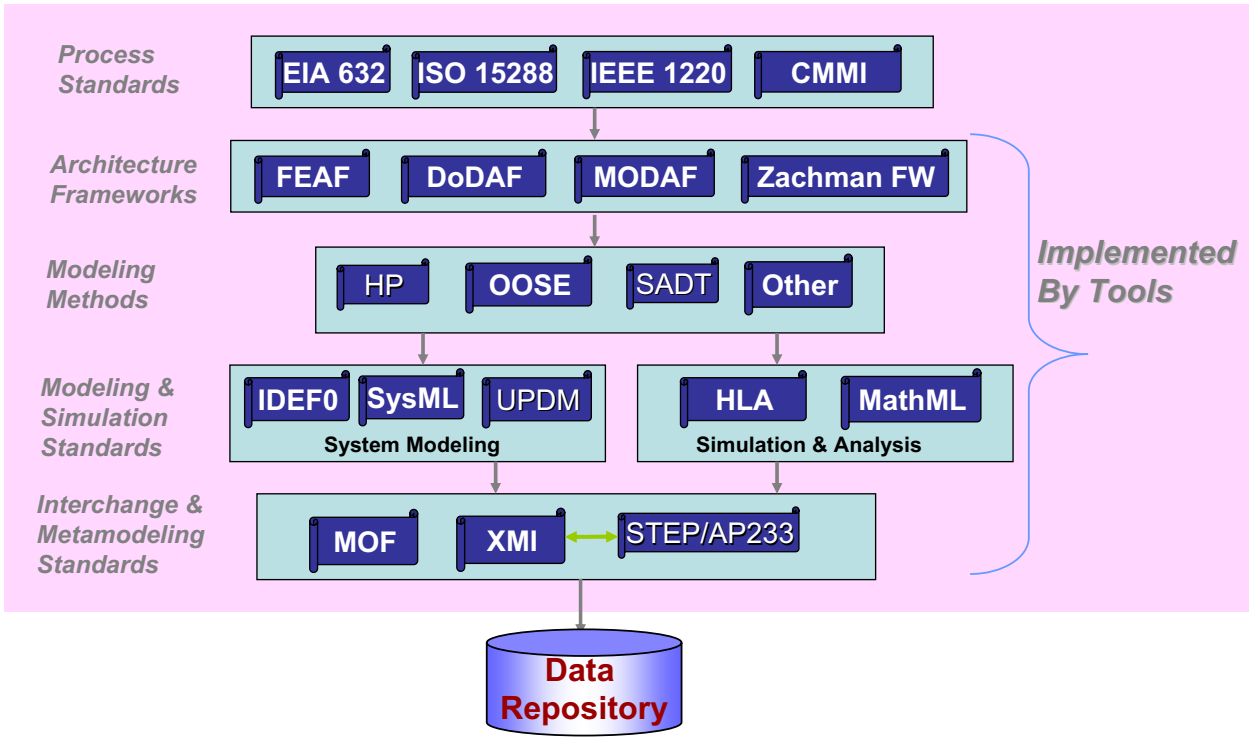


OOSEM Browser View
Artisan Studio™ Example

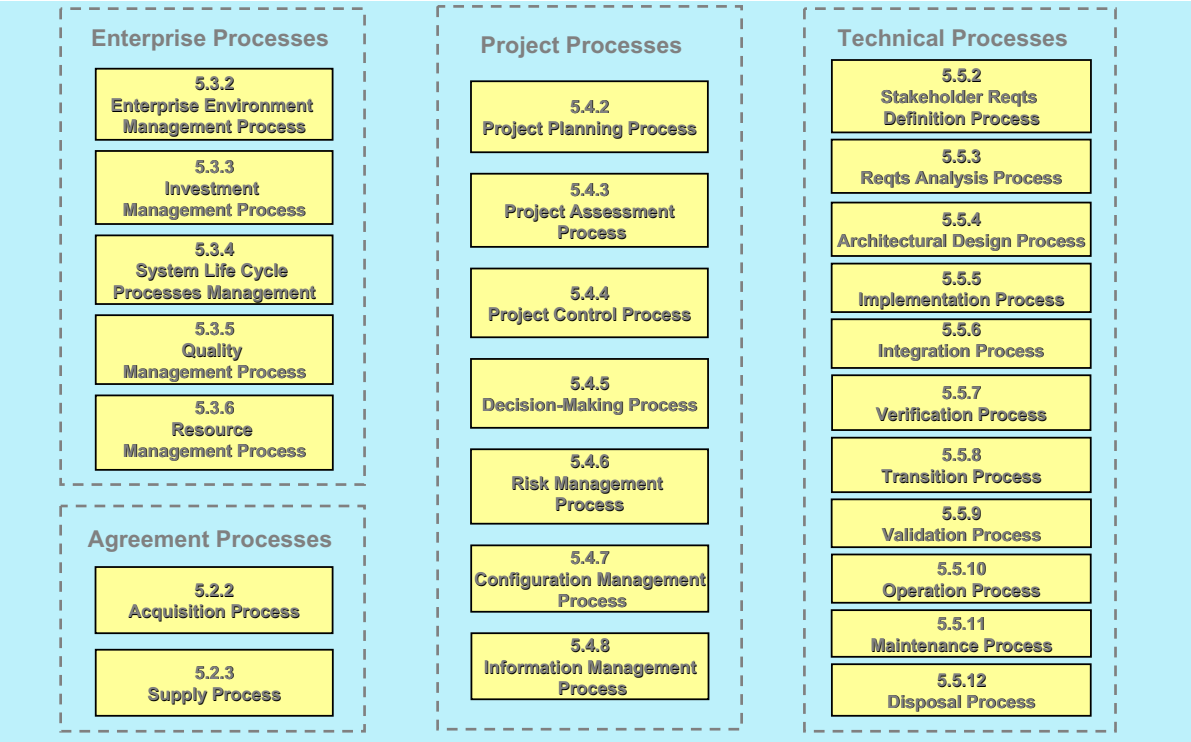


SysML in a Standards Framework

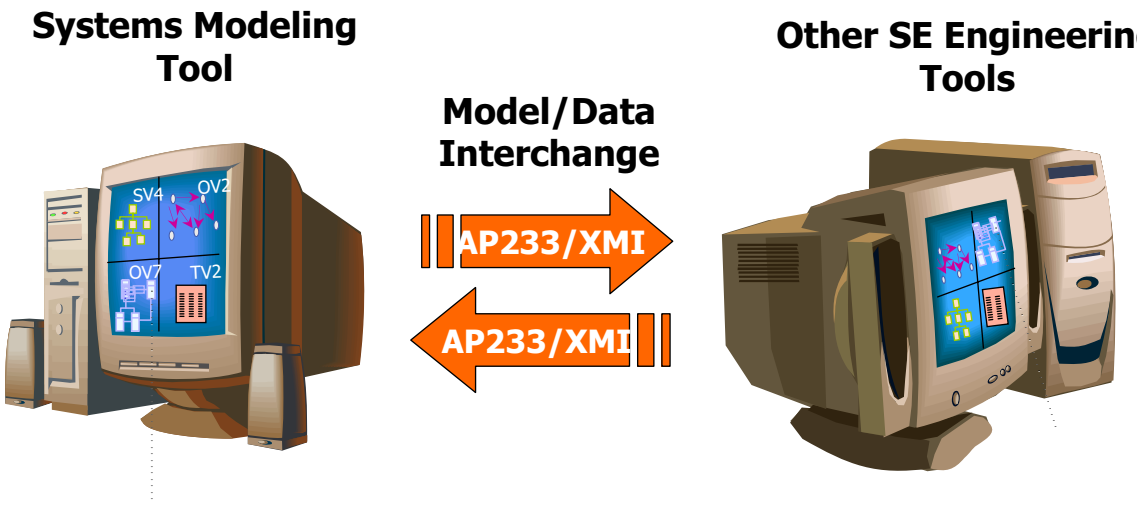
Systems Engineering Standards Framework (Partial List)



ISO/IEC 15288
System Life Cycle Processes



Standards-based Tool Integration with SysML



Participating SysML Tool Vendors

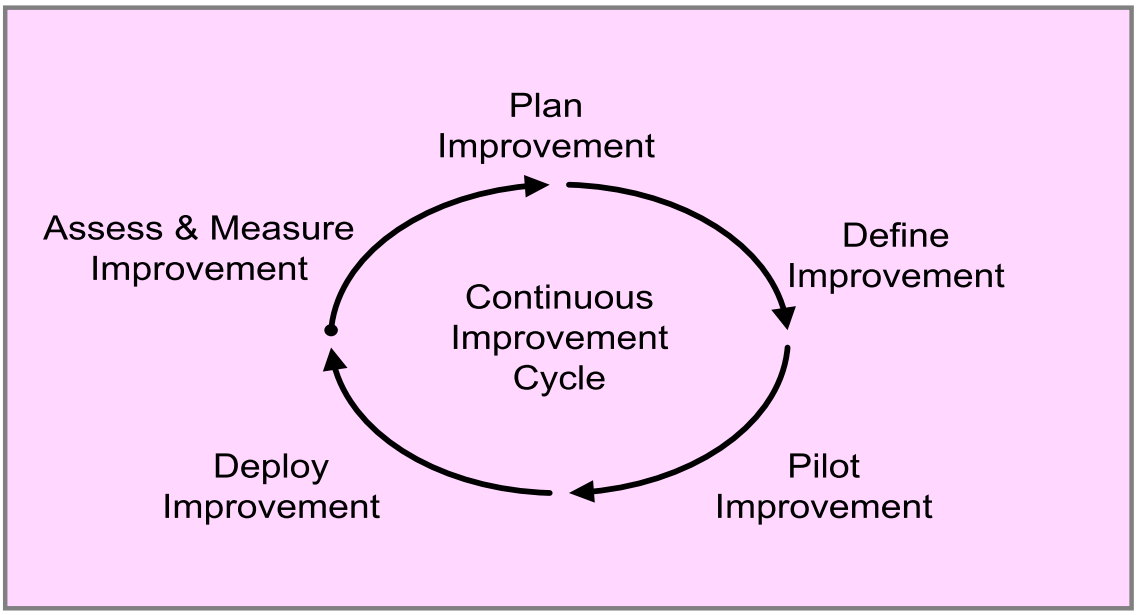
- Artisan
- EmbeddedPlus
  - 3rd party IBM vendor
- Sparx Systems
- Telelogic (includes I-Logix)
- Vitech

UML Profile for DoDAF/MODAF (UPDM) Standardization

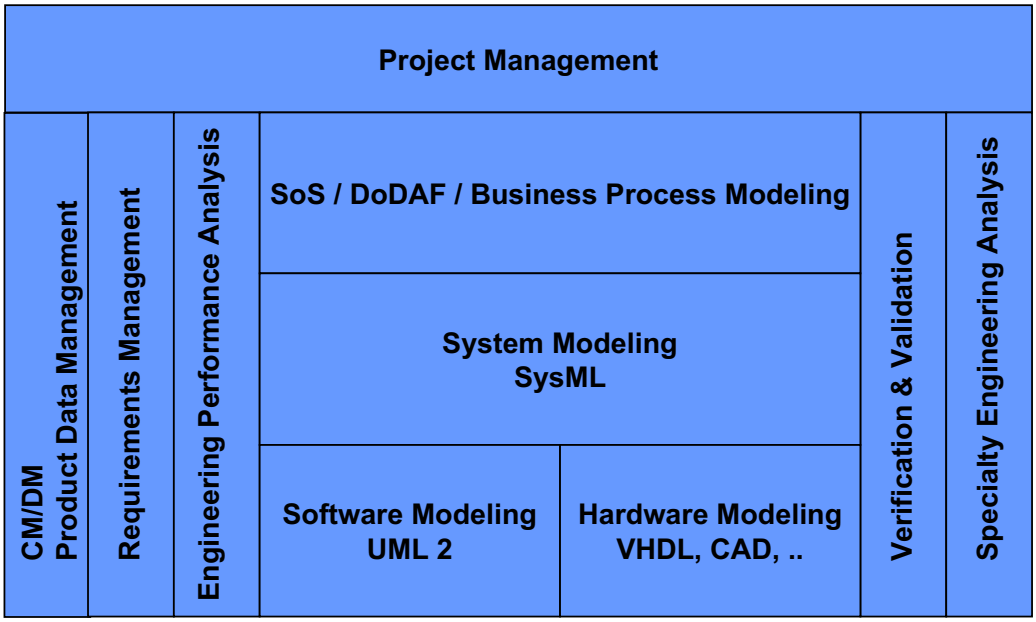
- Current initiative underway to develop standard profile for representing DODAF and MODAF products
  - Requirements for profile issued Sept 05
  - Final submissions expected Dec '06
- Multiple vendors and users participating
- Should leverage SysML

Transitioning to SysML

Using Process Improvement To Transition to SysML



Integrated Tool Environment



Summary and Wrap up

Summary

- SysML sponsored by INCOSE/OMG with broad industry and vendor participation
- SysML provides a general purpose modeling language to support specification, analysis, design and verification of complex systems
  - Subset of UML 2 with extensions
  - 4 Pillars of SysML include modeling of requirements, behavior, structure, and parametrics
- OMG SysML Adopted in May 2006
- Multiple vendor implementations announced
- Standards based modeling approach for SE expected to improve communications, tool interoperability, and design quality

References

- OMG SysML website
  - http://www.omgsysml.org
- UML for Systems Engineering RFP
  - OMG doc# ad/03-03-41
- UML 2 Superstructure
  - OMG doc# formal/05-07-04
- UML 2 Infrastructure
  - OMG doc# ptc/04-10-14

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Request For Proposal - DRAFT

OMG Document: robotics/2006-09-17

Letters of Intent due: <month> <day>, <year>
Submissions due: <month> <day>, <year>

Objective of this RFP

The Robotic Technology Component (RTC) Specification defines programming APIs and runtime semantics for component-based robotics applications. These features provide for portability and runtime interoperability of RT components.

As RTC adoption increases, a greater degree of interoperability will become necessary. In order to enable components developed with diverse tools to be deployed to diverse RT middleware implementations, a standard is needed for the packaging and deployment of RT component-based applications. Such a standard will allow an arbitrary RT middleware implementation to load RT component definitions from persistence storage, connect them, and execute the application they comprise.

This RFP solicits proposals for the following:

- A platform-independent model (PIM) for the persistence and subsequent deployment of RTC-based applications
- A platform-independent model (PSM) for that PIM corresponding to each of the PSMs in the RTC specification.

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 sub-licensees) 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 for review 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 <u>not</u> 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

- Makes interoperability possible
  - RTC submissions define what a component is, but not how to find, load, or create one
  - What is persistence format of component configuration files?
  - How are binaries and descriptors packaged together?
  - Can a particular component run on a particular platform?
- Improves reuse
  - Not just model reuse, but also PSM-level (source and/or binary) reuse
  - Component defined using compliant tool can be run on any compliant middleware

6.2 Scope of Proposals Sought

Respondents must indicate which of the following use cases are supported by their proposal and explain that decision. Respondents may also identify additional use cases not included in the list.

6.2.1 Static Deployment

- Relationships defined at design time
- Binaries statically linked at compile time
- Benefits
  - Necessary for deployment to many resource-limited and/or embedded devices
    - Platform may not support process model or dynamic library loading
    - Less resource intensive than dynamic deployment
    - Such devices are often price-sensitive
  - Most deterministic kind of deployment
    - Guarantee that deployment matches design
- Limitations
  - Where each component runs must be decided before application launch
  - Many types of changes require rebuilding whole application
  - Difficult to achieve with distributed system: some dynamic configuration (e.g. location) usually important

6.2.2 Semi-dynamic deployment

- Relationships defined at design time (by middleware)
- Allocation of components to nodes can take place at application launch

- Components connected during application initialization
  - After that, relationships are static
  - Middleware determines "appropriateness" of relationships
    - Based on comparing capabilities/characteristics of hardware and applications
  - Components loaded/started dynamically by middleware
- Existing standards
  - D&C for (Lw)CCM
  - SWRadio
  - Either requires extensions to handle extra information from RTC
- Benefits
  - Most of determinism of design-time relationships
  - Possibility to package components once for multiple platforms
    - Middleware can choose implementation/configuration based on deployment platform
  - Enables in-the-field upgrading of applications
  - Enables deployment/integration of third-party applications
  - Some benefit over fully dynamic: security (don't let anyone talk to anyone else)
    - Some security provision must be made in D&C, esp. *w.r.t.* authentication (authorization as well?)
- Limitations
  - Changes to component definitions require redeploying that component (but not whole application)
  - Changes to inter-component relationships require restarting application
- Error Handling Requirements
  - Describe how failures (*e.g.* in connectivity) will be handled
  - Tools should validate configuration at design time
  - Logging
    - Proposals need not include a log/test API; however, respondents should specify how events (*e.g.* successes and failures) will be logged
    - Include logging best practices/conventions

6.2.3 Fully dynamic deployment

- Application defines connections
- Components discover one another at runtime
  - Relationships chosen dynamically based on which components discover each other
  - Components can come and go while application is running
  - Relationships can change at any time
- Existing standards
  - SDO allows introspection of discovered components
  - CORBA defines naming service components can use to discover each other

    - SCA Core Framework supports looking up components by provided interfaces
    - SCA Core Framework allows components to find out when other components go away and fail over, but not directly supported by framework
- Benefits
    - Requires least work up-front
        - In particular, no a priori knowledge of collaborators necessary
    - Easy to change your mind at runtime based on observed behavior without shutting down application
    - Useful when application broadly distributed
- Limitations
    - Least deterministic kind of deployment
    - Potentially difficult to persist/repeat configuration changes made at runtime
    - Working around this is desirable. AIST, for example, doesn't avoid this yet.

6.3 Relationship to Existing OMG Specifications

Submissions are strongly advised to rely heavily on existing standards. Of particular interest are the following:

- *Deployment and Configuration of Component-based Distributed Applications*, version 4.0 (formal/06-04-02)
- *Component Document Type Definitions Specification* (dtc/06-04-07)

6.4 Related Activities, Documents and Standards

< Note to RFP Editors: List documents, URLs, standards, etc. that are relevant to the problem and the proposals being sought. Also describe any known overlaps with specification activities or specifications, competing or complementary, from other standards bodies. >

6.5 Mandatory Requirements

< Note to RFP Editors: Describe the requirements that proposals must satisfy i.e. for which proposals must specify an implementable solution. Avoid requirements that unnecessarily constrain viable solutions or implementation approaches.

Mandatory requirements should be stated using phrases such as:

"Proposals shall provide...", or
"Proposals shall support the ability to..."

Describe any modeling-related requirements.

Some guidelines for modeling requirements:

A PIM and one or more PSMs may be required by the RFP. RFPs may call for the specification of a PIM corresponding to one or more pre-existing PSMs, or for one or more PSMs corresponding to a pre-existing PIM.

If an RFP requests a PIM, it shall state explicitly of what technology or technologies the PIM shall be independent. For example, an RFP might state that a PIM should be independent of programming languages, distributed component middleware and messaging middleware. If an RFP requests a PSM, it shall state explicitly to what technology or technologies the PSM shall be specific, such as CORBA, XML, J2EE etc.

If it is anticipated that a related PIM, PSM or mapping will be requested by a successor RFP, that fact should be mentioned.

MDA RFPs usually fall into one of these five categories:

1. Service specifications (Domain-specific, cross-domain or middleware services).

For RFPs for service specifications, "Platform" usually refers to middleware, so "Platform Independent" means independent of middleware, and "Platform Specific" means specific to a particular middleware platform. Such RFPs should typically require that UML be used to specify any required PIMs. Variance from this drafting guideline must be defended to the Architecture Board.

Furthermore, such RFPs may require a submitted PSM to be expressed in a UML profile or MOF-compliant language that is specific to the platform concerned (e.g. for a CORBA-specific model, the UML profile for CORBA [UMLC]). Alternatively, the RFP may require that the PSM be expressed in the language that is native to the platform in question (e.g. IDL). If the RFP requests both, it must make clear which one is to be normative.

2. Data Models

In pure data modeling a PIM is independent of a particular data representation syntax, and a PSM is derived by mapping that PIM onto a particular data representation syntax.

RFPs should typically require submitted data models to be expressed using one of the following OMG modeling languages: UML, CWM, MOF.

3. Language Specification

The abstract syntax of a language shall be specified as a MOF-compliant metamodel

4. Mapping Specifications

A transformation model and/or textual correspondence description is required.

5. Network Protocol Specifications

It's possible to view a network transport layer as a platform, and therefore to apply a PIM/PSM split to specifying a network protocol – for instance, one could view GIOP as a PIM relative to transport, and IIOP as a PSM that realizes this PIM for one specific transport layer protocol (TCP/IP). Where possible, protocols should therefore be specified with an appropriate PIM/PSM separation. The models may include the protocol data elements and sequences of interactions as appropriate. >

6.5.1 Component Definitions

- Binary implementation(s)
  - In the event that RTC implementations become available in interpreted languages, source code-only (*i.e.* no compiled binary) deployments may become relevant. Proposals should indicate whether this use case is supported.
- Ports
- Properties
  - Descriptor must indicate whether binaries support static, semi-dynamic, or fully dynamic deployment (or some combination)
- Execution semantics
  - Execution contexts
  - Order of periodic execution
  - States and transitions
  - Modes of operation

6.5.2 Component Configurations

- Connections/assemblies
- Property values
- Which node component is deployed on
  - Component itself just describes requirements…
  - …and someone else can map requirements to available nodes
  - Resulting node choice may be different for different implementations of same logical component
- Execution rate(s)

6.5.3 Use Case Variances

6.5.3.1 Static Deployment

Depending on implementation, descriptor file(s) may not be needed at runtime.

6.5.3.2 Dynamic Deployment

- Capability/characteristic model to validate deployment
  - What resources does component "A" require?
  - What resources does platform "B" provide?
  - "Resource" may include some timeliness contracts
  - If B provides >= A's requirements, A can be deployed on B
- Clarification:
  - Configuration document may be static (probably text/XML file), …
  - …but (in the case of fully dynamic deployment) relationships may change at runtime

6.6 Optional Requirements

< Note to RFP Editors: Make requests for optional features which proposals may satisfy. While the satisfaction of requests is desirable (and will be taken into account in evaluating the submissions), proposals are not required to satisfy them, i.e. specify an implementable solution.

Requests should be stated using phrases such as:

"Proposals may provide...", or
"Proposals may support the ability to...">

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.)

6.7.1 Hardware/Software Interaction Mental Models

Proposals shall discuss the different ways of considering hardware/software interaction described in this section and indicate which they support and how.

6.7.1.1 Platform as a Platform

The hardware hosts the application(s).

6.7.1.2 Hardware in the Loop

Components with hardware and software-only components are peers. Real hardware may be replaced with a software simulation (or visa versa) transparently.

< Note to RFP Editors: Describe the composition and main characteristics of the solution for which proposals are being sought. >

6.8 Evaluation Criteria

< Note to RFP Editors: Conformance to the mandatory requirements along with consideration of the optional requirements and issues to be discussed, are implied evaluation criteria. RFP authors should describe any additional criteria that submitters should be aware of that will be applied during the evaluation process. >

6.9 Other information unique to this RFP

< Note to RFP Editors: Include any further information pertinent to this RFP that does not fit into the sections above, or which is intended to override statements in the Chapters 1 to 5. >

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.

Event or Activity	Actual Date
Preparation of RFP by TF	
RFP placed on OMG document server	*"Three week rule"*
Approval of RFP by Architecture Board *Review by TC*	
TC votes to issue RFP	*<approximate month>*
LOI to submit to RFP due	*<month> <day>, <year>*
Initial Submissions due and placed on OMG document server ("Three week	*<month> <day>, <year>*

rule")	
Voter registration closes	*<month> <day>, <year>*
Initial Submission presentations	*<month> <day>, <year>*
Preliminary evaluation by TF	
Revised Submissions due and placed on OMG document server ("Three week rule")	*<month> <day>, <year>*
Revised Submission presentations	*<month> <day>, <year>*
Final evaluation and selection by TF *Recommendation to AB and TC*	
Approval by Architecture Board *Review by TC*	
TC votes to recommend specification	*<approximate month>*
BoD votes to adopt specification	*<approximate month>*

Appendix A References and Glossary Specific to this RFP

A.1 References Specific to this RFP

< Note to RFP Editors: Insert any references specific to this RFP that are referred to in the Objective Section, Section 6 and any additional sections in the same format as in Section B.1 and in alphabetical order in this section. >

A.2 Glossary Specific to this RFP

< Note to RFP Editors: Insert any glossary items specific to this RFP that are used in Section 6 and any additional sections in the same format as in Section B.2 and in alphabetical order in this section. >

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/SDO-DSIG Joint Meeting

September 27, 2006

Anaheim, CA, USA

Disneyland Hotel

Approval of the Boston Minutes

Boston Minutes review

- **RTC submission recommended for adoption by MARS**
- **1 special talk was given by the Ontology PSIG**
- **Reports received from 3 active Technical WGs**
- **Contact reports received for a number of activities**
- **Contacts Sub-Committee formed**
- **Prof. Makoto Mizukawa was authorized as a contact between ISO TC184/SC2.**

Anaheim Meeting Quorum : 5
(AIST, RTI, ETRI, NEDO, Systronix, Technologic Arts, Shibaura-IT, UEC, JARA, Raytheon, Schlumberger)

minutes taker(s)

- Hung Pham (RTI)
- Olivier Lemaire (JARA)

Review Today's Agenda

08:50-09:00 Plenary Opening
09:00-09:40 Technical Presentation (Minsu Jang)
10:00-12:00 WG Activity Report
14:00-15:00 RTC 2nd revised submission presentation
15:30-16:00 Newcomer Presentation (Yoshisada Nagasaka)
16:00-16:30 Contact WG Report
16:30-17:00 Plenary Closing
(Re-charter, Next meeting agenda)

17:00-18:00 Robotics WG Co-Chairs Planning Session

Joint Meeting with MARS/RTESS

RTC specification 2nd revised submission
(vote-to-vote, vote to adopt) quorum:8

Thursday, Sept. 28 10:00-10:30 Avalon A, Marina

Voting List Member:

AIST, ETRI, Fujitsu, Technologic Arts, JARA, Shibaura-IT, RTI, MITRE,

Hitachi (proxy), NEC (proxy),

ADA Software, Alcatel, IONA, Lockheed Martin, NIST, NUWC, OIS, Raytheon, THALES,

Robot Ontology and Related Research in ETRI

2006-09-27
Minsu Jang (minsu@etri.re.kr)
Electronics & Telecommunications Research Institute

Contents

- Background: What is ontology?
- Research activities in ETRI
  - URCSP (URC Service Platform)
  - P-URCSP (Proactive URCSP)
  - CASA (Context Awareness Service Architecture)
- Robot Ontology
  - Robot Ontology for Urban Search & Rescue (NIST)
- Discussion

What is Ontology?

- Provides a formal syntax for specifying common vocabularies.
- Vocabularies are assigned with formal semantics of the language of ontology.
  - e.g. *owl:inverseOf(p,q)* → *(p(x,y)* → *q(y,x))*
- Based on the semantics, implications of explicit specifications can be derived.

An Example

- A description on a sensor

```
:TemperatureValue a :Temperature.
:TemperatureSensor rdfs:equivalentClass
 [a owl:Restriction; owl:onProperty :senses;
  owl:someValuesFrom :Temperature].
:sensor01 :senses :TemperatureValue;
          :output xsd:int; :locatedIn :room01.
:room01 a :LivingRoom; :locatedIn :house01.
:house01 a :House; :owner :person01.
:person01 a :Human; :locatedIn :room01.
:I a :Robot; :owner :person01;
             :locatedIn :room01.
```

What can be answered?

- *Give the list of temperature sensors?*
- *Which rooms have temperature sensors?*
- *Who owns me?*
- *Am I with my owner?*
- *Is there any sensor that can provide the temperature of the living room?*
- *What's the temperature of the living room?*
- *…*

Robot Ontology and Related Research in ETRI
Background

What can be done with different vocabulary?

- Another user described a similar sensor like this:

```
:TempValue a :Temp.
:sensor03 :senses :TempValue;
          :output xsd:float.
```

- We can still provide answers on this description.
  - If `:Temperature` is a parent class of `:Temp`, the following holds:
    `:TempValue a :Temperature.`
  - Otherwise, add a concept mapping to the context:
    `:TempValue owl:sameAs :TemperatureValue.`
    "`:sensor03` becomes an instance of `:TemperatureSensor`."
- **Well-established mechanism for interoperability!**

Observations

- It is just another data modeling tool like RDB.
- But it provides constructs for specifying more complex relationships between data:
  - *on sets e.g. subset/union/intersection/disjoint etc*
  - *on relations e.g. inverse/symmetric/complement etc*
- The semantics of the constructs derives hidden facts.
- Most of them are not available in RDB, and some of them are not available in object models.

What do we buy with Ontology?

- We get "Interoperability" in a broad sense.
  - Wider search results based on data compatibility, while more exact search by meaning
  - e.g. Different data types can be compatible, e.g. "79" and 79 if they are all data for representing `Temperature`.
  - Alignment/mapping between different data
- Robots get more initiatives in interactions.
  - Ontology is data in a machine-interpretable format.
  - We only need to provide general semantics!

The semantic web standards

- It's essential that we *commit to a standard language or model* for specifying ontology.
- Convergence to the semantic web standards
  - W3C Resource Description Framework (RDF), RDF Schema (RDFS), Web Ontology Language (OWL), and emerging Rule Interchange Format (RIF)
  - The essence of OMG ODM is providing tools to create OWL-compatible ontology using UML.
- Committing to the semantic web standards opens for robots *the door to the global interactions.*

Research Efforts in ETRI (1)

URCSP (Ubiquitous Robotic Companion Service Platform)

2004

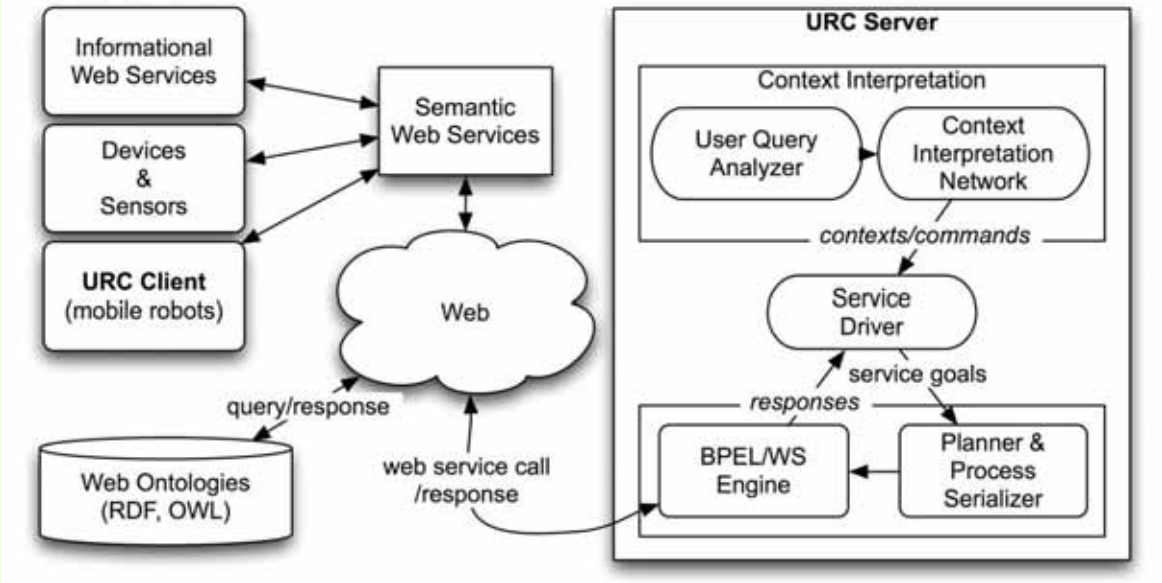
Requirements and Approaches (1)

- Robots should be able to work in new environments where they're not pre-configured to work.
  - Dynamic Resource Discovery
  - Semantic-based Resource Matching
- Robots should be able to interact with web services as well as remote devices.
  - Unified view of all the services via web services
  - Semantic descriptions of the services via OWL-S (for Discovery)

Requirements and Approaches (2)

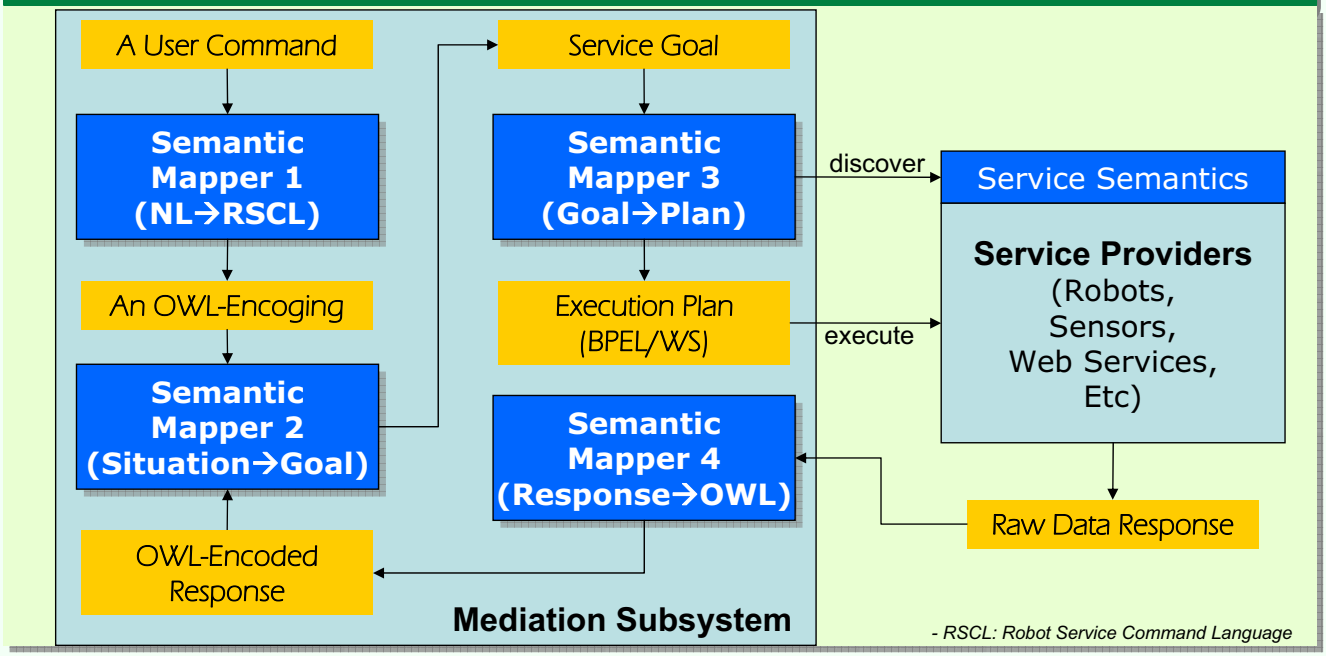
- Robots should be able to provide situation-aware services.
  - Context Interpretation
  - Situation-based Service Decision
- It should be easy to augment robot services.
  - Knowledge-centric service development and deployment

Architecture



Robot Ontology and Related Research in ETRI
Research Efforts in ETRI: URCSP(URC Service Platform)

Two functional parts of URCSP



Use Case 1

- **Command**: "Come here!"
- **RSCL**:
  SimpleCommand[theme=Come, tspace=Here]
- **Goal**:
  [Input={Location=loc001}, Effect=MoveTo]
- **Execution Plan**:
  [...., *call http://1.2.3.4/robot#MoveTo(loc001)*, ...]
- **Response**:
  [Success, Fail, or Exception]

Robot Ontology and Related Research in ETRI
Research Efforts in ETRI: URCSP(URC Service Platform)

Use Case 2

- **Command**: *"If it rains, wake me up at 7!"*
- **RSCL**:
  ConditionalCommand[
  Condition[theme=Rain],
  Action[theme=Wake, ttime=2006-09-28]]
- **Goal1** (for checking if it rains):
  [Input={City=city01}, Output=WeatherStatus, Effect=Know]
- **Execution Plan 1** (for checking if it rains):
  [...., *call http://6.7.8.9/Weather#getWeatherStatus(city01)*, ...]
- **Response**:
  Weather[currentStatus=Rainy] *<Rainy & Rain should be matched.>*

Use Case 2 (continued)

(scheduled for execution at 7)

- **Goal 2** (for waking up):
  [Input={Person=p01}, Effect=Wakeup]
- **Abstract Plan**:
  [approach → alarm]
- **Execution Plan 2** (for checking if it rains):
  [....,
  call http://1.2.3.4/Robot#MoveTo(loc02),
  call http://3.4.5.6/AlarmClock#ring(),
  ...]

Robot Ontology and Related Research in ETRI
Research Efforts in ETRI: URCSP(URC Service Platform)

Use Case 3 (Adapting to changes)

- What if new sensors or devices are introduced in the environment?

→ Typical web service publishing/discovery steps follow.

→ 1) Services provided by the newly added sensors/devices are announced by publishing their semantic descriptions.

→ 2) Services become discoverable by referring to the service descriptions.

→ 3) The newly added sensors/devices are available to URCSP.

Lessons (1)

- Ontology-based global interoperability
  - With URCSP, robots, in principle, can access any resources on the network that conform to OWL-S, OWL, SOAP & HTTP.
  - Higher-level of Interoperability
    - Data compatibility based on OWL semantics e.g. subsumption, equality etc,
    - Data compatibility through concept mappings
    - etc

Lessons (2)

- A unified service description, discovery & execution framework
  - Wrapping up all the sensing/actuating functionalities as OWL-S based semantic web services.

    → An OWL-S based discovery mechanism can discover any kind of resources like remote sensors, internal sensors, robots, web information services, digital appliances, etc.
    → Service execution is done by calling web services. Processes are managed by BPEL/WS engines.

Lessons (3)

- Dynamic adaptation to various situations
  - Robots are not statically bound to a predefined set of services via dynamic service discovery
  - e.g. In *Goal→Plan* Mapping:
    "If it's raining, ..."
    → URCSP can use sensors
    or web services depending on different situations.
  - Many ways of mappings from abstract goal into a set of primitive services based on policies and constraints.

Lessons (4)

- Easy maintenance of Robot Services
  - Many well-established tools are available for creating, consistency checking, and managing OWL ontologies.
  - Robot services are extended or altered by adding/altering mapping rules of the semantic mappers.
  - Highly modular and independent development is possible. (another benefit given by common vocabularies)

Research Efforts in ETRI (2)

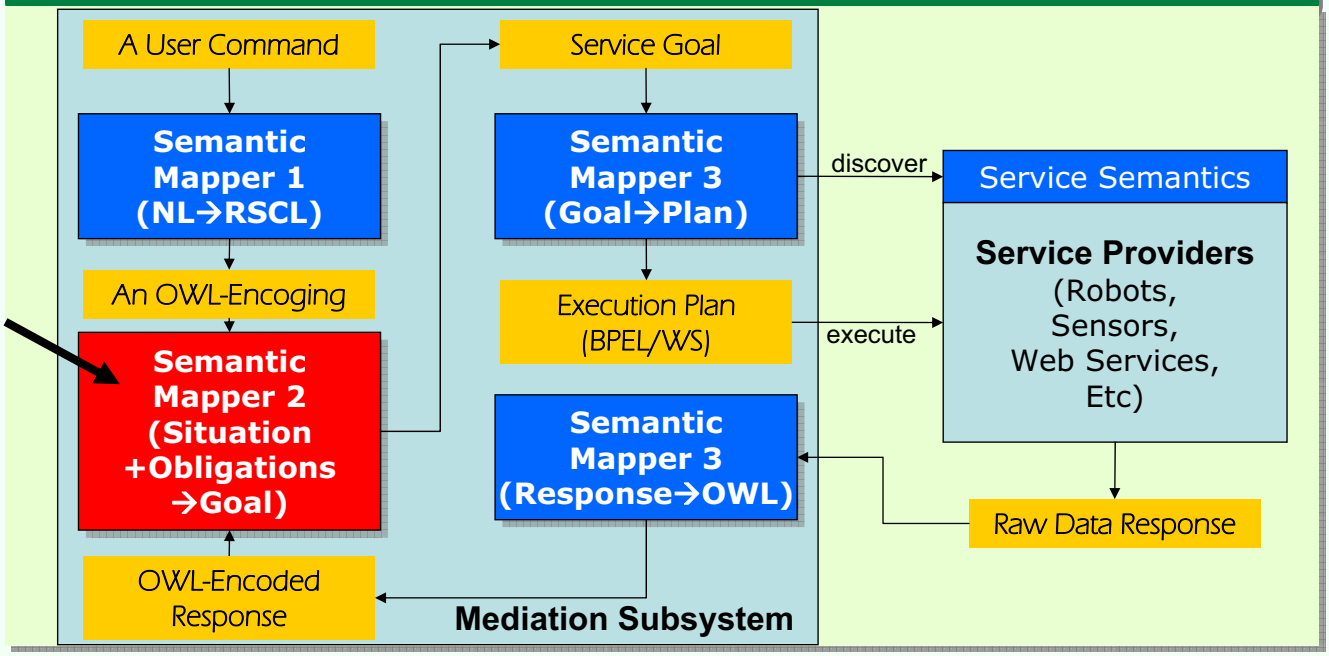
P-URCSP (Proactive URC Service Platform)

2005

Requirements and Approaches

- Robots should be able to have initiatives to provide services based on the situations.
  - Robots act proactively without user commands.

Architecture



Research Efforts in ETRI (3)

CASA (Context Awareness Service Architecture)

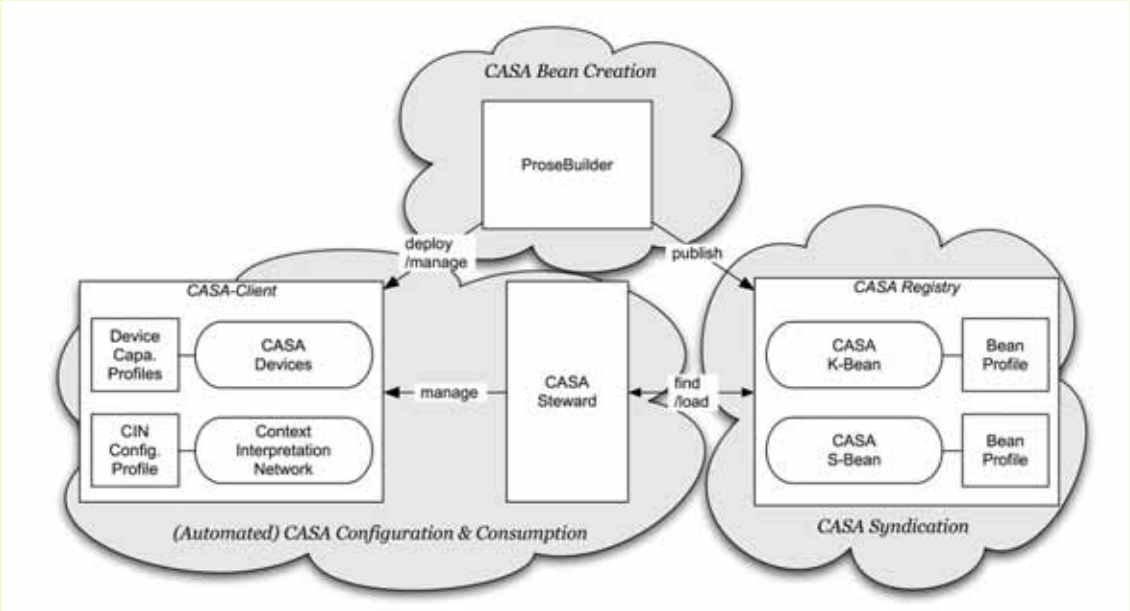
2006

Requirements and Approaches

- It should be possible to discover devices that are capable of some services.
  - Device Profiles
  - Service Profiles
  - Matchmaking
- It should be possible to deploy a service onto a capable device and execute it.
  - Dynamic Deployment

Robot Ontology and Related Research in ETRI
Research Efforts in ETRI: CASA (Context Awareness Service Architecture)

Architecture



Steps of Profile-based Device Discovery

- Devices/Sensors announce their IDs or profiles.
- CASA access the profiles of the devices/sensors directly or by looking up the profiles using the IDs.
- Given a service to execute, CASA searches devices/sensors that can deploy and execute the service by matching the device profiles and service profiles.
- The service is deployed on-line to the matched device/sensor, and executed.

Standardization in South Korea

Service Command Representation Language

- A standard data structure for specifying the meaning of user commands.
  - Provides a unified view of user commands
  - Provides a unified interface for processing user commands
- Defined as an OWL application
- Adopted by TTA in 2005

Service Template Description Language

- Standard data structures for specifying abstract service plans.
- Defined as an OWL application
- Adopted by TTA in 2005

Robot Capability Profile Language

- Standard data structures and vocabularies for specifying capabilities of robots
- Defined as a CC/PP application (like UAProf by OMA)
- In progress

Robot Ontology for Urban Search and Rescue

Introduction

- An effort by NIST (Craig Schlenoff et al., 2005)
  - The goal of this Robot Ontology effort is to develop and begin to populate a neutral knowledge representation (the data structures) capturing relevant information about robots and their capabilities to assist in the development, testing, and certification of effective technologies for sensing, mobility, navigation, planning, integration and operator interaction within search and rescue robot systems.

Robot Ontology and Related Research in ETRI
Robot Ontology for Urban Search & Rescue

Structure

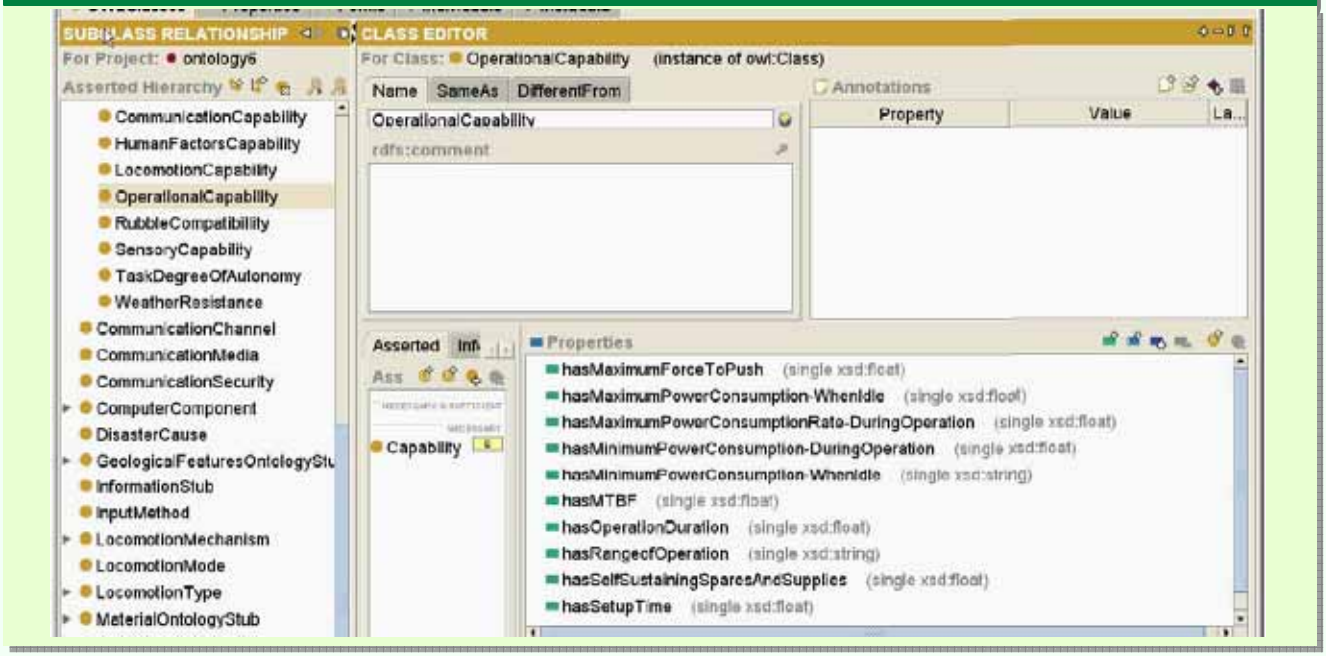
- A set of vocabularies for describing:
  - Structural Characteristics: physical and structural aspects of a robot
  - Functional Capabilities: behavioral features of the robot
  - Operational Considerations: interactions of the robot with the human and the interoperability with other robots

What're specified…

- Structural Characteristics:
  - Size, Weight, Power Source, Sensors, Processors, etc
- Functional Capabilities
  - Locomotion, Sensory, Weather Resistance, Degree of Autonomy, Communications, etc
- Operational Capabilities
  - Human Factors, Intra-Group Interaction, Inter-Group Interaction, etc

Robot Ontology and Related Research in ETRI
Robot Ontology for Urban Search & Rescue

Vocabularies



Use Cases

- Service/Content Selection
  - Decide which services can be done e.g. "Can the robot get through the door?", "Can it present a picture?"
- Service/Content Adaptation
  - For robot 1 with an arm: Dancing contents are played by the arm.
  - For robot 2 with no arm: Arm movements specified in the dancing contents are just ignored or replaced by head movements.
- Profiling standard robot types as in XHTML.

Discussion (1)

- Semantic technology itself is mature, but applying it effectively is still very hard.
- Interoperation is essential for modern robots. They are not isolated but connected!
  - Machine interpretable data and global interaction mechanism will boost the introduction of new kinds of interesting services for robots.
- I suggest more considerations on networked robots and their interactions with the web.

Discussion (2)

- Considerations
  - How about addressing semantic requirements on profiles?
    - relevant use-cases or requirements for RFP?
  - We can begin with a small step. Even a small step can open up a lot of possibilities!
    - Inspiration from RSS and FOAF
    - Unexpected use of robot ontology for interesting applications!!

Robot Ontology and Related Research in ETRI

THANK YOU!!

Infrastructure WG

Meeting Summary

September 2006
Anaheim, CA

SysML Presentation

- First half of Infra WG meeting
- Interest in SysML parametric models

RTC Deployment & Config

- RTC defines component APIs and behavior
  - Enables *portability*
  - Enables interoperability *once components are deployed and loaded*
- Still to be standardized for RTC:
  - RTC packaging
  - Deployment of RTCs to target(s)
  - RTC loading and application initialization
  - To enable *end-to-end interoperability*

Existing Standards

- CCM D&C
  - *a.k.a.* "Deployment and Configuration of Component-based Distributed Applications Specification"
- SWRadio component descriptors
  - *a.k.a.* "Component Document Type Definitions Specification"

Don't define how to store RTC-specific information

- XML Metadata Interchange (XMI)
  - Used for persisting UML models

Doesn't define how to store binaries or deployment information

D&C RFP Interested Members

- AIST
- ETRI
- RTI
- SNU
- Sun Microsystems
- Systronix

Moving Forward

- D&C scope is very broad
  - Which concerns should be included in RFP?
- We need to learn more before moving forward
  - RFP drafting on hold pending more experience with existing standards
  - ➢ Chairs will arrange presentations and joint meetings with relevant groups at OMG

robotics/2006-09-21

- OMG Robotics DTF-
- Robotic Functional Services Working Group -

Meeting Report
- Anaheim TC Meeting -

Anaheim (California, USA) – September 27, 2006

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

Schedule

- Monday 25th
  - 10:00 – 10:30 : WG Steering Committee
  - 10:30 – 12:00 : Robot Localization RFP Discussion
    - *SAIT Expectation on Standards for Robot Localization* (Yeon-Ho Kim - SAIT)
    - RFP for Localization Service for Robotics (Dr Han – ETRI)
    - Discussion
- Tuesday 26th
  - 8:30 – 11:00 : Robot Localization RFP Discussion (cont'd)

Roadmap

Item	Status	St. Louis Apr-2006	Boston Jun-2006	Anaheim Sep-2006	Was. DC Dec-2006	San Diego Mar-2007	TBD Jun-2007
Localization Service	On-going	Topic Discussion	Topic Discussion	Draft RFP	Draft RFP	RFP	
User Identification Service	Stand-by	Proposed	--	?	?	?	?

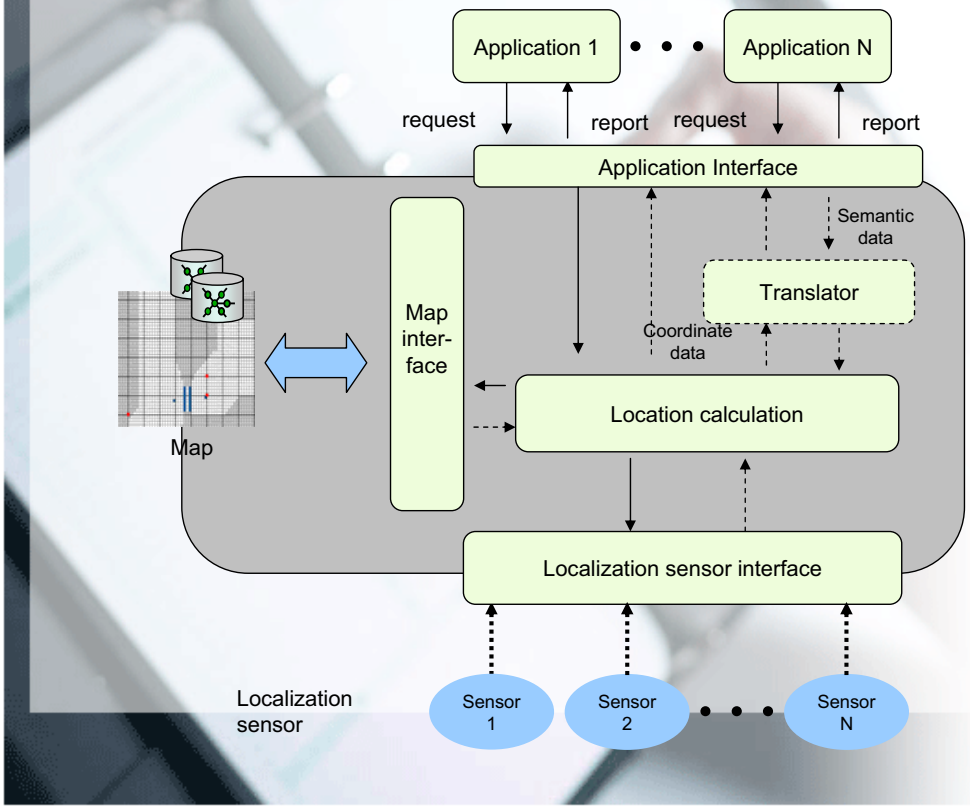
Discussion Summary

- Comments on RFP -

- First Draft RFP was written
- It gave a good base for discussion during this meeting

Discussion Summary

- Comments on RFP -



Discussion Summary

- Comments on RFP -

- We got the following comments :
  - Localization service could have a potentially very wide scope that we need to restrict
  - Should focus on Developer or User Point of View ?
    - Developer PoV : Define main typical building blocks of localization service so as to distribute them
    - User PoV : Define only the external interfaces

    -> Add Use-cases for a standard in Localization

  - Should figure out how to evaluate the submissions

Discussion Summary

- Comments on RFP -

- More details for the Location Calculation Module is necessary
- Need to define more what is expected for each interface

Anaheim 2006 Sep 27

OMG Robotics DTF
Robotics Devices
and
Data Profiles Working Group
Progress Report

Seung-Ik Lee and Bruce Boyes, co-chairs

2006 Anaheim Summary

- The Working Group met 2006 Sep 25-27
  - Changed name of WG
  - Reviewed Boston meeting minutes
  - Presentation on Localization which might affect Profile WG
  - Semantics/ontology presentation – might also affect Profile WG
  - Draft RFP is required but was not available
  - Presentation and demonstration of wireless sensors (SunSPOTs)
- Plans for next meeting Dec 2006

2006 Dec Meeting Plans
Presentations & Fun

1. Presentation on IEEE-1588 (confirmed)
2. Presentation on IEEE-1451 (tentative)
3. Presentation on JAUS (NIST: Dr Huang?)
4. Report from ISO TC184/SC2 (Prof Mizukawa)
5. Demonstration of Microsoft Robotics Studio, with mobile robots and wireless sensors (Boyes)
6. Possible visit to NIST or area technology museum

WG Actions
prior to next meeting

1. Limit scope of RFP(s) for Draft?
2. Do we need one RFP for hardware/bottom up and another for software API/top down, or just one?
3. Review existing standard data formats (1451, 1588, JAUS, OMG)
4. Review OMG Smart Transducer Interface OMG-Spec 03-01-01
5. Create draft RFP for publication 3 weeks prior to Wash DC meeting

2006 Dec Meeting Plans
Group Work

1. Review data format(s) of applicable standards (need volunteers – Boyes, ??)
2. Relation to (Infrastructure WG) Localization sensors specification (with IS WG - Lemaire, ??)
3. Consider semantic requirements in Profile WG? (Jang?, ??)
4. Review draft RFP which has been created through mailing list collaboration

Robotics Devices and
Data Profiles WG Road Map

Item	Anaheim Sep-2006	Wash DC Dec-2006	San Diego Mar-2007	TBA Jun-2007
Programmers API: Typical device abstract interfaces and hierarchies	Discuss	draft RFP	draft RFP	RFP
Hardware-level Resources: define resource profiles	Discuss	draft RFP	draft RFP	RFP

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.

Introduction to RTC

Robotic Technology Component Specification

Second Revised Submission

Robotics DTF, September 2006

Anaheim, CA

National Institute of Advanced Science & Technology (AIST)

Real-Time Innovations (RTI)

Timeline

- September 2005: RFP issued
  - ptc/2005-09-01
- February 2006: Initial submissions
  - National Institute of Advanced Industrial Science and Technology (AIST)
    - mars/2006-01-05
    - Japan Robot Association (JARA) and Technologic Arts Incorporated join as supporters
  - Real-Time Innovations (RTI)
    - mars/2006-01-06
- June 2006: Revised submission
  - Joint submission by AIST and RTI
    - mars/2006-06-11
  - Seoul National University (SNU) joins as third supporter
  - Recommended by MARS, but AB raised issues to be addressed prior to adoption
- September 2006: Revised submission
  - Addresses specific AB feedback
  - mars/2006-08-01 (specification), -02 (XMI), -03 (IDL)

What is RTC?

- Robotic Technology Component (RTC) Specification
- Component model for robotics
  - Basis for software modularization and integration at infrastructure/ middleware level in this domain
  - Builds on – does not replace – general-purpose component models

Benefits of RTC

- General benefits of component-orientation

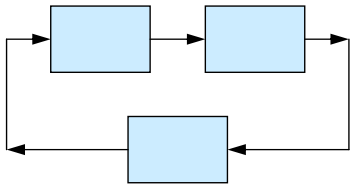
+

- Power of domain-specific extensions

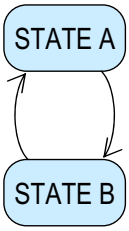
- Choice of platforms: CORBA/CCM or Local communication

Benefits of RTC

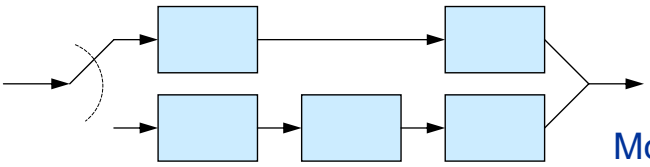
- Execution Semantics package standardizes common design patterns



Data flow / periodic, synchronous processing



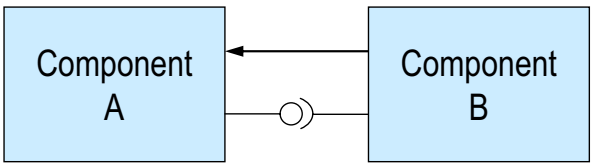
Stimulus-response / discrete-event processing



Modes of operation

Benefits of RTC

- Introspection package provides the information you need about…
  - components, ports, and connections



  - which components are working together, and at what rate

Summary: Features of RTC

- Provides rich component lifecycle to enforce state coherency among components (LwRTC)
- Defines data structures for describing components and other elements (Introspection)
- Supports fundamental design patterns
  - Collaboration of fine-grained components tightly coupled in time (*e.g.* Simulink) (LwRTC, Local PSM)
  - Local or distributed components (PSMs)
  - Stimulus response with finite state machines (Exec. Sem.)
  - Dynamic composition of components collaborating synchronously or asynchronously (Exec. Sem., Introspection)

Relation to Existing Standards

- UML
  - Domain-specific profile for UML components
- Super Distributed Objects (SDO)
  - Introspection of distributed components
  - Ports exposed as SDO services
- May be combined or implemented with another model
  - *e.g.* Lightweight CORBA Component Model
  - *e.g.* Software Radio components

Change Summary

- Changes limited to responses to specific AB issues
- AB Recommendations
  1. Define PSM conformance criteria more precisely
  2. Define PIM-to-IDL mappings more precisely
  3. Clarify modeling of error conditions
  4. Clarify modeling of basic types
  5. Update models and diagrams to eliminate UML 1.x elements

1. PSM Conformance Criteria

- **Issue**: Ambiguity about what level of PSM support was required
- **Resolution**: New language:
  - *At least one of the [PSMs] must be implemented for each of the conformance points … to which conformance is claimed.*

2. PIM-to-IDL Mappings

- **Issue**: Mappings from certain PIM UML features to IDL were ambiguous
- **Resolutions**
  - PIM-to-IDL mapping rules described in more detail and reorganized for clarity
  - Non-normative material removed from PSMs to avoid confusion

Timeline of Anaheim Meeting

- Presentation to MARS Monday
  - No further comments on issues addressed since last time
  - New questions on Local PSM conformance
    - Should be parameterized with IDL-to-programming language mapping
    - Are there CORBA dependencies in language mapping that specification fails to remove?
- Released addendum clarifying these issues
- Votes on Thursday
  1. Vote-to-vote
  2. Vote to recommend
  3. Vote to adopt
  - *Voters: Please attend or give proxies*

Conclusion

- RTC defines domain-specific extensions to a general-purpose component model
  - Behavioral design patterns
  - Introspection of distributed components
- RTC is founded on proven technologies
  - Existing standards
    - UML
    - SDO
    - CORBA Component Model
  - Existing proprietary middlewares
    - OpenRTM from AIST
    - Constellation from RTI
- All issues raised have been addressed

Getting Involved

- Evaluate RTC for your application
- Give feedback to implementers
  - In person, or post to the newsgroup
    - omg-infrastructure@m.aist.go.jp
- Participate in Finalization Task Force (FTF)
  - Starts post-adoption
  - Membership not limited to submitters
  - Process described at http://www.omg.org/gettingstarted/process4-Finalize.htm

OMG Meeting Sept. 27th
robotics/2006-09-24

Autonomous systems for Japanese Agriculture in Paddy Field

National Agricultural Research Center
Yoshisada Nagasaka

National Agricultural Research Center

Agenda

- About National Agricultural Research Center
- Research Background
- Objectives of our research
- Our recent research about autonomous rice transplanter
- Recent research about autonomous farming in Japan
- What standard we need for Japanese agriculture in paddy field?

National Agricultural Research Center

About NARC

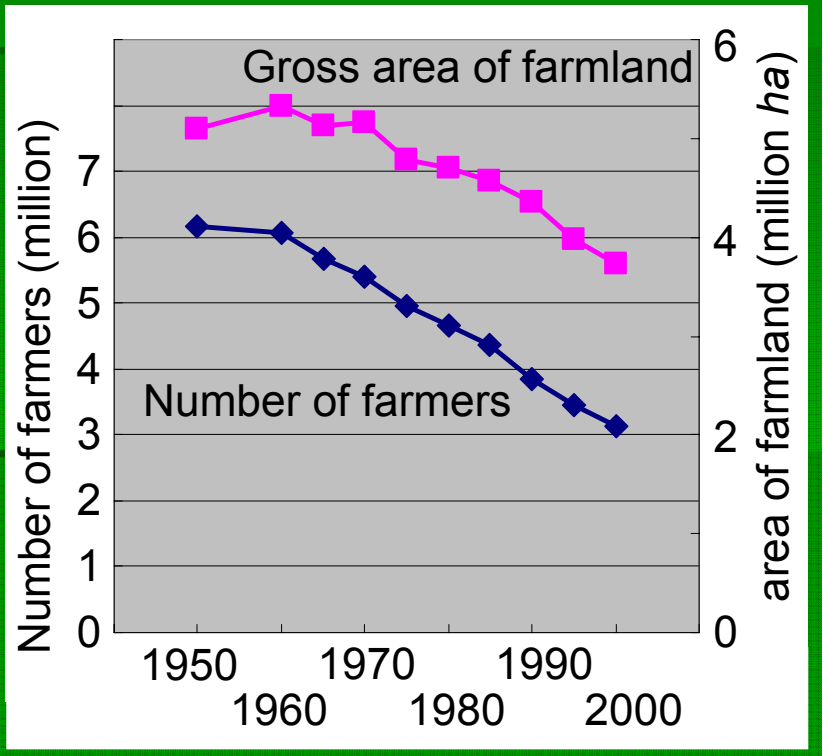
- 1893 Founded as the Agricultural Experiment Station in Saitama
- 1985 National Agriculture Research Center was founded in Tsukuba
- 2001 National Agricultural Research Center was founded as one of the institutes of NARO (National Agriculture Research Organization)

Our Mission

- NARC carries out research to innovate the crop production in Japan and leading investigations for the development of agricultural technologies.

Research Background 1

- Decreasing the number of farmers
- Keep or increase food-sufficiency ratio



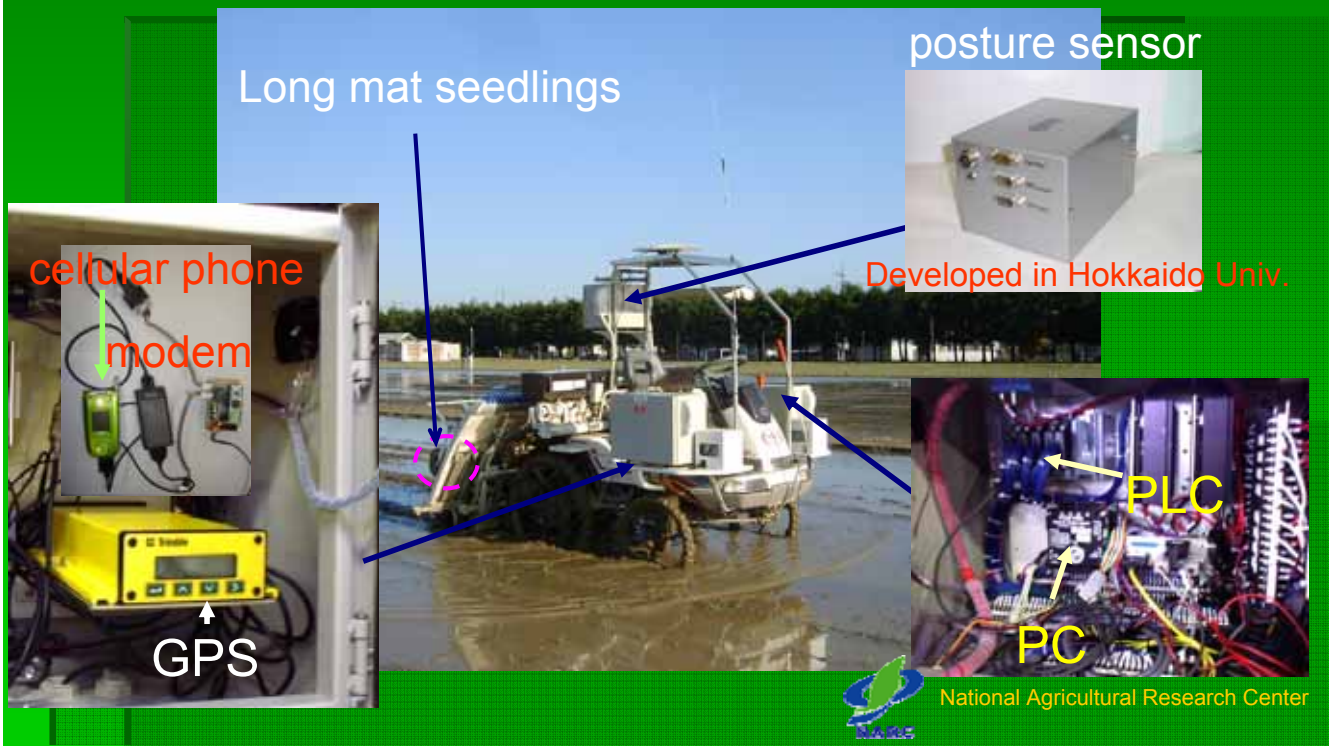
Objectives

- To develop autonomous operating systems in paddy field

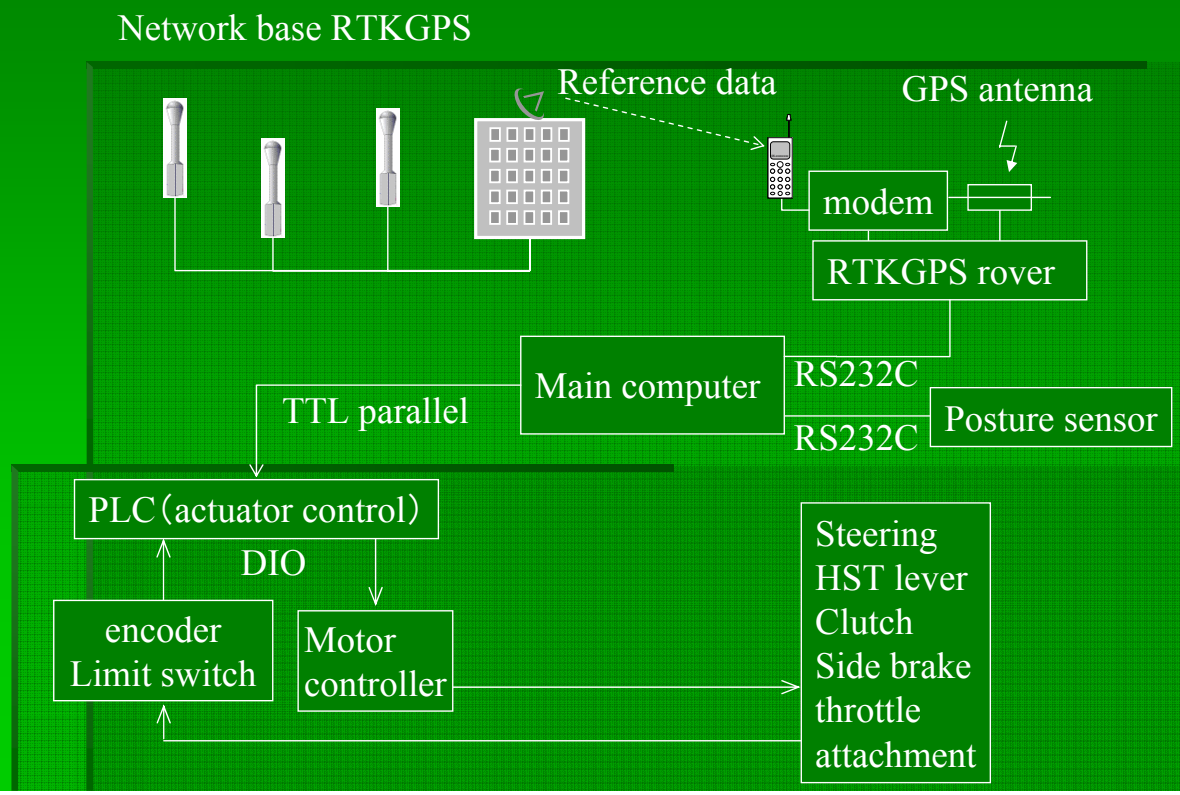
  →Rice transplanter

  - Modification of commercial rice transplanter
  - Developing control method in a muddy condition

Autonomous rice transplanter 1



Automated Rice Transplanting System 1



Results

- Transplant all field including headland
- Operation accuracy 10cm
- Efficiency 20minutes/0.1ha (1ha=0.4acre)

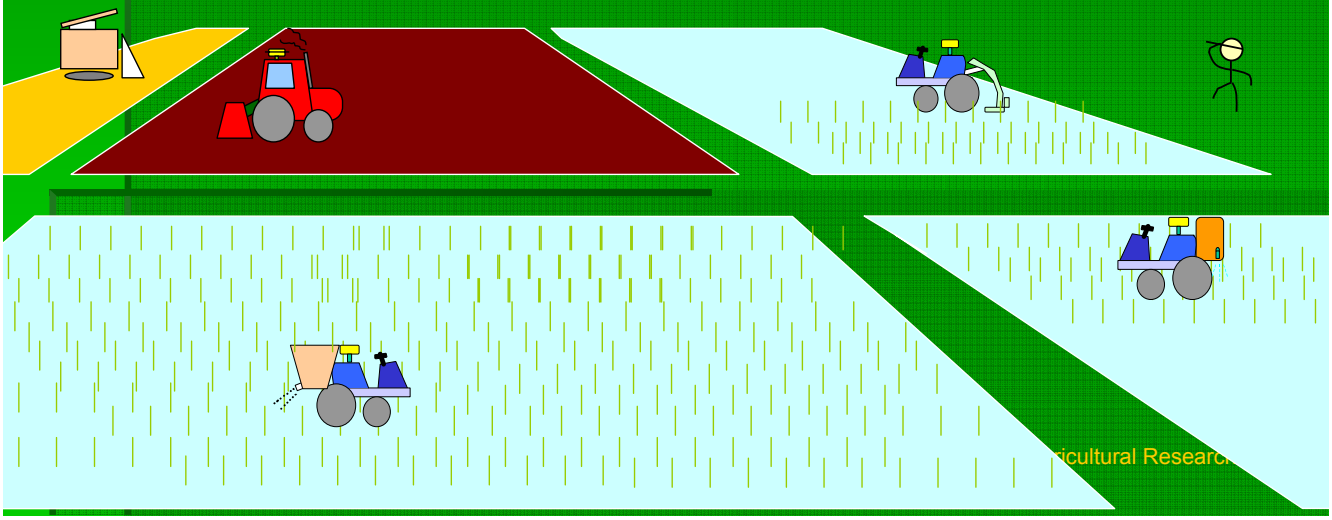
Demonstration in a farmer's field

What we do next?

- We developed an autonomous rice transplanter. But it is used only in spring.
- We need to develop other autonomous operating machines to cover all field operation such as tractor, sprayer (fertilizer), combine harvester.

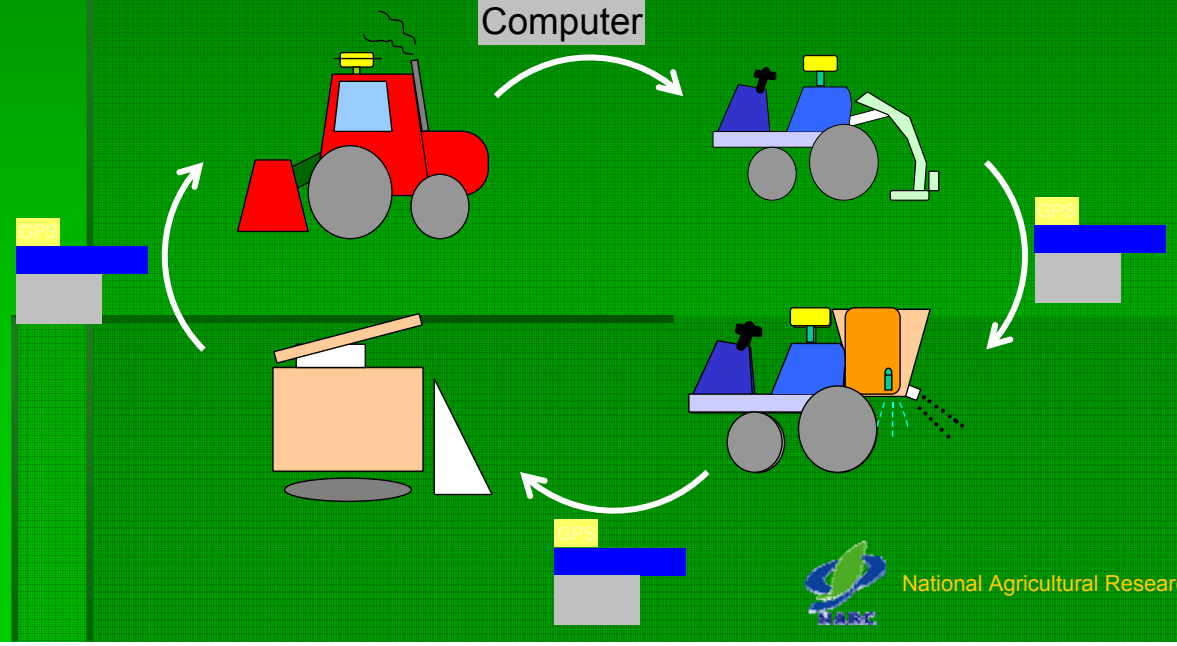
Autonomous systems in Paddy Field

Auto-field
From tillage to harvesting



Sharing sensors

GPS
Posture Sensor
Main Computer



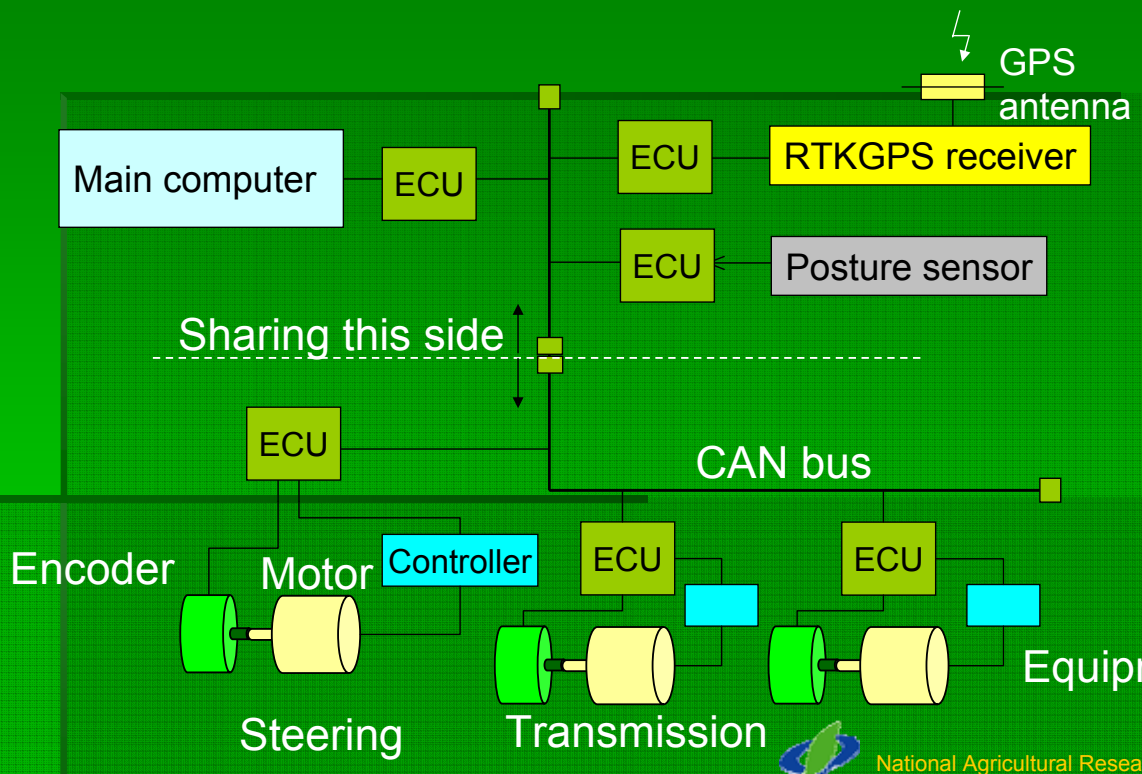
National Agricultural Research Center

Autonomous rice transplanter 2

- Use CAN bus
- We referred to ISO 11783 communication Protocol to control this rice transplanter

National Agricultural Research Center

Automated Rice Transplanting System 2



National Agricultural Research Center

Results

- It works as same as previous system.

What standard we need?

- We referred to ISO 11783, but it has not been defined about protocol for autonomous operation yet. (in part 14 2008?)
- We need standard communication protocol to share sensors and controllers among each farm operating system.

ISO11783

- Part 1: General standard for mobile data communication
- Part 2: Physical layer
- Part 3: Data link layer Harmonized with J1939/21
- Part 4: Network layer
- Part 5: Network management
- Part 6: Virtual terminal
- Part 7: Implement messages applications layer
- Part 8: Power train messages Harmonized with J1939/71
- Part 9: Tractor ECU
- Part 10: Task controller and management information system data interchange 2007
- Part 11: Mobile data element dictionary 2007
- Part 12: Diagnostic 2007
- Part 13: File Server 2006
- Part 14: Automated functions 2008

Thank you for your attention.

Contact Report

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

ORiN and RAPI

- ORiN (Open Resource interface for the Network)
- RAPI (Robot communication framework and Application Program Interface)
  - to distribute a new work item proposal based on RAPI, including distribution to ISO/TC 184 and ISO/TC 184/SC 5 for possible comments.
  - In order to better inform the other subcommittees, SC 2 recommends ORiN to make the same presentation on RAPI at the next ISO/TC 184 plenary meeting in Madrid 9-10 October 2006.

the next ISO/TC 184/SC 2 meeting

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

IROS2006 Workshop
Robotic Standardization

- Technically Sponsored with OMG Robotics Domain Task Force
- Contact (Organaizers):
  - Tetsuo KOTOKU (AIST)
  - YunKoo CHUNG (ETRI)
  - Makoto MIZUKAWA (Shibaura Inst. Tech.)
- Tuesday, October 10, 2006 Beijing, China

OS059 RT (Robot Technology) System Integration Oct 19(Thu), 20(Fri)

- Organizers:
  - Makoto MIZUKAWA (Shibaura Inst. Tech.)
  - Yun Koo Chung (ETRI)
- 20 papers
  - TA12(6)
  - TP12(4)
  - TE12(5)
  - FA12(5)

SICE-ICCAS 2006 SICE-ICASE International Joint Conference 2006
October 18(Wed.)-21(Sat.), 2006 in BEXCO, Busan, KOREA

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OS059 RT (Robot Technology) System Integration TA12

Session No.	Paper No.	Paper Title	Country	Presenter
TA12-1	A1636	An Executable Service Process Generation System using Web Service and OWL-S	Korea	Mr. CheonShu Park
TA12-2	A1599	Calling Motion and Natural Hand Detection for Gesture Recognition	Korea	Ms. Hyejin Kim
TA12-3	A1595	The Impulse Sound Source Tracking using Kalman Filter and the Cross-Correlation	Korea	Mr. Woo-han Yun
TA12-4	A1591	Appearance-based Face Recognition from Robot Camera Images with Illumination and Distance Variations	Korea	Graduate Student KyuDae Ban
TA12-5	A1586	Visual Processing of Rock, Scissors, Paper Game for Human Robot Interaction	Korea	Dr. Hosub Yoon
TA12-6	A1185	The Robot Software Communications Architecture (RSCA): QoS-Aware Middleware for Networked Service Robots	Korea	Graduate Student Jonghun Yoo

OS059 RT (Robot Technology) System Integration TP12

Session No.	Paper No.	Paper Title	Country	Presenter
TP12-1	A1541	Sensory Data Processing Middlewares for Service Mobile Robot Applications	Japan	Mr. Eijiro Takeuchi
TP12-2	A1355	Dynamic Integration of Ubiquitous Robotic Systems through Capability Model Processing	Japan	Mr. Olivier Lemaire
TP12-3	A1270	Study on Kinematic Optimization of a Combined Parallel-Serial Manipulator	Korea	Dr. Kun-Woo Park
TP12-4	A0182	An Information Delivery Method Driven by Event Matching for Information and Control Systems	Japan	Mr. Tsuneo Sobue

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OS059 RT (Robot Technology) System Integration TE12

Session No.	Paper No.	Paper Title	Country	Presenter
TE12-1	A1471	Robot Middleware and its Standardization in OMG -- Report on OMG Technical Meeting in St. Louis --	Japan	Dr. Tetsuo Kotoku
TE12-2	A1314	Enhancement of Versatility of the Agent Robot Operation Environment in the Physical Agent System- Proposal of Data Server Framework-	Japan	Graduate Student Sumiko Takeda
TE12-3	A1286	Development of RT-Middleware for Image Recognition Module	Japan	Mr. Akihiro Ikezoe
TE12-4	A1280	Development of the Robot Power Management System Adapting to Tasks and Environments -The design guideline of the Power Control System Applied to the Distributed-Control Robot-	Japan	Graduate Student Kazuya Ogawa
TE12-5	A1132	The Development Projects of Advanced Robot Technology in Japan	Japan	Mr. Masayoahi Yokomachi

OS059 RT (Robot Technology) System Integration FA12

Session No.	Paper No.	Paper Title	Country	Presenter
FA12-1	A1651	Request-driven Service Provisioning	Germany	Dr. Stephan Steglich
FA12-2	A1637	Development of Light-Weight RT-Component (LwRTC) on Embedded Processor	Japan	Graduate Student Yutaka Tsuchiya
FA12-3	A1598	Design and Implementation of Service-Oriented Task Model for Autonomous Service Robot	Korea	Mr. Joongki Park
FA12-4	A1264	Distributed Control of Robot Functions using RT Middleware	Japan	Graduate Student Kenichi Ohara
FA12-5	A1062	RT(Robot Technology)-Component and its Standardization	Japan	Dr. Noriaki Ando

KIRSF – Contact Report

Robotics DTF (Boston Meeting)
Date: June 28th, 2006
Reporter: Yun Koo Chung

- RUPI (Robot Unified Platform Initiative) standardization planning will be launched on July 4th :
  - Specifications for testing and performance evaluation for commercial home service robots
  - Communication protocols for URC robots.
  - Supports OMG and ISO standardization activities

- Korea-Japan Robot Standardization Workshop 2006 was held.
  - June 16th (Friday), 2006
  - Jeju, Korea - 6 speakers presented

Robotics-DTF/SDO-DSIG Joint Meeting

September 27, 2006

Anaheim, CA, USA

Disneyland Hotel

Document Number

- robotics/2006-09-01 Final Agenda (Tetsuo Kotoku)
- robotics/2006-09-02 Boston Meeting Minutes [approved] (Hung Pham)
- robotics/2006-09-03 Kickoff Presentation (Tetsuo Kotoku)
- robotics/2006-09-04 RTC 2nd Revised Submission Review [mars/2006-09-18] (Rick Warren)
- robotics/2006-09-05 Robotic Functional Services WG Meeting Schedule (Olivier Lemaire)
- robotics/2006-09-06 Localization (Yeon-Ho Kim)
- robotics/2006-09-07 Localization RFP - DRAFT (Kyuseo Han)
- robotics/2006-09-08 Localization RFP Presentation (Kyuseo Han)
- robotics/2006-09-09 Robotic Profile Presentation (Bruce Boyes)
- robotics/2006-09-10 Steering Committee (Tetsuo Kotoku)
- robotics/2006-09-11 Publicity Report (Masayoshi Yokomachi)
- robotics/2006-09-12 Amendment Robotics-DTF Charter - DRAFT (Hung Pham)
- robotics/2006-09-13 Localization RFP Presentation v2 (Kyusen Han)
- robotics/2006-09-14 Wireless Robot Sensors: SunSPOT (Bruce Boyes and Eric Arseneau)
- robotics/2006-09-15 Space Robotics in Past, Current and Future [space/2006-09-xx] (Hiroshi Ueno)
- robotics/2006-09-16 OMG System Modeling Language (OMG SysML) (Sanford Friedenthal)
- robotics/2006-09-17 Configuration and Deployment RFP - DRAFT (Rick Warren)

Document Number

- robotics/2006-09-18 Plenary Opening (Tetsuo Kotoku)
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- robotics/2006-09-28 Roadmap for Robotics Activities (Tetsuo Kotoku)
- robotics/2006-09-29 Next Meeting Preliminary Agenda - DRAFT (Tetsuo Kotoku)
- robotics/2006-09-30 RTC FTF Charter (Rick Warren)
- robotics/2006-09-31 DTC Report Presentation (Tetsuo Kotoku)
- robotics/2006-09-32 Anaheim Meeting Minutes - DRAFT (Hung Pham)

Publicity Activities

- IROS2006 Workshop
  October 10, Beijing, China
  http://www.iros2006.org/
  Kotoku@AIST, Chung@ETRI, Mizukawa@Sibaura-IT

  • Call for volunteer (Program Committee)
  • Call for paper (submission due: Aug. 1st)

- SICE-ICASE International Joint Conference
  October 18-21, Pusan, Korea
  http://sice-iccas.org/
  Mizukawa@Sibaura-IT, Chung@ETRI

  • Call for Participation (Organized Session)

Next Meeting Agenda

Dec. 4-8 (Arlington, VA, USA)

Monday:

Steering Committee (Mon morning)
WG activity [3WG in parallel]

Tuesday:

Joint activity with other SG

Wednesday :

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

Thursday:

WG activity (optional)

Potential Plenary Speaker

- Bruce Boyes (Systronix), “Microsoft Robotics Studio?”
- Jerry Bickle (PrismTech) “Configuration and Deployment in SBC).
- Shigetoshi Sameshima (Hitachi) “Examples of SDO Implementations”
- John Eidson (NIST), “Introduction to IEEE 1588 (precision networked time reference)”
- ? (NIST) Introduction to IEEE 1451
- John Hogg (Zeligsoft), “Introduction to Zeligsoft Component Enabler 2.4?”

- ManTIS is postpone to the Washington DC (Tue. or Thu.) [pending]

Roadmap for Robotics Activities

robotics/2006-09-28

Item	Status	Boston Jun-2006	Anaheim Sep-2006	DC Dec-2006	San Diego Mar-2007	Brussels Jun-2007	Jacksonville Sep-2007
Robot Technology Components RFP (SDO model for robotics domain)	In Process	Revised Submittion	adoption				
SDO model for xxx Domain	Planned			discussion	draft RFP		
Charter on Robotics WG in SDO	done Oct-2004						
Flyer of Robotics-DTF [Publicity Sub-Committee]	In Process	review 1st Draft	discussion	issue ver.1.0			
Localization Service RFP [Services WG]	In Process	discussion	draft RFP	review RFP	RFP		Initial Submittion
User Identification RFP [Services WG]	Planned			discussion	draft RFP	review RFP	RFP
Programmers API: Typical device abstract interfaces and hierarchies RFP [Profile WG]	In Process		Topic discussion	draft RFP	review RFP	RFP	
Hardware-level Resources: define resource profiles RFP [Profile WG]	In Process		Topic discussion	draft RFP	review RFP	RFP	
Deplyment and Configuration RFP [Infrastructure WG]	In Process	Outline discussion	rough draft	draft RFP	review RFP	RFP	
etc…	Future						
Robotics Information Day [Technology Showcase]	Planned				Info. Day	Info. Day	
Robotic Systems RFI [Robotics: Initial Survey]	done Apr-2006						
Charter on WGs [Service, Profile, Infrastructure]	done Apr-2006						
Charter on Robotics TF	done Dec-2005						
Charter on Robotics SIG	done Feb-2005						

Robotics Domain Task Force Preliminary Agenda -DRAFT ver0.0.3 robotics/2006-09-29

OMG Technical Meeting - Washington DC, USA -- December 4-8, 2006

		TF/SIG				
		Host	Joint (Invited)	Agenda Item	Purpose	Room
Sunday (Dec. 3)						
				No business		
Monday (Dec. 4) WG activity						
9:00	10:00	Robotics	(SDO)	Robotics Steering Committee	Robotics/SDO Joint Meeting Kick-off	
10:00	12:00	Robotics		**Infrastructure WG**(2h): - Saehwa Kim, Noriaki Ando, and Rick Warren	discussion	
				Profile WG(2h): Discussion on profile standardization - Seung-Ik Lee, Bruce Boyes	discussion	
				Robotic Services WG(2h): Definition of Functional Services in Robotic Systems, WG Steering Committee, Roadmap Update - Olivier Lemaire and Soo-Young Chi	discussion	
12:00	13:00	**LUNCH**				
13:00	18:00			Architecture Board Plenary		
13:00	17:00	Robotics		**Infrastructure WG**(2h): - Saehwa Kim, Noriaki Ando, and Rick Warren	discussion	
				Profile WG(2h): Discussion on profile standardization - Seung-Ik Lee, Bruce Boyes	discussion	
				Robotic Services WG(2h): Definition of Functional Services in Robotic Systems, WG Steering Committee, Roadmap Update - Olivier Lemaire and Soo-Young Chi	discussion	
Tuesday (Dec 5) WG activity						
9:45	10:00	Robotics		Joint Plenary Opening	Robotics/SDO joint plenary kick-off	
10:00	11:00	Robotics	(SDO)	**Invited Talk:** Configuration and Deployment in SBC **(tentative)** - Jerry Beckle (PrismTech)	presentation and discussion	
11:00	12:00	Robotics	(SDO)	Introduction to Zeligsoft Component Enabler 2.4?**(tentative)** - John Hogg (Zeligsoft)	presentation and discussion	
12:00	13:00	**LUNCH**				
13:00	14:00	Robotics		**IEEE 1588** precision networked time reference – John Eidson, NIST	presentation and discussion	
14:00	15:00	Robotics		**IEEE 1451 (tentative)**	presentation and discussion	
				Break (30min)		
15:30	16:30	Robotics		**Invited Talk:** Examples of SDO Implementation **(tentative)** - Sameshima (Hitachi)	presentation and discussion	
16:30	17:30	Robotics				
17:00	18:00	OMG		The Revision and Finalisation Task Force Chairs' Tutorial	discussion	
Wednesday (Dec 7) Robotics Plenary						
9:00	12:00	Robotics	(SDO)	WG Reports and Roadmap Discussion (Infrastructure, Robotic Service, Profile)	reporting and discussion	
12:00	14:00	**LUNCH and OMG Plenary**				
14:00	15:00	Robotics	Robotics	Demonstration of Microsoft Robotic Studio - Bruce Boyes (Systronix)	Demonstration and Informative	
				Break (30min)		
15:30	16:30	Robotics	(SDO)	**(TBA)**	presentation and discussion	
16:30	17:00	Robotics	SDO	Contact Reports: - Makoto Mizukawa(Shibaura-IT), and Yun-Koo Chung(ETRI)	Information Exchange	
17:00	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 San Diego, Draft report for Friday	planning for next meeting	
18:00	20:00	**OMG Reception**				
Thursday						
8:30	12:00	Robotics		RTC FTF Meeting		
12:00	13:00	**LUNCH**				
13:00	18:00			Architecture Board Plenary		
				NIST tour?		
17:00	18:00	MARS		Agenda Coordinatging Meeting - San Diego TM	planning for next meeting	
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		
9:00	12:00	OMG		Tutorial - Introduction to OMG's meeting and Middlewere Specifications		
13:00	17:00	OMG		Tutorial - An Overview of UML 2.0		
18:00	19:00	OMG		New Attendee Reception (by invitation only)		
Tuesday						
9:00	12:00	OMG		Tutorial - Introduction to the Data Distribution Service		
13:00	17:30	OMG		Tutorial - MDA -- Where it Came From and Where it's Going		
Wednesday						
9:00	12:00	OMG		Tutorial - Intruduction to the XML Telemetric and Command Exchange (XTCE) Specification		
14:00	17:00	OMG		Tutorial - Introduction to OMG's new Ontology Defenition Metamodel (ODM) Specification		

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

Proposed Charter for RTC FTF

TC Meeting Date: 29 Sep. 2006
Presenter: Rick Warren, RTI
Group email: rtc-ftf@omg.org
WIP page (URL):
http://www.omg.org/techprocess/meetings/schedule/RTC_FTF.html

- **Adopted Specification:**

  Robotic Technology Component (RTC) Specification
  - mars/2006-08-01 (Specification)
  - mars/2006-08-02 (XMI file)
  - mars/2006-08-03 (IDL file)
  - mars/2006-09-33 (Local PSM addendum)
  - mars/2006-09-34 (Example C++ header)
  - mars/2006-09-37 (CORBA PSM addendum)
- **Members:**
  - Noriaki Ando, AIST
  - Yun-Koo Chung, ETRI
  - Saku Egawa, Hitachi
  - Saehwa Kim, Real-Time Operating Systems Lab, SNU
  - Jim Kulp, Mercury Computer Systems
  - Olivier Lemaire, Japan Robot Association (JARA)
  - Makoto Mizukawa, Shibaura Institute of Technology
  - Tom Rutt, Fujitsu
  - Takeshi Sakamoto, Technologic Arts Inc.
  - Rick Warren (**Chair**), Real-Time Innovations (RTI)
  - Virginie Watine, Thales
  - Masayoshi Yokomachi, NEDO
- **Deadlines:**
  - Draft Adopted Specification: 31st October, 2006
  - Final Adopted Specification Publication: 30th November, 2006
  - Comments Due: 2nd July, 2007
  - Report Deadline: 5th October, 2007

Robotics-DTF

Date: Friday, 29th September, 2006
Chair: Tetsuo Kotoku, YunKoo Chung, Hung Pham
Group URL: http://robotics.omg.org/
Group email: robotics@omg.org

➢Highlights from this Meeting:

Robotics/SDO Joint Plenary:

- **3 WG Reports** [robotics/2006-09-20, -21, -22]
- **4 Interesting Talks**
  - SunSPOT demo – Bruce Boyes(Systronix) and Eric Arseneau (Sun) [robotics/2006-09-14]
  - SysML brief tutorial - Sanford Friendenthal (Lockheed Martin) [robotics/2006-09-16]
  - Robot Ontology - Minsu Jang (ETRI) [robotics/2006-09-19]
  - Japanese Agriculture Robot - Yoshisada Nagasaka (AFFRC) [robotics/2006-09-24]

Joint Meeting with MARS-PTF :

- RTC 2nd Revised Submission (recommend to adopt)

Joint Session in the Space Information Day :

- Space Robot in Japan – Hiroshi Ueno (JAXA) [robotics/2006-09-15]

Robotics-DTF

Date: Friday, 29th September, 2006
Chair: Tetsuo Kotoku, YunKoo Chung, Hung Pham
Group URL: http://robotics.omg.org/
Group email: robotics@omg.org

➢Deliverables from this Meeting:

- **RTCs 2nd revised submission** (Recommend to Adoption) **(joint with MARS-PTF, SDO-DSIG)**

➢Future deliverables (In-Process):

- **Localization Service RFP (discussion)**
- **RTC Configuration and Deployment RFP (discussion)**

➢Next Meeting (Washington DC, USA):

- **3 WG sessions in Parallel**
- **Guest presentations**
- **Roadmap discussion**
- **Contact reports**

Summary of the Robotics DTF Plenary – DRAFT –

Sep 26-27, 2006
Anaheim, CA, USA
robotics/2006-09-32

Meeting Highlights

The 2nd Submission of Robotic Technology Component (RTC) has been recommended in MARS-PTC, AB board, and Technology Committee. And we chartered RTC Finalization Task Force (FTF).
We had four interesting talks; SunSPOT demo – Bruce Boyes(Systronix) and Eric Arseneau (Sun), SysML brief tutorial - Sanford Friendenthal (Lockheed Martin), Robot Ontology - Minsu Jang (ETRI), and Japanese Agriculture Robot - Yoshisada Nagasaka (AFFRC).
Three WGs have active discussions about the topics of potential RFPs.

List of generated documents

- robotics/2006-09-01 Final Agenda (Tetsuo Kotoku)
- robotics/2006-09-02 Boston Meeting Minutes [approved] (Hung Pham)
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- robotics/2006-09-32 Anaheim Meeting Minutes - DRAFT (Hung Pham)

MINUTES

Tuesday, Coronado Suite

Attendees: 18

Rick Warren (RTI)
Masayoshi Yokomachi (NEDO)
Bruce Boyes (Systronix)
Eric Arseneau (SUN)
Joo Chan Sohn (ETRI)
Yun Koo Chung (ETRI)
Dong Hee Choi (KNU)
Vitaly Li (KNU)
Olivier Lemaire (JARA)
Takeshi Sakamoto (Technologic Arts)
Yoshisada Nagasaka (NARC)
Takashi Suehiro (AIST)
Makoto Mizukawa (SIT)
Seiichi Shin (UEC)
Tetsuo Kotoku (AIST)
Noriaki Ando (AIST)
Hung Pham (RTI)
Sanford Friedenthal (LMC)

"Introduction to SysML" – Sanford Friendenthal (LMC)
- presented an overview of SysML and talked about its applicability to robotics
- fielded questions about relationships among various diagrams
- particular interest was expressed in the parametric model diagrams

Wednesday, Balboa Suite

Attendees: 22

Makoto Mizukawa (SIT)
Seiichi Shin (UEC)
Claude Baudoin (Schlumberger)
Roy Bell (Raytheon)
Rick Warren (RTI)
Joo Chan Sohn (ETRI)
Hung Pham (RTI)
Kyuseo Han (ETRI)
Incheol Jeong (ETRI)
Dong Hee Choi (KNU)
Vitaly Li (KNU)
Yun Koo Chung (ETRI)
Su Young Chi (ETRI)
Olivier Lemaire (JARA)
Masayoshi Yokomachi (NEDO)
Bruce Boyes (Systronix)
Tetsuo Kotoku (AIST)

Takeshi Sakamoto (Technologic Arts)
Minsu Jang (ETRI)
Yoshisada Nagasaka (NARC)
Dave Stringer (Borland)
Noriaki Ando (AIST)

Proceedings
Meeting called to order at 8:56am (Toku, AIST)

Review of the Agenda (Toku, AIST)

"Robot Ontology and Related Research in ETRI" – Minsu Jang (ETRI)
- Described ontology and its applicability to robotics
  * Using vocabulary to model data, like RDB
  * However, provides constructs for specifying mode complex relationships between data
  * Speaker conclusion: ontology provides well-established mechanism for interoperability in "broad sense"
- Described ontology-related research at ETRI, *e.g.*,
  * service/content selection
  * service/content adaptation
- Considerations
  * how about addressing semantic requirements on profiles? how about relevant use-cases or requirements for RFP?

WG Reports
Infrastructure WG Report (Warren, RTI)
- Reviewed existing D&C standards
  * SBC, CCM, XMI
- Moving forward, need to define the scope of a potential D&C RFP
  * delay RFP process until further information can be exchanged with CORBA, SBC, *etc.*

Robotic Functional Services WG report (Lemaire, JARA)
- Roadmap remains on track
- First draft of RFP was written
  * issues regarding scope and perspective, i.e., User's *vs.* Developer's point of view
  * more details of location calculation module is necessary
  * need to define more what is expected for each interface

Robotic Devices and Data Profiles WG report (Boyes, ETRI)
- Demonstration of SunSpot given
- Upcoming presentations proposed
- Work plan
  * review data format of application standards
  * relation to localization sensors specification
  * possible: consider semantic requirements in Profile WG?
  * review draft RFP which has been created through mailing list collaboration
- Draft RFP tentative for Wash DC, perhaps combine these 2 topics
  * typical device abstract interfaces and hierarchies
  * hardware-level resources: define resource profiles

Review of the Boston Minutes (Toku)

- AIST motioned to accept
- JARA seconded
- SIT suggested white ballot

RTC submission update
(Warren, RTI)
- Provided overview of the RTC
  * had been recommended for adoption by MARS at previous tech meeting
  * AB had raised issues which needed to be addressed by this technical meeting

"Autonomous systems for Japanese Agriculture in Paddy Field," Yoshisada (NARC)
- Developing autonomous system to transplant rice in paddy fields
- Prototyped rice transplanter with modular sensing package
- What standards do we need?
  * ISO 11783 has not defined protocol for autonomous operations yet
  * Need standard comm protocol to share sensors and controllers among each farm operating robots

Contact reports
ISO TC184 – SC2 (Mizukawa, SIT)
- Next meeting in DC Jun 7-8, 2007
  * PT Robots in personal care & Advisory Group (AG) Service robots planning to meet Jun 4-6
  * International Robots and Vision Show will take place in Chicago in Jun 11-15

IROS2006 Workshop (Mizukawa, SIT)
- Organizers: Kotoku (AIST), Chung (ETRI), and Mizukawa (SIT)
- Scheduled Oct 10, 2006.

OS059 Robot Technology System Integration Oct 10-20 (Mizukawa, SIT)
- Organizers: Chung (ETRI) and Mizukawa (SIT)
- Scheduled Oct 18-19, 2006

KIRSF contact report (Chung, ETRI)
- RUPI (Robot Unified Platform Initiative) standardization launched on Jul 4, 06.
- URC (Ubiquitous Robotic Companion) robots (~650) will be distributed in field tests beginning Oct

Publicity report
Robotics DTF brochure (Yokomachi NEDO)
- Showed flier to group
- Requested pics of robots to put on flier
- Requested feedback on flier
- Targeting 3 wks before DC

New Business
Next meeting agenda for Dec 4-8 in DC (Toku, AIST)
- Monday
  * Steering committee (Mon morning)
  * WG activities (3WG in parallel)
- Tuesday
  * WG activities, joint activity with other SG

- Wednesday
  * Plenary
    - WG reports
    - Guest and member presentation
    - Contact reports
    - DTC report

Meeting was adjourned at 4:52 pm

Prepared and submitted by Hung Pham (RTI).