Management of Applications in Large and Heterogeneous Systems

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Engineering Solutions That Last Generations

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Agenda

- AMSM: state of problem
- AMSM: spec overview
- SELEX Sistemi Integrati experience
- Cardamom vs AMSM

AMSM: state of problem

Problem Statement

- **Naval Combat Management Systems**
- Built upon huge variety of underlying computing platforms
  - hardware and software
- Need for consistency amongst Application Management platforms
  - enable integrators to abstract from platform dependencies
- Specific naval CMS QoS constraints

Design Rationale

The design of the specification follows the following principles:

- Maximum use possible of existing standard DMTF CIM (it is a widely accepted standard for management of software and hardware systems)
  - The specification selects a relevant subset of CIM for the CMS domain and extends it where needed.
- Inclusion of HPI-based hardware monitoring as optional PSM.
  - CIM does not model hardware elements to the detail level required by AMSM RFP.
  - A set of PSMs covering a variety of platform technologies:
    - CORBA, DDS/DCPS, XML, DMTF CIM Managed Object Format (MOF), HPI.
    - A hierarchical 3-level model of software systems, applications and software executable elements.
    - A division between design-time and run-time information of software and hardware entities.
    - A flexible deployment model allowing user defined conditions and actions to be defined.

AMSM History

- RFP issued: June 25th, 2004
- Initial submission deadline: May 30th, 2005, responses from:
  - Thales, SELEX, Themis, Progeny and Atlas
- Revised submission drafts: February 2006, April 2006, May 2006, June 2006, September 2006, December 2006 prepared by:
  - Thales, SELEX, Themis and Progeny
- Draft Adopted Specification: April 2007

AMSM: spec overview

Submission overview

– Form of the submission:

- **Platform Independent Model** (PIM)
  - in UML for data models and service interfaces
- **5 Platform Specific Models** (PSM):
  - CORBA/IDL
  - DMTF/CIM (=> DMTF/WBEM)
  - DDS/DCPS
  - XML (initialisation files)
  - HPI (cross-reference with HPI initialisation files)

Conformance Profiles

Profile vs. Packages rule[s]		Profiles				
		Normal	**HW System Management**	**Fault Tolerance**	**Load Balancing**	**Maximum Control**
PACKAGES	**LW Logging**	F	F	F	F	F
	AMSM Management	P	P	+ opt. classes and Assoc.	+ opt. classes and Assoc.	F
	Supported Application Model	F	F	F	F	F
	Application	P	P	+ opt. classes and Assoc.	+ opt. classes and Assoc.	+ opt. methods
	Application Spec	P	P	+ opt. Classes	+ opt. Classes	
	Application Deployment	F	F	F	F	F
	Application Deployment Spec.	F	F	F	F	F
	Logical Hardware		F			
	Logical Hardware Spec.		F			

A - At least one among them
P - Partial
F - Full

Conformance Profiles

Profiles vs. Implementation rules		Profiles				
		Normal	HW System Management	Fault Tolerance	Load Balancing	Maximum Control
Implementation	Must	X				
	May		X	X	X	X

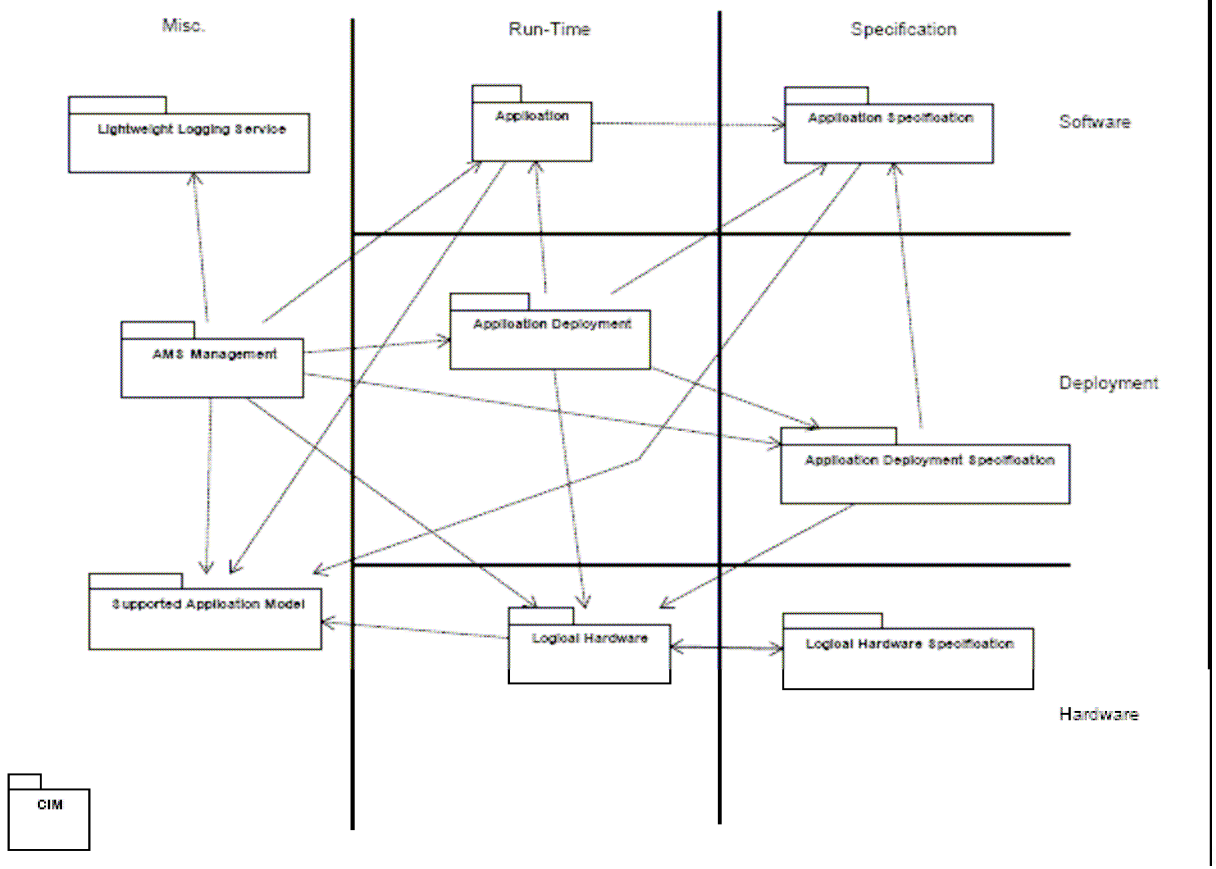
Implementation vs. PSMs rules			Implementation	
			Must	May
PSMs		XML	X	
	Core PSMs	IDL	A	
		CIM		
		DCPS/ f		
		DCPS/ m		X
		HPI		X

PIM Packages Structure

- In order to break down the overall model in a modular way such that interdependencies and complexity are minimized, two dimensions were considered:
  - Hardware vs. Software vs. Deployment (i.e., Software on Hardware)
  - Run-Time (monitoring) classes vs. Specification Classes

Package	Hardware	Software	Deployment
Run-Time	Logical Hardware	Application	Application Deployment
Specification	Logical Hardware Specification	Application Specification	Application Deployment Specification

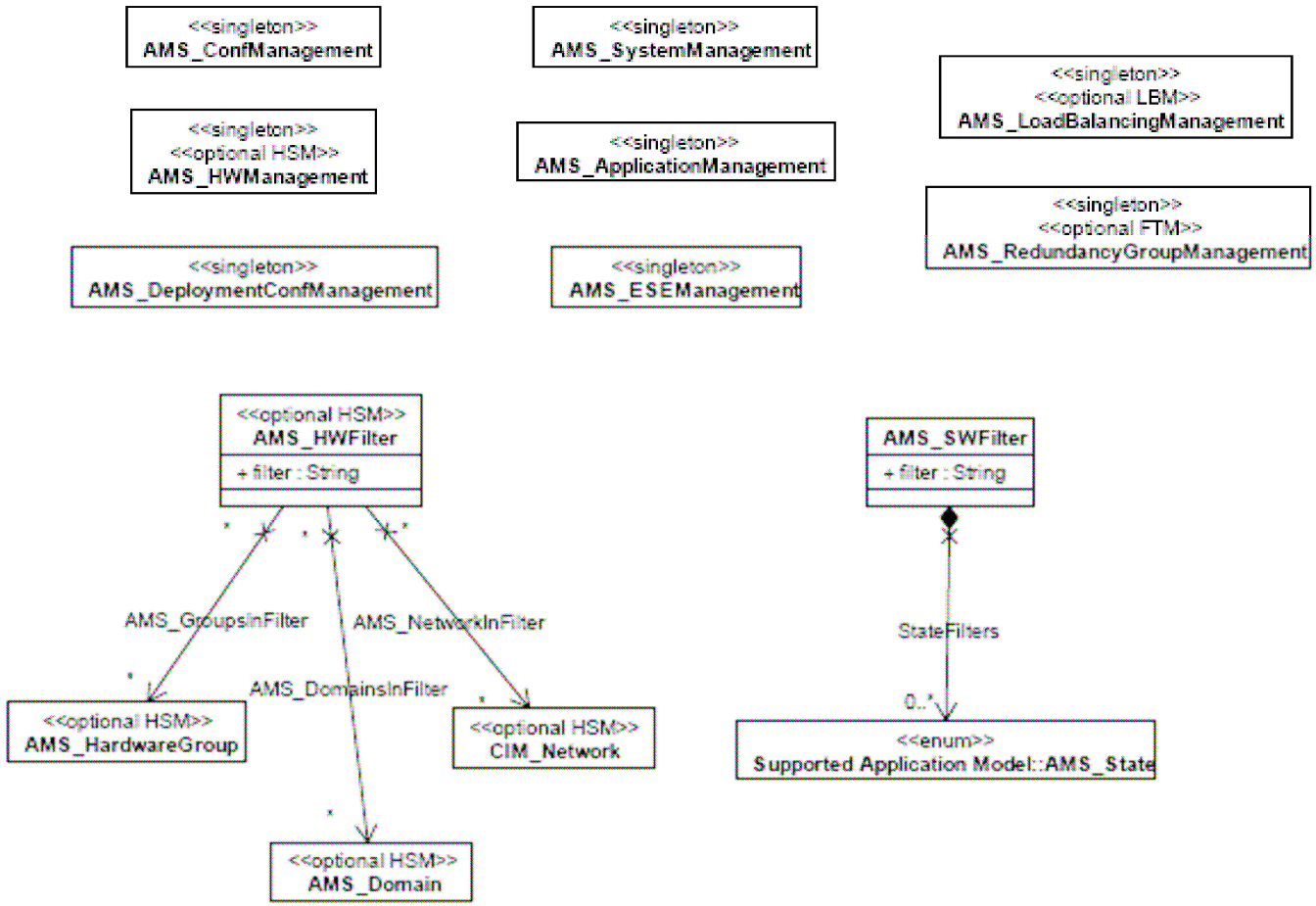
Packages overview



AMS Management Package

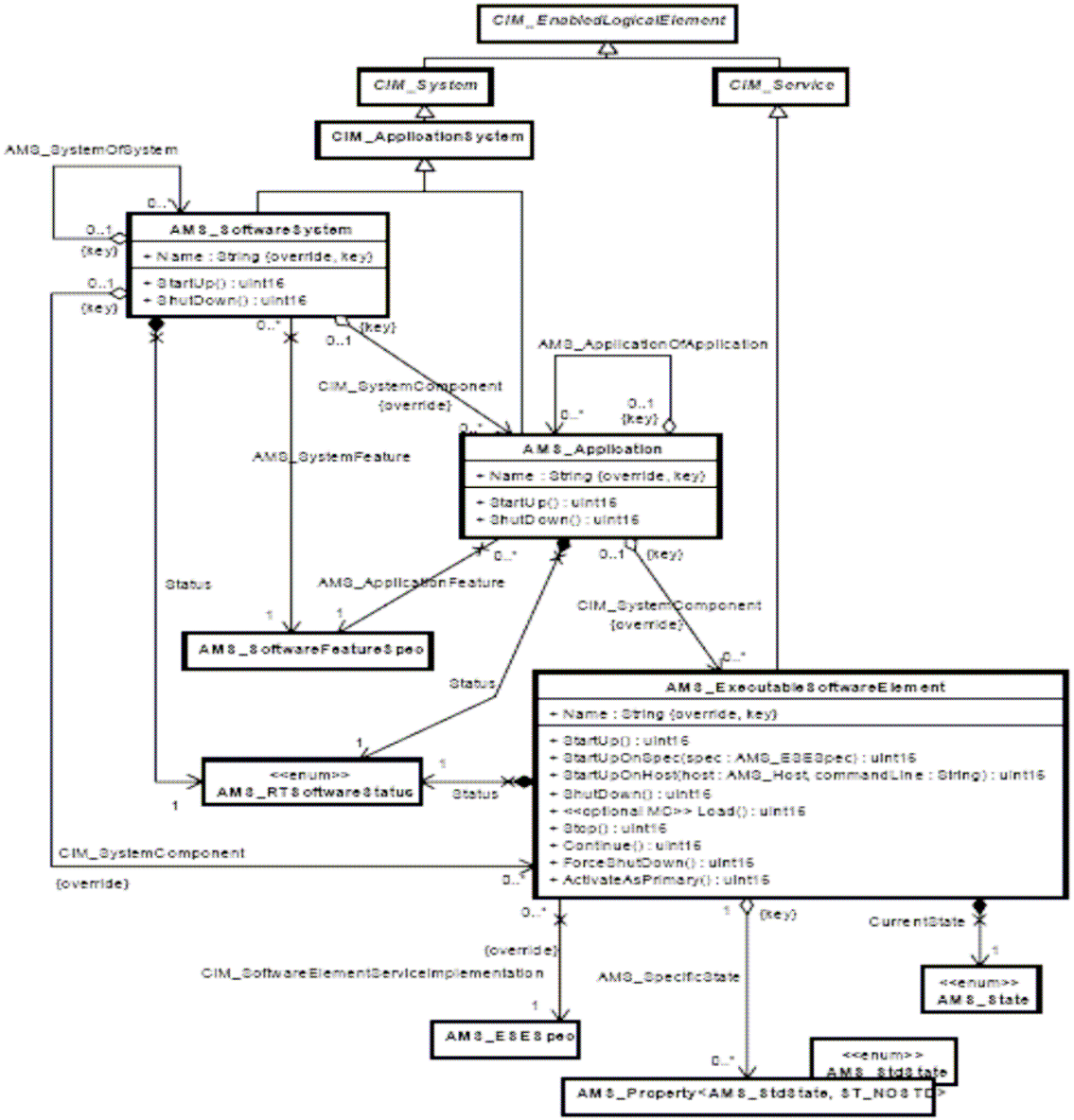
- 8 classes that provide the entry points of the AMSM service with the operations that give access to the remainder of the model
  - AMS_HWManagement and AMS_PhysicalHWManagement for hardware
  - AMS_DeploymentConfManagement for the deployment configurations
  - AMS_SystemManagement for systems
  - AMS_ApplicationManagement for applications
  - AMS_ESEManagement for executable software Elements
  - AMS_LoadBalancingManagement for load balancing groups
  - AMS_RedundancyGroupManagement for redundancy groups

AMS Management Package

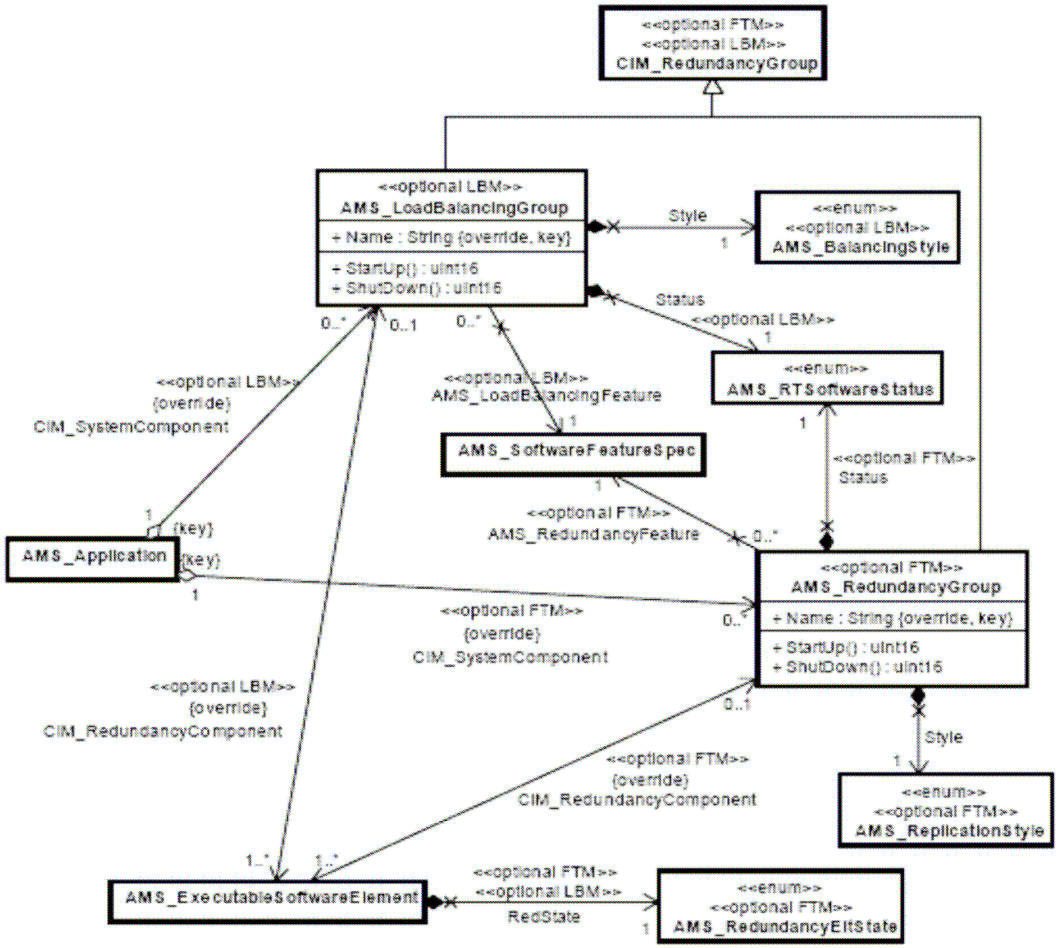


AMS Application Package

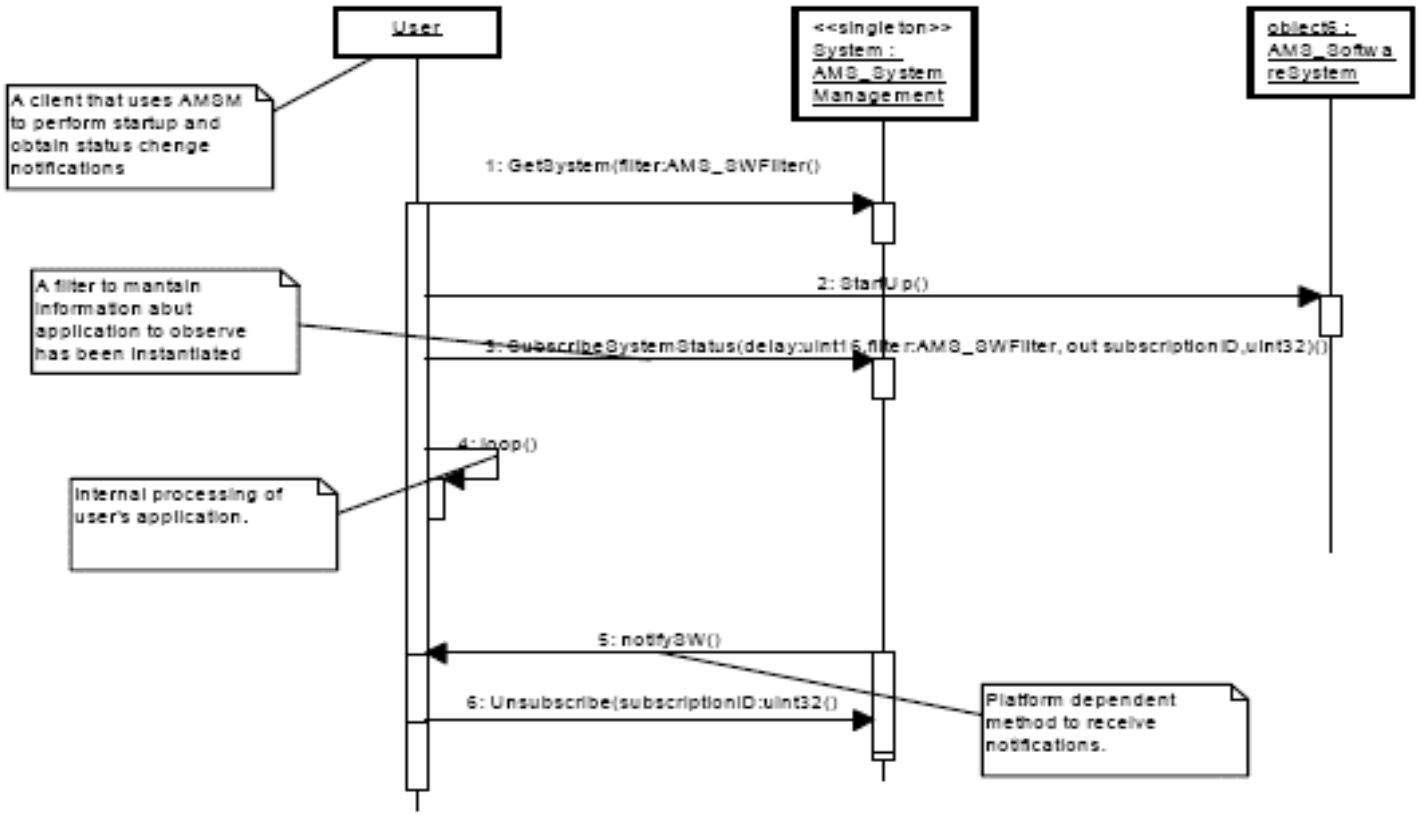
- The "Application" package groups the classes needed to manage and monitor applications while they are running (information for the application definition are in “Application Specification” package).
- Since some items needed to manage applications are defined beforehand, there are links from this package to the "Application Specification" package.
- Roughly AMS_Application is designed as a set of executable software elements and/or redundancy groups and/or load balanced groups.
  - A redundancy group (AMS_RedundancyGroup) gathers executable software elements which are executed in a redundant way.
  - A load balancing group (AMS_LoadBalancingGroup) gathers executable software elements, which are executed in a load, balanced way



AMS Application – LB and FT



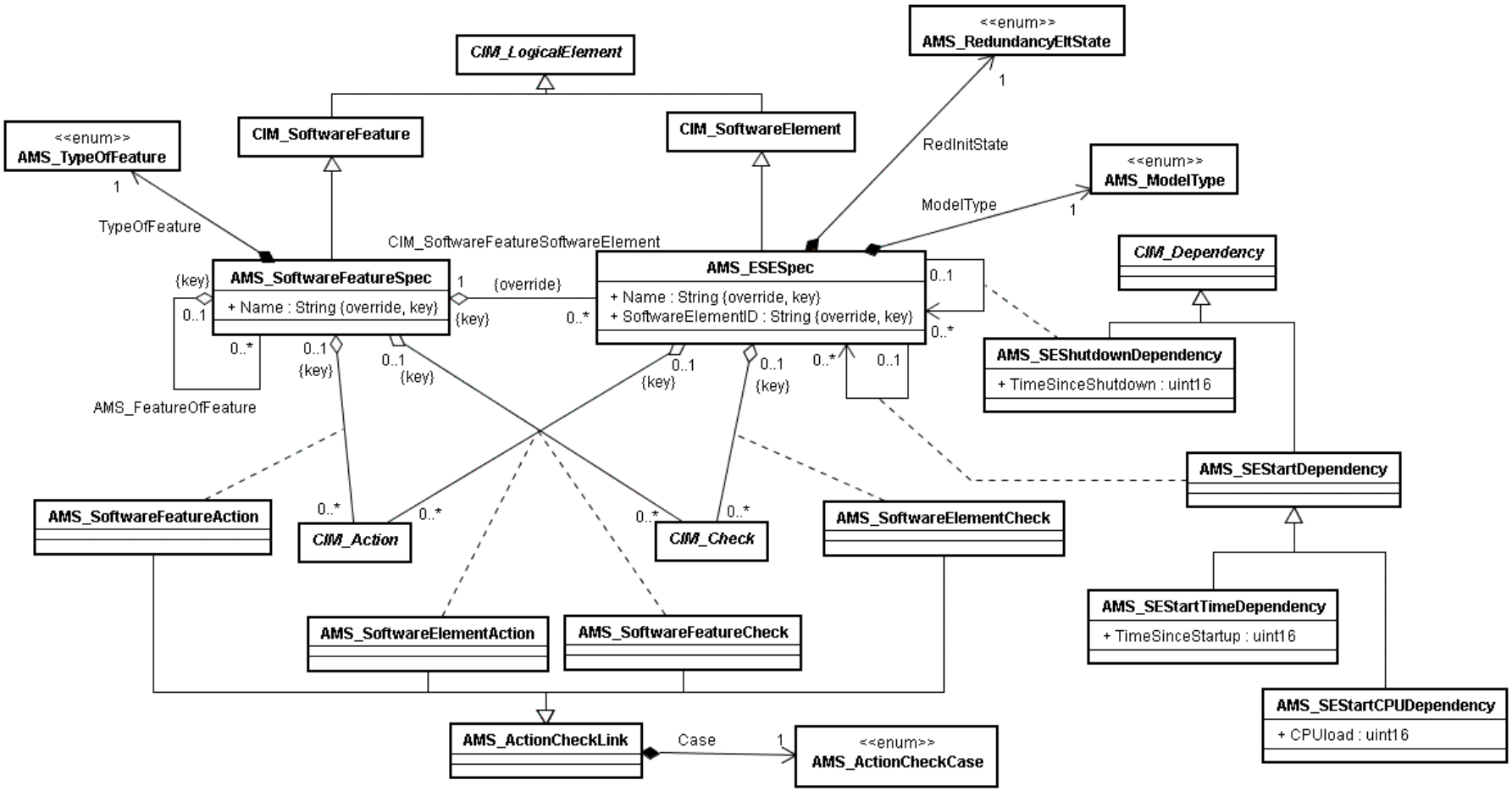
Starting up an application



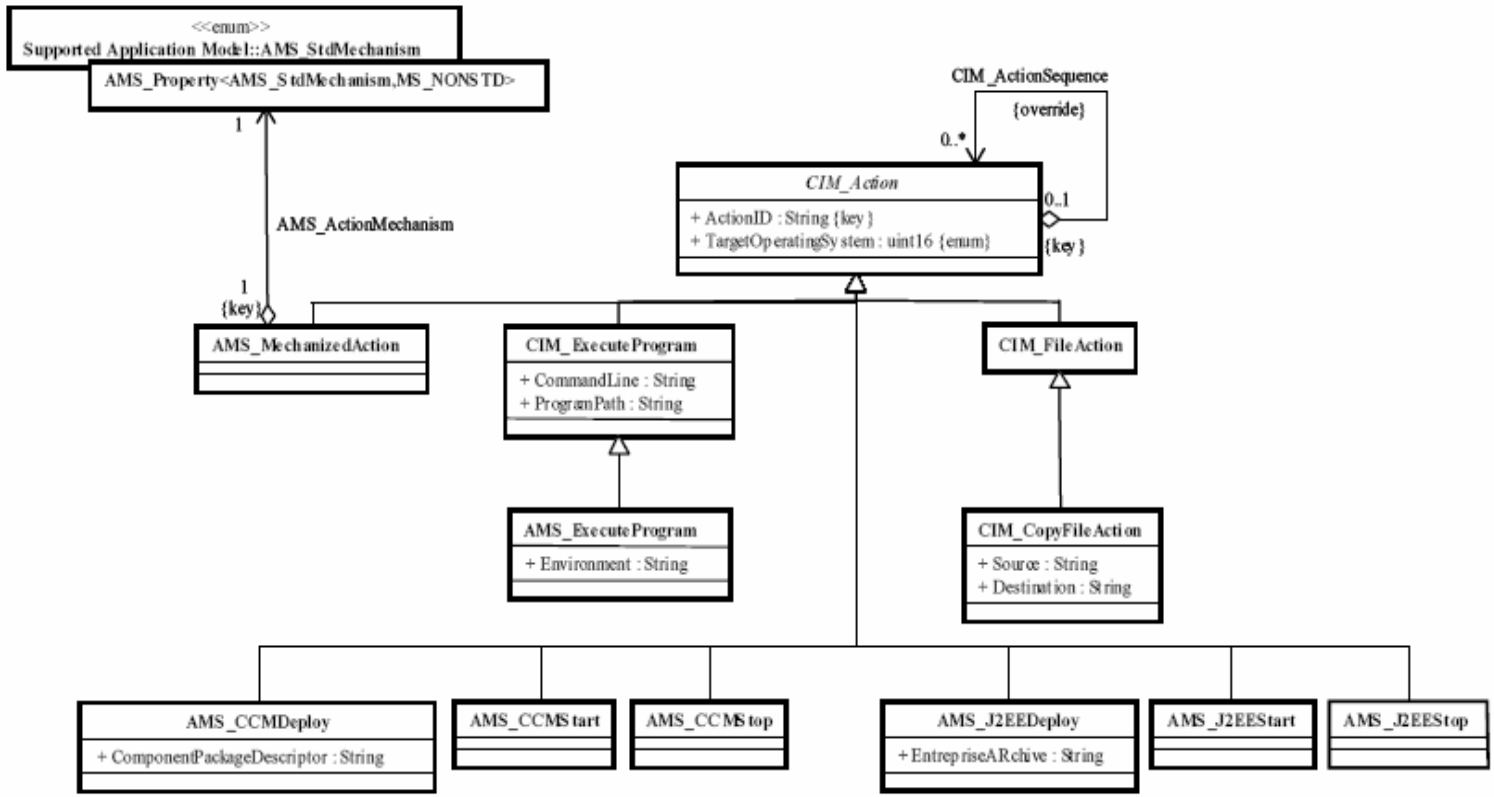
AMS Application Specification Package

- The "Application Specification" package groups the classes needed to model applications so they can be deployed subsequently.
  - This package is a configuration view of applications.
  - The main entity is the specification of an executable software element: an AMS_ESESpec
  - An executable software element specification is the object which the AMSM service needs to deploy applications (i.e., create an executable software element from its specification)
    - An actual executable software element will not hold a lot of information in itself since it will use its specification to keep them. Of this application information, the most important are the checks (CIM_Check) and actions (CIM_Action).

AMS Application Specification Package



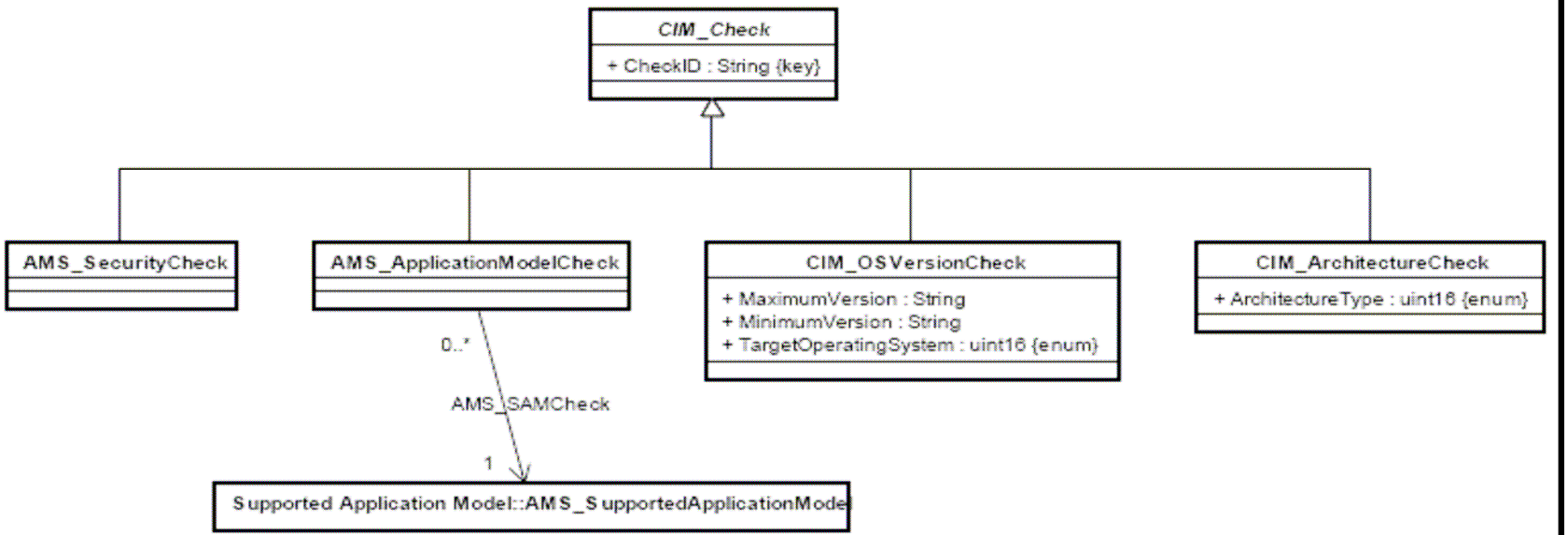
Action Specification Classes



CIM_Action are operations that are part of a process to start or shutdown (or deploy) a software element

Check Specification Classes

CIM_Check are conditions or characteristics that have to be true so as to deploy a Software Element



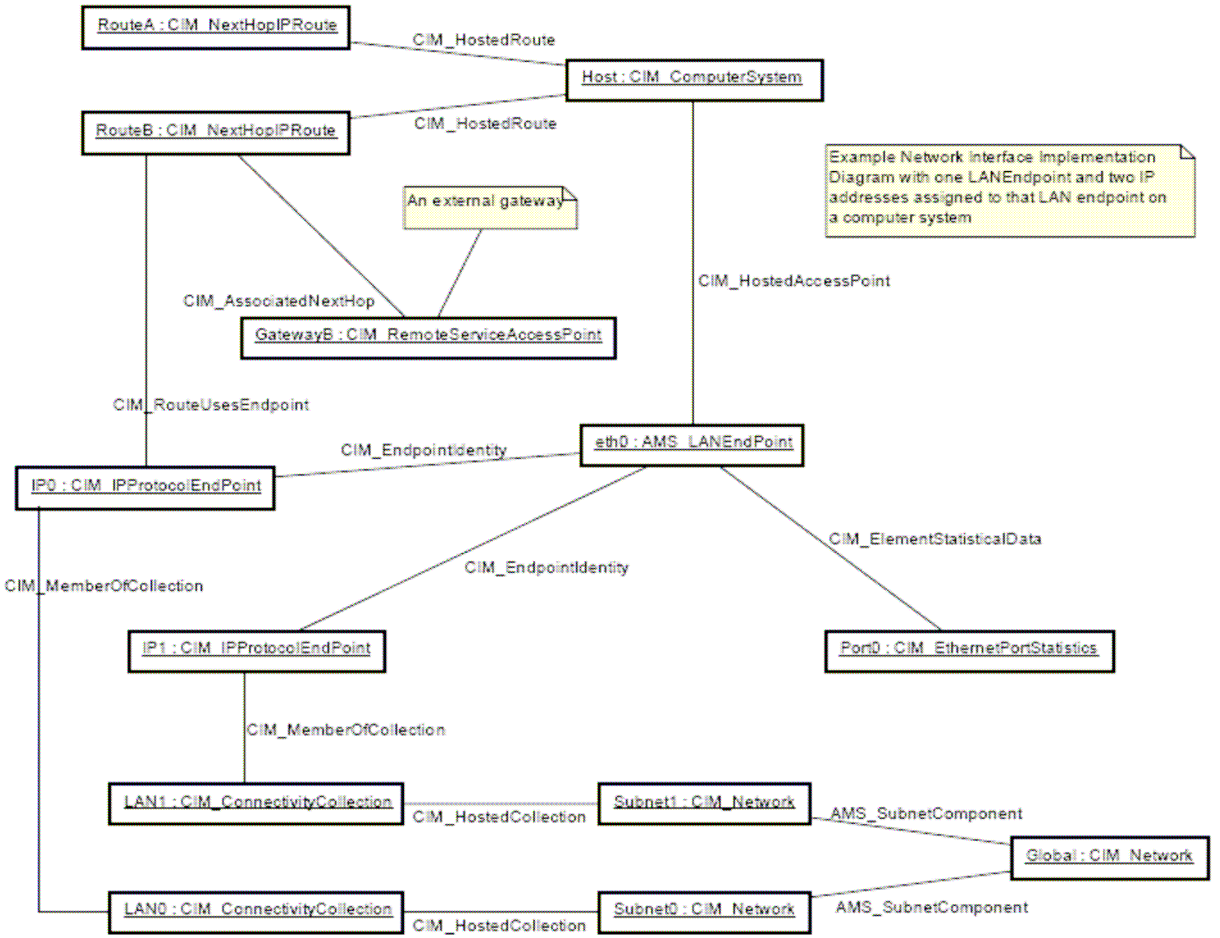
An association class between AMS_ESESpec and either CIM_Action or CIM_Check specifies the condition (start, stop, deploy) in which the action or check will take place.

AMS Logical Hardware Package

It represents the "Hardware" sub-package describing the effective hardware topology.

- These classes permit the representation of an actual network.
- The essential class is AMS_ComputerSystem which represents:
  - A computer as an aggregation of hardware elements.
  - A computer as a node in a network.
- An AMS_ComputerSystem aggregates a hardware configuration (CIM_LogicalDevice)
  - processor, memory, file systems, and gets some operating systems (AMS_OperatingSystem) which support application models

An example of network instantiation



All the AMS_ComputerSystem class and sub-classes are interfaces offering monitoring methods.

CORBA/IDL PSM

- There are different ways in which this PSM may be utilized is:
  - Browsing software system structures: application, groups, and ESEs.
  - Browsing networks and computer systems.
  - Discovery and configuration of networks and computers.
  - Software data inventory.
  - Display of computers and/or applications statuses.
  - GUI-based management of applications and computers.

These uses may be gathered in two main purposes:

- Getting information from a database of software and hardware
  - Need of interfaces to get all the attributes and to iterate on all the associations
- Managing some of these element: applications, ESEs, computers
  - Need for a way to quickly retrieve elements of the object

DDS/DCPS PSM

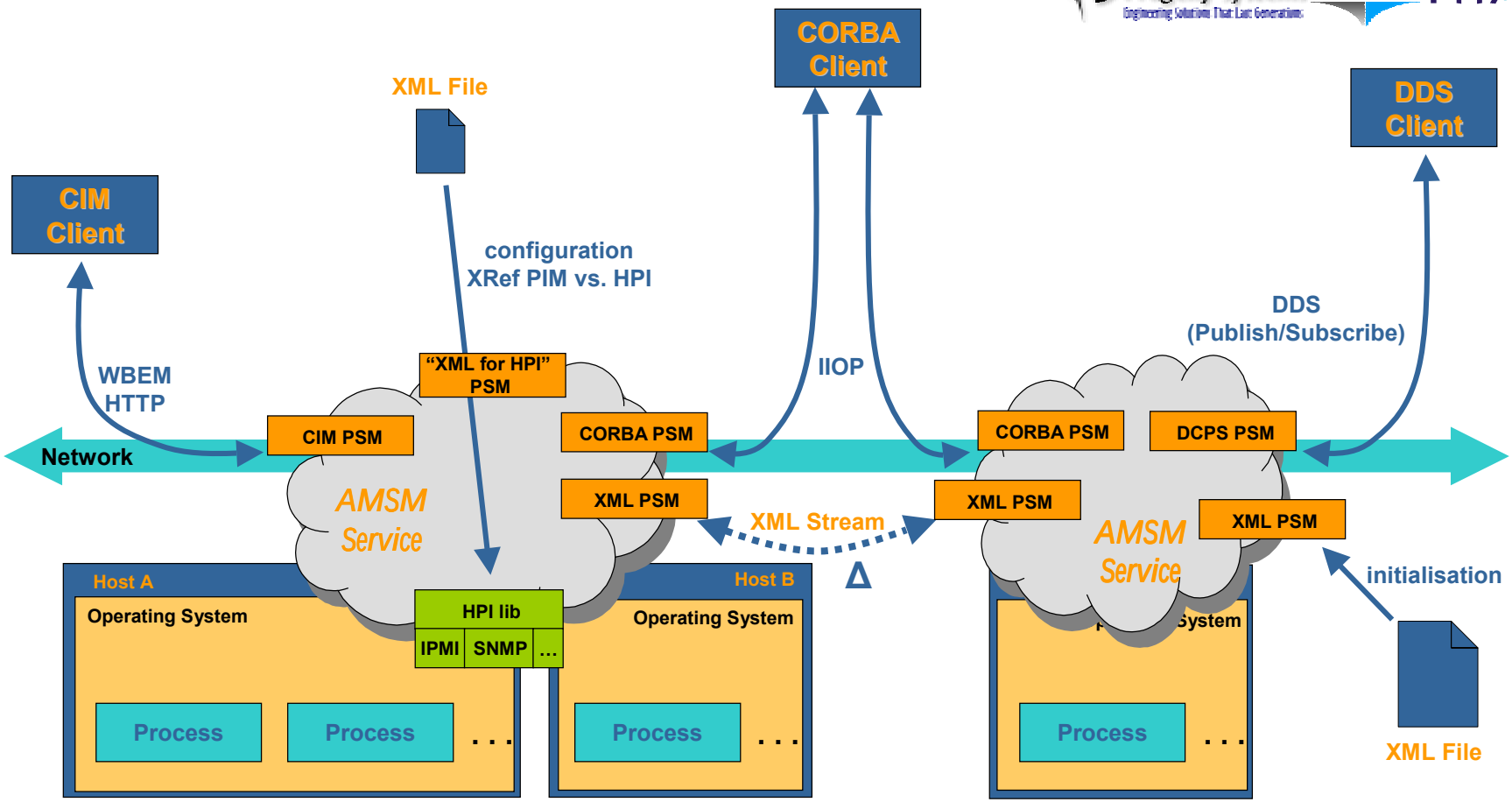
The PSM is divided into two parts:

- The DCPS/f ('/f' stands for full) PSM is intended to be equivalent to the CORBA/IDL and CIM profile, and thus compliant implementations are not required to deploy any elements of the CORBA and/or CIM profiles
- The DCPS/m ('/m' stands for monitoring) PSM is a subset of the DCPS/f PSM, and contains those elements which are required for asynchronous monitoring of states of the different (software and hardware) elements.
  - The DCPS/m PSM is defined to allow other PSMs (CORBA and/or CIM) to import it and use it for asynchronous monitoring tasks.
  - The inclusion of DCPS/m profile in CORBA and/or CIM PSM is not a mandatory, but an optional (convenience) mechanism.
- Typically, the integration will be implemented through the various “subscribe” methods in the CORBA and CIM PSM, which, in case when DCPS/m PSM is included, will result in subscription (registration of interest) to the relevant DCPS topics from the DCPS/m profile.

XML PSM

- Normalize the format of the files which can be read or written by an AMSM service
- The uses of these files by an AMSM service are threefold:
  - May be the configuration files allowing the user of the AMSM service (integrator…) to initialize the service with
    - Software system specifications
    - Application specifications
    - Deployment specifications,
    - A (first) drawing of the network.
  - May be used as a backup capability allowing an AMSM service to be re-started with its previously recorded state.
  - May be used to exchange data amongst multiple instantiations of the AMSM service.

The whole picture



What's next

- Now undergoing finalisation
- Possible scope for future revisions of the standard
  - **dynamic** deployment and creation of software specification
  - **dynamic** hardware discovery
  - **dynamic** creation of software specification
  - multiple **cooperating or competing** AMSM services
    - API to **exchange** data among AMSM services
  - "**low-weight**" profile
    - hardware definition cuts to the minimum
    - no "check" classes …
  - new "Action" type: On Error
  - new specific "Action" classes in order to deploy and run **component packages** (CCM D&C, J2EE)
  - new classes of devices

So what is it?

- A **complete solution** for application management and system monitoring of near real-time (naval) CMS and C4I systems

- Object model based on **worldwide know-how** on naval CMS
  - about 60 specific classes
  - 50 classes extracted from DMTF/CIM standard

- Several kinds of implementation foreseen
  - CIM/HPI : **interoperability with today's management tools**
  - CORBA and DDS : **integration in today's systems**
  - XML : **initialisation and exchange streams**

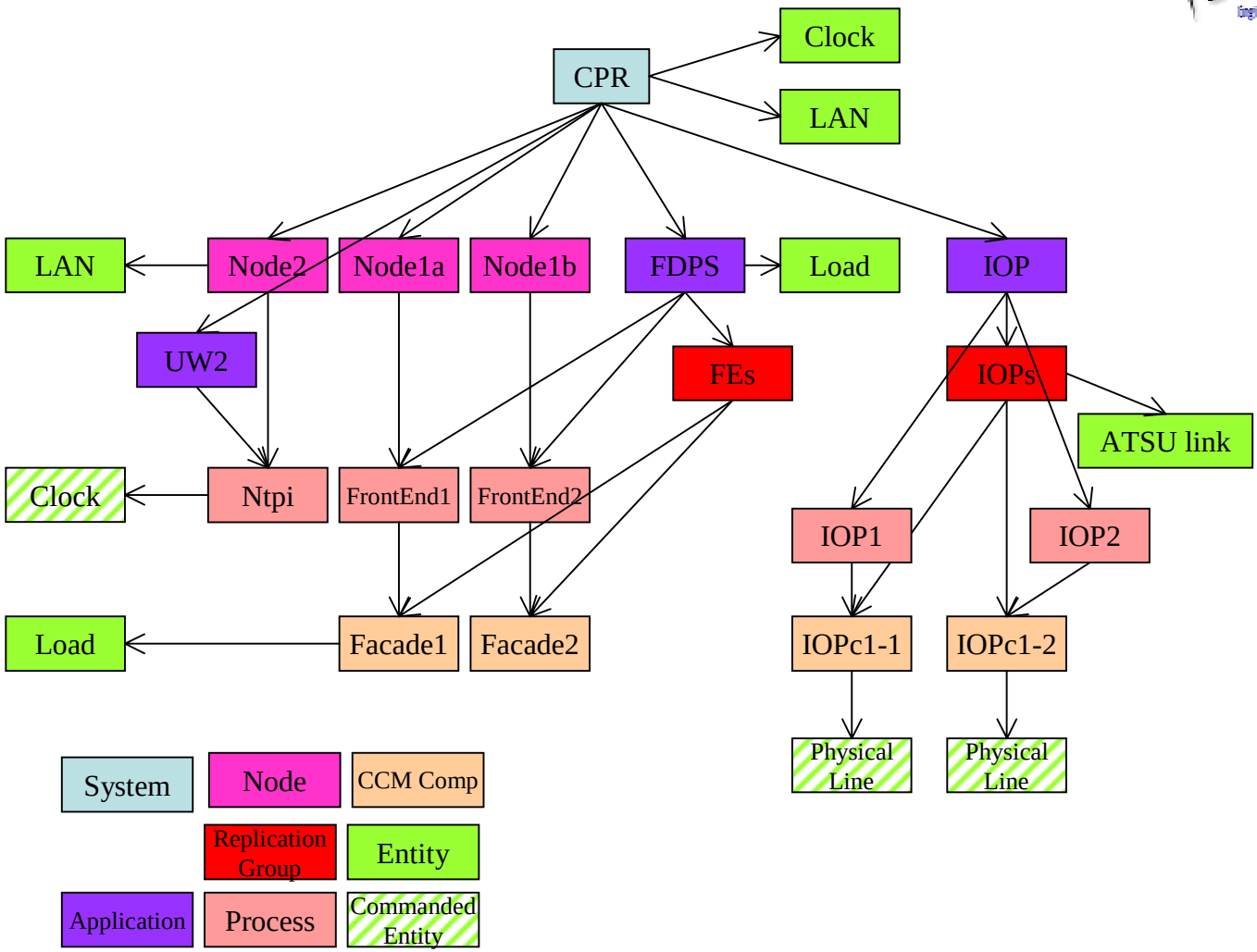
Selex Sistemi Integrati experience

Overview of Required Capabilities for System Management Framework

Expected System Management capabilities:

- System Configuration
  - initial definition of the system configuration
  - runtime modification of system configuration (where applicable)
- System Control
  - start-up and stop of the whole system or of a system subset
  - shutdown and reboot of nodes
- System Monitoring
  - Monitoring of processes
  - Monitoring of nodes
- System State report and Notification
  - get the system state upon request (Administration HMI)
  - be automatically notified when a specific event happens (Observer)

Complex System: a real case



This picture shows the complexity and hierarchy of elements that a System Management framework should be aware of and should be able of:

1) configure,

2) control,

3) monitor,

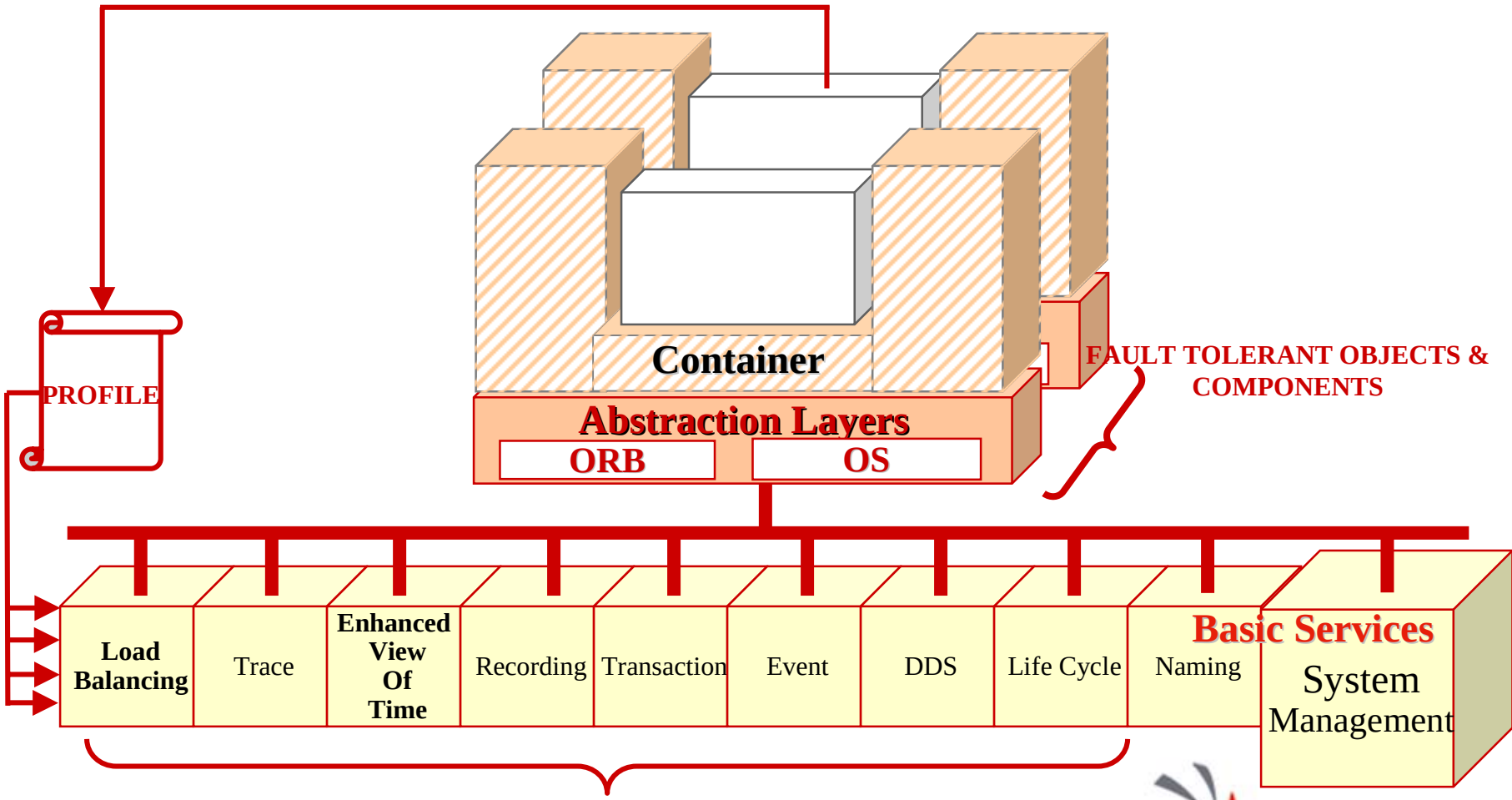
4) generate reports or alerts about.

The Cardamom Solution

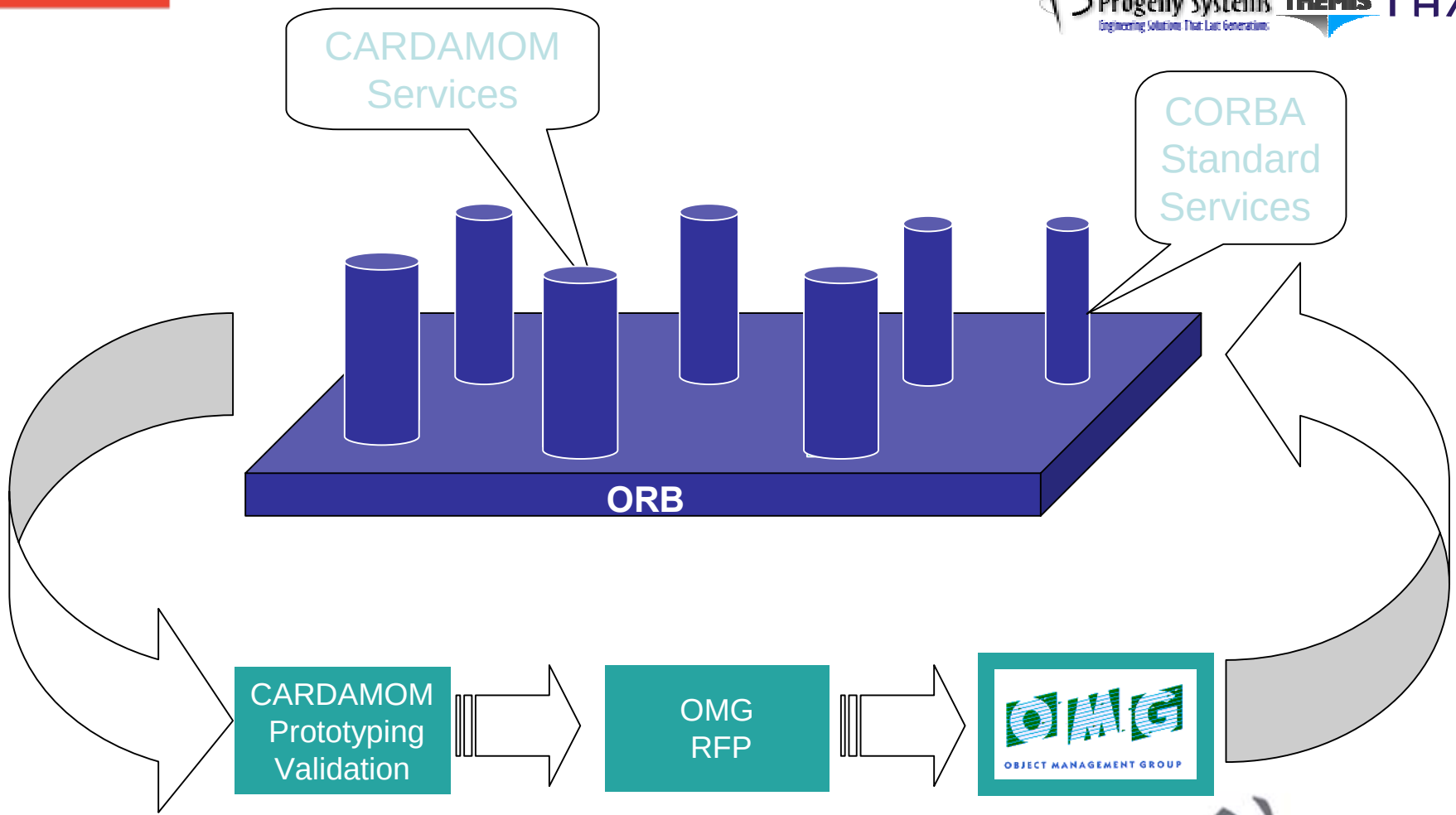
- Cardamom a open source, CORBA based middleware to deploy near real-time application
- Jointly developed by SELEX and Thales
- Addresses the problem to perform AMSM via CORBA

Cardamom vs AMSM

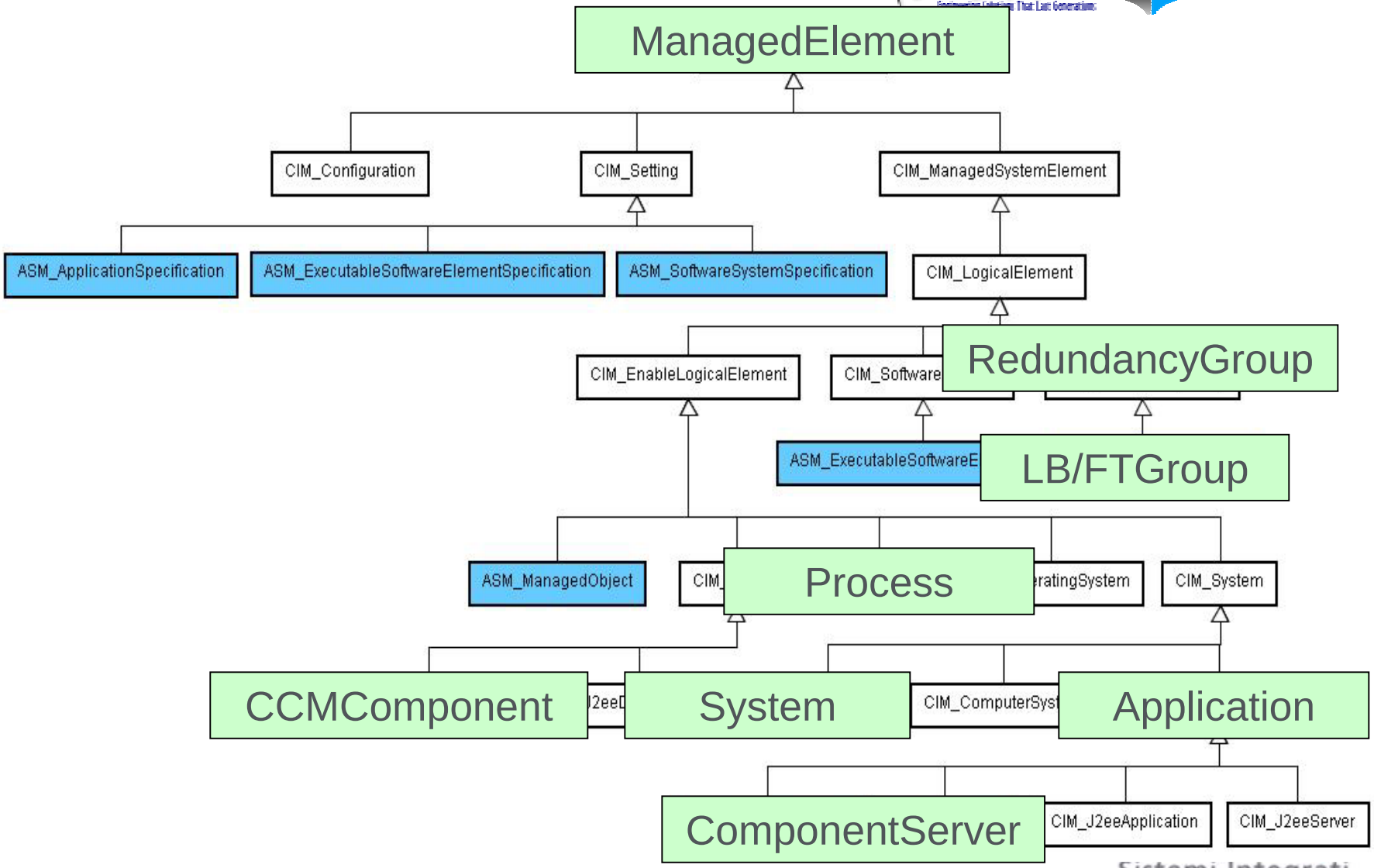
The Big Picture



Cardamom Approach in OMG



What in AMSM



AMSM and Cardamom

- PRO
  - Uses a CORBA-like profile
  - Addresses the AMSM capabilities over Large Systems
  - Provides functionalities to use CCMComponents
- CONS
  - Hardware management

Thanks for your attention

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