A Middleware-agnostic Unified Component Model

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Introduction

- Increasing interest in CBSE for distributed real-time and embedded (DRTE) systems
- Few domain specific component models have been emerging in the past few years, e.g. Autosar, Orocos, etc
- The OMG LwCCM standard is a domain-independent component model targeting DRTE systems
- No single component technology has been widely adopted
DRTE Requirements on component technologies

- Portability
  - Platform, Network and middleware independence
- Resource-constrained
  - Small and lightweight
- Component Modeling
  - Standard modeling language (Ex. UML)
  - Modeling tools support
- Computational Model
  - Execution threads management support
- Real-time features
  - Analyzability
  - Real-time services (Ex: Timers, Schedulers, … )
Lightweight CCM is a profile for the CORBA Component Model targeting resource constrained systems.

- An open, distributed, platform and programming-language independent component model.
- Multiple existing implementations.
- Specifies all the development cycle from design to deployment.
# LwCCM facing DRTE Systems Requirements

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<th>Requirement</th>
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<td><strong>Portability</strong></td>
<td>- programming-language, platform and network independent</td>
<td>- Strong dependency to CORBA</td>
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<td><strong>Resource-Constrained</strong></td>
<td>- Reduced set of functionality wrt. CCM</td>
<td>- Not light enough - Additional CORBA footprint even when not used</td>
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<td><strong>Component-Modeling</strong></td>
<td>- UML profile for CCM</td>
<td>- Lack of mature supporting MDE tools</td>
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<td><strong>Computational Model</strong></td>
<td>- Single and multi threaded components support - Reactive execution model</td>
<td>- No support for RT models e.g. Periodic, Sporadic</td>
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<td><strong>Real-time features</strong></td>
<td>- may be extended by real-time services thanks to Qos4CCM - May rely on RT-CORBA</td>
<td>- No native support to RT components - No standard RT services</td>
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LwCCM remains the most appropriate foundation for DRTE systems, *But, it needs to evolve into a new, simpler and middleware-independent standard that better address the business and technical needs of DRTEs*
Towards a Unified Component Model (UCM)
UCM key requirements

- Middleware-independent
- Simple and modular
- Extensible and Customizable
- Model-Driven Engineering enabled
Middleware independence

- **Container level**
  - Removing CORBA dependency
  - No built-in support to any presumed middleware
  - Deliver middleware flexibility through the connectors

- **Component level**
  - CORBA-independent language mapping
  - Middleware-independent connectors API (ex: Event API, Request/Reply API, Data-centric API, etc)
    - Middleware-dependent connector implementation (ex: CORBA, DDS, etc)

- **Deployment level**
  - Middleware-independent deployment interfaces of the components
  - The component model should be independent from the deployment tool middleware
Middleware independence – how?

- Removing CORBA types from components.idl
  - Cookie valuertype, CORBA::OctetSeq, CORBA::Object

- An UCM component may have only facets, receptacles and extended ports
  - Facets and Receptacles ports express provided and used local interfaces
  - Extended ports are the only means to express middleware-mediated communications

- Removing events ports
  - Providing Event-oriented extended port and connector definition

- Remote interfaces with the deployment tool
  - How to make CCMHome, Navigation interfaces and attributes remotely accessible by the deployment tool?
Simple and Modular

- Reduce dramatically the complexity of current CIF and container programming model
- Enhance extensibility and modularity to reduce footprint
- Define standard profiles to modularize the component model implementation
Simple and Modular – how?

- Only keyless homes supported
- No supported interfaces
- Removing CORBA will simplify the component implementation framework and the container programming model
  - Removing all interfaces/operations related to CORBA references and servants
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Extensible and Customizable

- Open and extensible enough to support the variety of services, middleware and communication paradigms used in DRTE systems
- Ability to integrate new technical services
  - Extensible set of non functional services
- Ability to integrate new connectors and middlewares
- Ability to integrate different execution/computation models for the component, Periodic, Aperiodic, Sporadic, ...
- Ability to evolve to a domain-specific model by customization
Extensible and Customizable – how?

- Extensibility support with the Generic interaction Support and QoS4CCM
- Leveraging Qos4CCM specification to support container extensibility
  - An interception framework for interception-based services
  - A registration framework for “pure” services
- Connectors integration already stated by DDS4CCM
- How supporting different execution models?
MDE enabler

- Standard meta-models for components specification, implementation, packaging, assembly, configuration and deployment
- Promotes MDE tools support
- Tools and vendor independent Models
- Mature and productive modeling tools is key for UCM
MDE enabler – how?

- LwCCM Specifies all the development cycle from design to deployment
- Deriving a middleware-independent UCM meta-model from the CCM meta-model
- Using the Deployment&Configuration specification for components deployment
Concluding Remarks

- DRTE systems still need component technologies
- Openness, extensibility, modeling, platform, network, and middleware independence are key features for the next successful component technology for DRTE systems
- The UCM standard is already on the road to meet these challenges
Thank You!

Any Questions?