MACCIS 2.0 – An Architecture Description Framework for Technical Infostructures and their Enterprise Environment

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Problem area

- Defense increasingly changing
- Need flexible systems
- Assemblies from standard "components"
  - Must respond to requirements
  - Should capture relevant information
  - Should be standardised
- Common architectural description framework that prescribes component-based system models
History

- RM-ODP
- C4ISR-AF
- MACCIS 1.0
- MACCIS 2.0
- Component-based technology
- Enterprise support
- MACCIS 2.0 Enterprise Edition
- MACCIS 2.0 Infostructure Edition

Timeline:
- 1995
- 1997
- 1999
- 2001
- 2002
Objectives

- Create framework that allows users in different communities to create architecture descriptions using a common terminology and set of concepts.
  - The framework should provide means to describe the same as C4ISR AF (and later DoD AF [10-12]), but should add concepts to specifically describe distributed and component-based systems. Civilian and military standards should be used as the basis whenever possible.
  - The Unified Modeling Language (UML) should be used as the language for notation, in addition to structured text. Where more expression power is needed one should opt to utilise the standard extension mechanisms provided by UML.
  - The framework should be simple enough to actually be used, yet have enough expression power to be useful for describing C2IS and C2 architectures.
  - The framework should support both the process of defining and procuring a new system, and maintaining and extending existing systems.
  - The main focus of the framework is to be description of the architectures of information infrastructures and their enterprise environments.
  - The main problem domain is to be Command and Control, Communications, Computers and Intelligence (C4I).
Foundations and content
Components everywhere

Components of the Enterprise

Components of the Infostructure

Telecom and Informatics
Integration by viewpoints & concerns

- Business Viewpoint
- Component Viewpoint
- IT Architect Stakeholder
- Business Stakeholder
- Security Concern
- Business Model
- Component Model
- Security Concern
- Business Security Model
- Component Security Model
- Architecture Description of Enterprise or Infostructure
## Generic structuring rule

<table>
<thead>
<tr>
<th>Concern1</th>
<th>Concern2</th>
<th>Concern...</th>
<th>ConcernN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viewpoint1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viewpoint2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viewpoint...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ViewpointN</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**View** = Viewpoint2 x (Concern1...N)

**Filtered View** = Viewpoint2 x Concern2
Enterprise Architecture Description

M2EE

Viewpoints x Concerns

Models

Context Model
Operational Description
Distribution Description
Security Description

Enterprise Model
Operational Description
Distribution Description
Security Description

Realisation Model
Operational Description
Distribution Description
Security Description

Context
Operational Distribution Security

Enterprise

Realisation
Infostructure Architecture Description

Viewpoints x Concerns

M2IE

Models

Business Model
- Operational Description
- Distribution Description
- Security Description

Requirements Model
- Functionality Description
- Distribution Description
- Security Description
- QoS Description
- Usability Description

Component Model
- Functionality Description
- Distribution Description
- Security Description
- QoS Description

Platform Model
- Functionality Description
- Distribution Description
- Security Description
- QoS Description
Use: C2IS procurement

UML Use Case Model

C2IS Functionality

UML Activity Model

C2 Processes

UML Class Model

C2IS Information Interfaces
Future work
System levels

(Virtual) Enterprise

Business

(Technical) Infostructure

(Technical) Component

Decomposition

System levels
Stakeholders and concerns

Stakeholders & Concerns

Model world

Real world

Enterprise Stakeholder #1

Enterprise Stakeholder #2

C2 context (environment of C2)
C2 enterprise (context of C2IS)
C2IS infostructure (realisation of C2)
Use: Automatic protection

Electronic Security System
- Management
- Supply
- Operation

1. Describe organisational structures, organisational roles and responsibilities.
2. Describe processes performed by organisations and organisational roles.
3. Extract and define process roles for the processes described.
4. Assign process roles to performers and describe alternative/new processes.

Alternative UML Activity Models
- Alternative a
- Alternative b

UML Activity Model
UML Use Case Model
UML Class Model

Electronic Security System
- Management
- Supply
- Operation

Telecom and Informatics
Use: NCW
## M2EE models: Context model

<table>
<thead>
<tr>
<th>Model</th>
<th>Sub-model</th>
<th>Concern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context Model</td>
<td>Overview and Summary</td>
<td>O</td>
<td>The overview and summary model is an informal model that focuses on the purpose and scope of the enterprise, the actors and artefacts involved, and the operational concepts. This model may include descriptions of missions, products, society, authorities and corporations that are relevant to the enterprise.</td>
</tr>
<tr>
<td></td>
<td>Distribution Context</td>
<td>D</td>
<td>The distribution context model describes the geographical locations and distribution of the enterprise.</td>
</tr>
<tr>
<td></td>
<td>Security Context</td>
<td>S</td>
<td>The security context model describes security policies and regulations that enterprise must adhere to.</td>
</tr>
</tbody>
</table>
# M2EE models: Enterprise model

<table>
<thead>
<tr>
<th>Model</th>
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<th>Concern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Model</td>
<td>Vision</td>
<td>O</td>
<td>The purpose of this model artefact is to identify and describe the enterprise vision.</td>
</tr>
<tr>
<td>Enterprise Model</td>
<td>Enterprise Goals</td>
<td>O</td>
<td>The purpose of this model is to describe a hierarchical goal structure that can be agreed upon with the stakeholders so that a set of required high-level processes can be identified for further analysis in the areas of responsibility.</td>
</tr>
<tr>
<td>Organisation Structure</td>
<td>O, D</td>
<td></td>
<td>The purpose of this model is to describe the organisation of the enterprise, both formal and informal structures.</td>
</tr>
<tr>
<td>Stakeholders &amp; Concerns</td>
<td>O</td>
<td></td>
<td>The purpose of this model is to identify the stakeholders and their concerns for the enterprise in order to clarify the scope of the enterprise and possibly resolve potential conflicts of interest.</td>
</tr>
<tr>
<td>Organisation roles &amp; Responsibilities</td>
<td>O</td>
<td></td>
<td>The purpose of this model is to describe organisation roles and corresponding areas of responsibilities in order to relate enterprise activities, enterprise goals, organisation structures and enterprise resources.</td>
</tr>
<tr>
<td>Enterprise Processes &amp; Process Roles</td>
<td>O</td>
<td></td>
<td>The purpose of this model is to describe the enterprise processes and the corresponding process roles required to perform the activities of the processes.</td>
</tr>
<tr>
<td>Enterprise Resources</td>
<td>O, D, S</td>
<td></td>
<td>The purpose of this model is to describe enterprise resources such as information and equipment that are needed by the enterprise processes. This model can be extended with distribution and security descriptions of the resources.</td>
</tr>
<tr>
<td>Role-Distribution</td>
<td>O, D</td>
<td></td>
<td>The purpose of this model is to describe physical distribution of the different business roles, e.g. organisation roles.</td>
</tr>
<tr>
<td>Role-Activity-Distribution</td>
<td>O, D</td>
<td></td>
<td>The purpose of this model is to describe the distribution units with its roles and the activities in each of the units.</td>
</tr>
<tr>
<td>Activity-Distribution</td>
<td>O, D</td>
<td></td>
<td>The purpose of this model is to describe the distribution units and the activities from each of the units.</td>
</tr>
<tr>
<td>Security</td>
<td>S</td>
<td></td>
<td>The purpose of this model is to describe security constraints related to how actors carry out their duties and how information is treated.</td>
</tr>
<tr>
<td>Risk Assessment Model</td>
<td>S</td>
<td></td>
<td>The purpose of this model is to describe the strengths, weaknesses, opportunities, threats, unwanted incidents and risks related to the enterprise.</td>
</tr>
</tbody>
</table>
## M2EE models: Realisation model

<table>
<thead>
<tr>
<th>Model</th>
<th>Sub-model</th>
<th>Concern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Realisation Model</td>
<td>Work Analysis Refinement Model</td>
<td>O</td>
<td>The purpose of this model is to refine the enterprise processes and the enterprise resources in order to identify the activities where infostructures are used and what information objects they manage.</td>
</tr>
<tr>
<td></td>
<td>Infostructure Distribution Model</td>
<td>D</td>
<td>The purpose of this model is to describe the distribution of the information systems and the communication infrastructure of the enterprise.</td>
</tr>
<tr>
<td></td>
<td>Security Threatment Model</td>
<td>S</td>
<td>The purpose of this model is to describe the security measures and treatments that must be provided by the infostructure.</td>
</tr>
</tbody>
</table>
## M2EE symbols

<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
<th>UML mapping</th>
<th>Icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artillery</td>
<td>Ground Track Unit Combat Field Artillery</td>
<td>Class <code>&lt;&lt;OrgUnit_Artillery&gt;&gt;</code></td>
<td><img src="artillery.png" alt="Artillery Icon" /></td>
</tr>
<tr>
<td>Support Electronic Warfare</td>
<td>Ground Track Unit Combat Support Military Intelligence Electronic Warfare</td>
<td>Class <code>&lt;&lt;OrgUnit_SupportEW&gt;&gt;</code></td>
<td><img src="ew.png" alt="EW Icon" /></td>
</tr>
<tr>
<td>Support Explosive Ordnance</td>
<td>Ground Track Unit Combat Support Explosive Ordnance Disposal</td>
<td>Class <code>&lt;&lt;OrgUnit_SupportEOD&gt;&gt;</code></td>
<td><img src="eod.png" alt="EOD Icon" /></td>
</tr>
<tr>
<td>Support Military Intelligence</td>
<td>Ground Track Unit Combat Support Military Intelligence</td>
<td>Class <code>&lt;&lt;OrgUnit_SupportMI&gt;&gt;</code></td>
<td><img src="mi.png" alt="MI Icon" /></td>
</tr>
<tr>
<td>Infantry</td>
<td>Ground Track Unit Combat Infantry</td>
<td>Class <code>&lt;&lt;OrgUnit_Infantry&gt;&gt;</code></td>
<td><img src="infantry.png" alt="Infantry Icon" /></td>
</tr>
<tr>
<td>Support Information Warfare Unit</td>
<td>Ground Track Unit Combat Support Information Warfare Unit</td>
<td>Class <code>&lt;&lt;OrgUnit_SupportIW&gt;&gt;</code></td>
<td><img src="iw.png" alt="IW Icon" /></td>
</tr>
<tr>
<td>Engineer</td>
<td>Ground Track Unit Combat Engineer</td>
<td>Class <code>&lt;&lt;OrgUnit_Engineer&gt;&gt;</code></td>
<td><img src="engineer.png" alt="Engineer Icon" /></td>
</tr>
<tr>
<td>Service Support Supply</td>
<td>Ground Track Unit Combat Service Support Supply</td>
<td>Class <code>&lt;&lt;OrgUnit_ServiceSupply&gt;&gt;</code></td>
<td><img src="service_supply.png" alt="Service Supply Icon" /></td>
</tr>
</tbody>
</table>

...
# M2IE models: Business and requirements models

<table>
<thead>
<tr>
<th>Model</th>
<th>Sub-model</th>
<th>Concern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Model</td>
<td>Enterprise Processes, Enterprise Resources, Distribution, Security, Work Analysis</td>
<td>O, D, S</td>
<td>The business model contains the subset of model artefacts that are relevant to the infostructure we are describing the architecture of. The sub-models listed are those we have found relevant in most cases.</td>
</tr>
<tr>
<td>Requirements Model</td>
<td>Requirements</td>
<td>F, D, S, Q, U</td>
<td>The purpose of this model is to describe the system boundaries, the main actors and their responsibilities, and the main services offered by the system. Requirements related to distribution, security, QoS and usability can also be added to this model.</td>
</tr>
<tr>
<td>User Interface Model</td>
<td>F, Q, U</td>
<td></td>
<td>The purpose of this model is to define the boundaries of the information system towards the user. This model can be extended with quality of service requirements put forward by the users and user interface sketches that addresses system usability.</td>
</tr>
</tbody>
</table>
## M2IE models: Component model

<table>
<thead>
<tr>
<th>Model</th>
<th>Sub-model</th>
<th>Concern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component Model</td>
<td>System Dependency Model</td>
<td>F, D</td>
<td>The purpose of this model is to describe how the system at hand fits into the set of existing systems that are currently in use.</td>
</tr>
<tr>
<td>System Decomposition Model</td>
<td>F</td>
<td></td>
<td>The purpose of this model is to describe the system as divided into different subsystems or components, and how these are related to form a coherent whole.</td>
</tr>
<tr>
<td>Interface Description Model</td>
<td>F, Q</td>
<td></td>
<td>The purpose of this model is to describe the interfaces of a component or subsystem in a manner that the software artefact can be understood and possibly reused. The interface descriptions can be annotated with QoS specifications.</td>
</tr>
<tr>
<td>Structure Model</td>
<td>F, D, S</td>
<td></td>
<td>The purpose of this model is to specify relationships between information objects that must always be true (invariants). The structure model can also be used to describe the distribution and security classification of the information objects.</td>
</tr>
<tr>
<td>Instance Model</td>
<td>F</td>
<td></td>
<td>The purpose of this model is to expresses assertions that must be true at a single point in time. Typically, an instance model is used to specify the states of information objects.</td>
</tr>
<tr>
<td>Processing Model</td>
<td>F</td>
<td></td>
<td>The purpose of this model is to specify how the information can evolve as the system operates.</td>
</tr>
<tr>
<td>System Security Model</td>
<td>S</td>
<td></td>
<td>The purpose of this model is to describe the different security mechanisms that are used in the system.</td>
</tr>
<tr>
<td>Distribution Model</td>
<td>D, Q</td>
<td></td>
<td>The purpose of this model is to describe logical units consisting of a set of subsystems that must be distributed and deployed together. QoS requirements can be described for the communication links.</td>
</tr>
<tr>
<td>Distribution Patterns</td>
<td>D</td>
<td></td>
<td>The purpose of this model is to describe general solutions to RM-ODP defined distribution transparencies or identified distribution concerns for the system.</td>
</tr>
<tr>
<td>Distributed Component Profile</td>
<td>F, D</td>
<td></td>
<td>The purpose of this model is to describe the design specification for the implementation of the system components in a technology-independent manner.</td>
</tr>
</tbody>
</table>
# M2IE models: Platform model

<table>
<thead>
<tr>
<th>Model</th>
<th>Sub-model</th>
<th>Concern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform Model</td>
<td>Standards</td>
<td>F, D, S, Q, U</td>
<td>The purpose of this model is to provide a normative reference list of the standards being used.</td>
</tr>
<tr>
<td></td>
<td>Deployment Model</td>
<td>D, Q</td>
<td>The purpose of this model is to describe the physical relationships among software and hardware components in the system.</td>
</tr>
<tr>
<td></td>
<td>Architecture Extension Model</td>
<td>F, D, S</td>
<td>The purpose of this model is to document non-standard technology-specific extensions that are used.</td>
</tr>
<tr>
<td></td>
<td>Technology Component Profile Model</td>
<td>F, D, S</td>
<td>The purpose of this model is to give a detailed view of the design and implementation of the system components in the chosen component technologies.</td>
</tr>
<tr>
<td></td>
<td>Data Storage Model</td>
<td>F, D, S</td>
<td>The purpose of this model is to describe the implementation of the data model at a level of detail that makes it possible to maintain and change the system implementation as the system evolves over time.</td>
</tr>
</tbody>
</table>