

MINISTRY OF DEFENCE



MOD Architectural Framework

White Paper on Systems View 2 (SV-2): *System Communications Description*

Draft 0.6
27 January 2005

Prepared by:-



Approved by:-

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RECORD OF CHANGES

This page will be updated and re-issued with each amendment. It provides an authorisation for the amendment and a checklist to the current amendment number.

Issue No.	Date	Revision Details
Draft 0.1	02 November 2004	First draft for review
Draft 0.2	08 November 2004	A and C views swapped. Extra documentation added for each view.
Draft 0.3	14 November 2004	New draft incorporating revised introduction and layout
Draft 0.4	21 January 2005	ERM Excerpts removed for release
Draft 0.5	27 January 2005	Final revision prior to release
Draft 0.6	21 February 2005	Amendments to ports in line with meta-model thinking and recommendations from ISSE team
Release 1.0	30 March 2005	Addition of MMM excerpts and minor corrections

Introduction

The purpose of this paper is to describe the initial content and layout of the modified SV-2 view in a way which would allow peer review from stakeholders. With the exception of this section, the rest of the paper follows the layout of the DODAF volume II document. The intention is that this format will be retained and used in the final MODAF documentation, currently scheduled to be published July 2005.

The MOD Architectural Framework (MODAF) is being developed with the intention of providing a rigorous way to specify systems of systems, and is a key enabler to NEC¹. The framework will predominantly be used for acquisition purposes, and a key driver for its adoption is the need to improve interoperability between systems. However, MODAF could equally well be used to analyse existing, operational systems and better enable their integration with other systems (both new and existing).

An architectural framework defines a set of key business and technical information for describing a system of systems architecture. The purpose of an architectural framework is to define the operational context (organizations, locations, processes, information flows, etc.), the system architecture (interfaces, data specifications, protocols, etc.), and the supporting standards and documents that are necessary to describe the system of systems. The information presented in an architectural framework is split into logical groupings – usually known as views. The same system and business elements may be present in more than one view, but the purpose of each view is different and so each provides a different viewpoint on the information.

The most mature and widely adopted architectural framework in the defence industry is the US DoD Architectural Framework (DoDAF). This framework has its origins in the C4ISR community and is seen as a fundamental part of the DoD's drive towards Network Centric Warfare. The MODAF is to be based on the DoDAF specification, and will use many of the aspects of DoDAF without alteration. MODAF will also add a number of new views needed to support MOD-specific processes and structures. In addition, other views will be modified, based on lessons learned by users of DoDAF.

The current SV-2 view in DoDAF does not provide a great deal extra information above what is presented in the SV-2 view. For this reason, it is proposed that the MoDAF specification introduces more rigour and depth to the SV-2 view by splitting it into four parts:

SV-2a System Port Specification – defines the ports on each system, and the protocol / hardware stack that is specified or implemented for each of those ports.

SV-2b System to System Port Connectivity – defines the connections between individual ports and shows the protocols and hardware spec used for each connection.

SV-2c System Connectivity Clusters – defines how the individual connections between systems are clustered to form inter-nodal connections. The SV1 view will compliment this by showing how systems are located at individual nodes.

SV-2d System Connection to Port Connection Matrix – specifies how the system to system connections in SV-1 are realised as port connections in SV-2b.

¹ CM(IS) NEC Next Steps paper of April 2003

System Communications View (SV-2)

Overview of System Communications View

The SV-2 view is split into four views which define the communications links between systems. The views are:

- **SV-2a System Port Specification** – defines the ports on each system, and the protocol / hardware stack that is specified or implemented for each of those ports.
- **SV-2b System to System Port Connectivity** – defines the connections between individual ports and shows the protocols and hardware spec used for each connection.
- **SV-2c System Connectivity Clusters** – defines the bundles of system to system connections that go to make up an inter-nodal connection (see SV-1).
- **SV-2d System Connection to Port Connection Matrix** – specifies how the system to system connections in SV-1 are realised as port connections in SV-2b.

The goal of the four views is to provide a comprehensive specification of how systems are connected, what interfaces each system exposes (ports), the hardware interface used, and the protocols which are transmitted across the interface. Key elements are repeated from view to view, and are also common to the SV-1 view. These key elements are:

Systems
Nodes
Ports
System-to-system connections
Inter-nodal connections

The elements are shown in different perspectives in the different views. In an SV1 view, the systems are logically grouped by the nodes they belong to (or are located at). The SV1 view also shows the connections between nodes, and between systems. In the SV2 views, more information is added – particularly about the ports on each system and the protocols which each port supports. In addition, the SV2 views describe which protocols are supported for specific system-to-system connections.

The SV2 views are key to implementing the MOD's Network Enabled Capability strategy. They enable acquisition specialists and systems engineers to quickly plan and visualise how communications between systems are to be implemented. When MODAF is used as an analytical tool for existing systems, the SV2 views provide a detailed way to document the interfaces exposed by those systems.

System Port Specification View (SV-2a) – Product Description

Product Definition – A *System Port Specification* view specifies the ports on a system, and the protocols used by those ports when communicating with other systems.

Product Purpose – An SV-2a is intended to provide a specification for how each system in the architecture can communicate with other systems.

Product Detailed Description – An SV-2a view is used to fully describe the communications protocols and hardware specifications of each port on a system. The view comprises of one diagram for each system in the architecture. Each port on the system is specified in terms of:

- its name,
- the communications protocols used (e.g. OSI Stack),
- the physical port specification (e.g. the physical element of the stack)

In many cases, a physical port may support more than one protocol in parallel (e.g. a TCP/IP network supporting http, ftp, telnet, etc.). All supported protocols relevant to the architecture shall be shown in the SV2a view. Figure 1 shows an example port specification port 3b and 3c use the same physical port to support POP3 and SMTP for e-mail over TCP/IP.

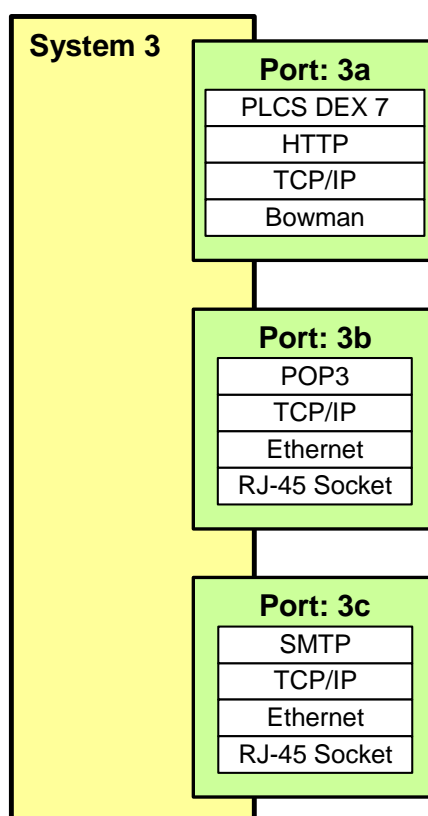


Figure 1 – Example System Port Specification

If a port supports a particular data protocol, supported by an information model, this should also be specified. In Figure 1, Port 3a supports the PLCS DEX 7 XML Schema definition for in-service feedback.

Any protocol referred to in an SV2a diagram must be defined in the TV-1 Technical Standards View

Taxonomies

The MODAF Taxonomy is to be developed in a related project in conjunction with the communities of interest. The Integration Authority is coordinating current work and subsequent ownership will rest with DG Info.

UML Representation

The emerging SysML² standard may offer a solution for SV-2a protocol stacks, but the standard is not yet finalised. Figure 2 shows the current thinking on protocol stacks in SysML:

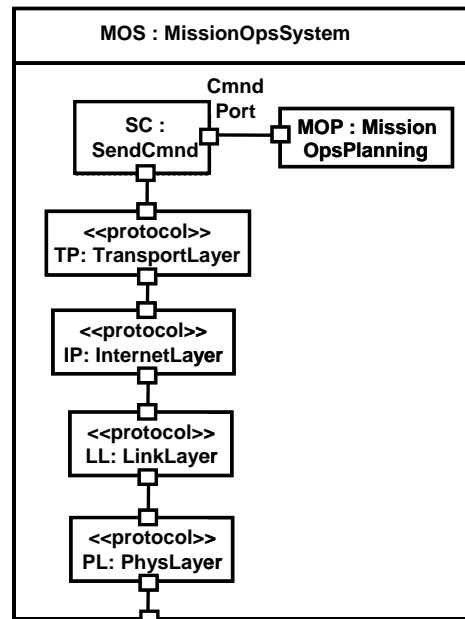


Figure 2 – SysML Protocol Stack (image copyright SysML Partners)

System to System Port Connectivity View (SV-2b) – Product Description

Product Definition – A *System to System Port* view defines the protocol stack used by a connection between two ports. The ports may be on different systems.

Product Purpose – An SV-2b is used to specify the nature of a connection between two systems. This may be an existing connection, or a specification of a connection that is to be made.

Product Detailed Description – The SV2b view comprises of a set of diagrams showing each connection between ports of systems. The architect may choose to create a diagram for each connection in the architecture (recommended) or to show all the connections on one diagram (may be harder for readers to follow). Each diagram shall show:

- Which ports are connected
- The systems that the ports belong to
- The nature of the connection in terms of the physical connectivity and any protocols that are used in the connection.

² See www.sysml.org

The SV-2b view is closely related to the SV-2a view which specifies the available protocols on each port. Any connection specified in an SV-2b view shall conform to the protocols specified on the corresponding port definitions in the SV-2a view. The examples in figure 3 shows how the ports defined in figure 1 are connected to other ports, and the protocols used in that connection.

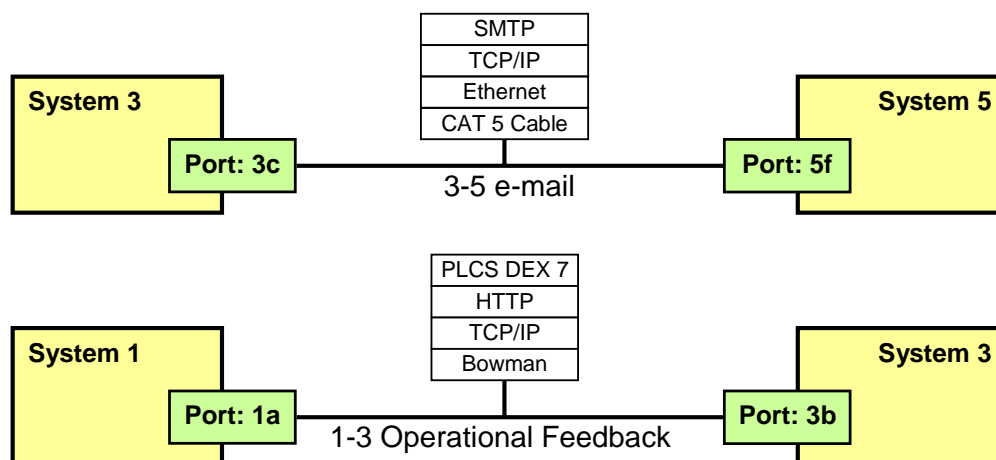


Figure 3 – Example System to System Protocol Stack diagrams.

Any protocol referred to in an SV-2b diagram must be defined in the TV-1 Technical Standards View

Taxonomies

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UML Representation

The emerging SysML standard may offer a solution for SV-2b, but the standard is not yet finalised. Figure 4 shows the current thinking on protocol stacks in SysML:

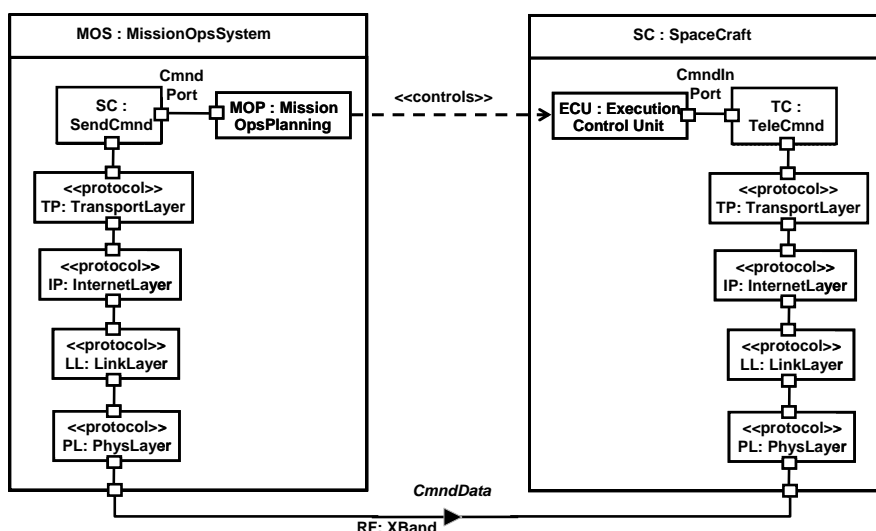


Figure 4 – SysML Connections (image copyright SysML Partners)

System Connectivity Clusters View (SV-2c) – Product Description

Product Definition – A *System Connectivity Clusters* view defines how individual connections between system ports are grouped into logical connections between nodes.

Product Purpose – An SV2c serves to define the connectivity requirements between nodes, and is used for estimating requirements for physical routing and bandwidth.

Product Detailed Description – An SV-2c view provides a different viewpoint on information already specified in the SV1 and SV2 views. It is useful for estimating bandwidth requirements between nodes. An SV-2c view is also useful when planning physical connections and routings between nodes.

The SV-2c view is intended to aid analysis of the connectivity between systems and nodes. In particular it is a useful way of highlighting redundancy issues, showing when too many or too few connections are used between nodes – i.e. there could be cost savings from using a common network, or there may be a need for redundancy to increase reliability.

An SV-2c view consists of a diagram for each inter-node connection. Each diagram shall show:

- The link between two nodes
- The system-to-system connections which run between those nodes
- Which systems are located at each node
- Which ports are used in the system-to-system connections

Figure 5 shows two SV-2c diagrams, with system to system connections encapsulated in a node-link.

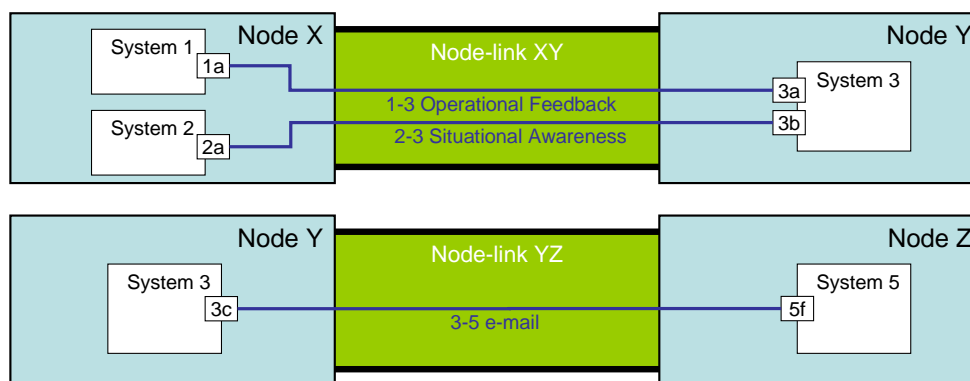


Figure 5 – Example System Connectivity Clusters View

Taxonomies

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System Connection to Port Connection Matrix (SV-2d) – Product Description

Product Definition – A *System Connection to Port Connection Matrix (Sv-2d)* view defines how the connections shown between ports in an SV-2b satisfy the system to system connections shown in an SV-1.

Product Purpose – An SV-2d provides a specification of the connections (port-to-port) required to satisfy the systems connections specified in an SV-1.

Product Detailed Description – An SV-2d specifies how the systems connections from an SV-1 are mapped onto the port-to-port connections shown in an SV-2b view. The system connections shown in an SV-1 are at a lower level of detail than the information shown in an SV-2b. In other words, the SV-1 connections act as a requirements specification for system connectivity, whereas SV-2b fills in the details of how the connections are to be achieved.

An SV-2d can be shown as a matrix (see Figure 6) or as structured text (see Figure 7)

	System 1	System 3		System 5
	1-3 Op Feedback <i>PLCS DEX 7</i> <i>HTTP</i> <i>TCP/IP</i> <i>Bowman</i>	1-3 Op Feedback <i>PLCS DEX 7</i> <i>HTTP</i> <i>TCP/IP</i> <i>Bowman</i>	3-5 e-mail <i>SMTP</i> <i>TCP/IP</i> <i>Ethernet</i> <i>CAT-5</i>	3-5 e-mail <i>SMTP</i> <i>TCP/IP</i> <i>Ethernet</i> <i>CAT-5</i>
Sys1-Sys3	X	X		
Sys3-Sys5			X	X
etc.				

Figure 6 – SV-2d Matrix

<p>System 1 to System 3 Connection Satisfied by 1-2 Op Feedback connection using <i>PLCS DEX 7</i> over <i>HTTP</i> over <i>TCP/IP</i> over <i>Bowman</i></p> <p>System 3 to System 5 Connection Satisfied by 3-5 e-mail connection using <i>SMTP</i> over <i>TCP/IP</i> over <i>Ethernet</i> over <i>CAT-5 Cable</i></p>

Figure 7 – SV-2d Specification in Text

Taxonomies

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UML Representation

SV-2d is not well suited to UML representation.

1.1.1 MODAF Meta Model Support for SV-2

The MODAF Meta-Model defines a UML profile for exchanging information between MODAF tools using the XMI file format. Figures 8 to 11 show the meta model excerpts for SV-2a to SV-2d in that order. It should be noted that the classes shown for one view may be used in several other views.

The classes defined in the MODAF Meta-Model specify the allowable UML stereotypes that may be exchanged in an XMI file. As it is a meta-model, all relationships that feature in the view are also modelled as classes. Rather than define a class for every conceivable item that could appear in a view, the meta-model defines generic classes and allows references to the MODAF Taxonomy. For example, the MOD would be represented in XMI as an Organization stereotype, with a tagged value referring to the element in the taxonomy which says “Ministry of Defence”.

For more information on the use of XMI in MODAF, refer to the document “XMI UML & MODAF”, available from www.modaf.com

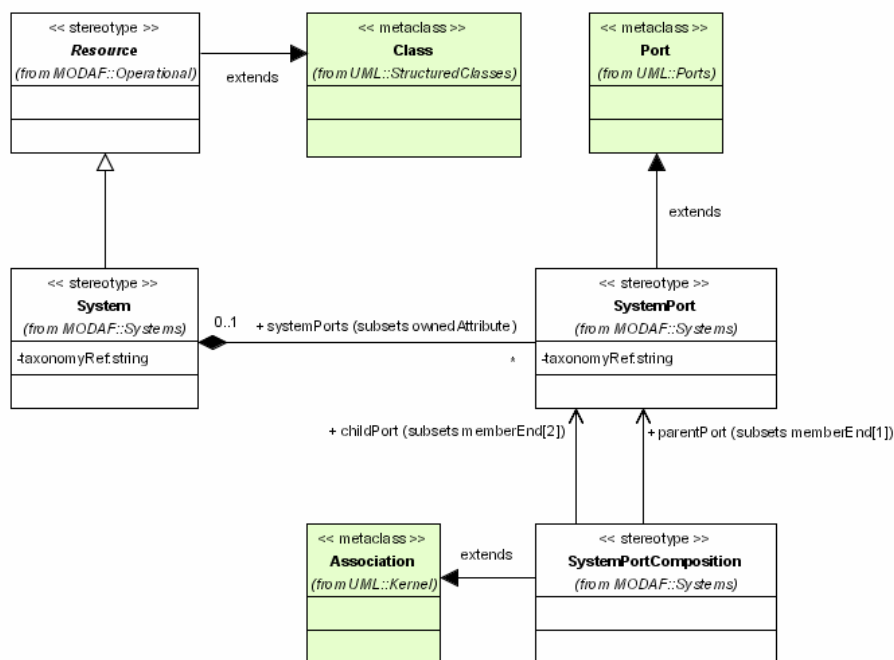


Figure 8 – MODAF Meta Model Excerpt for SV-2a

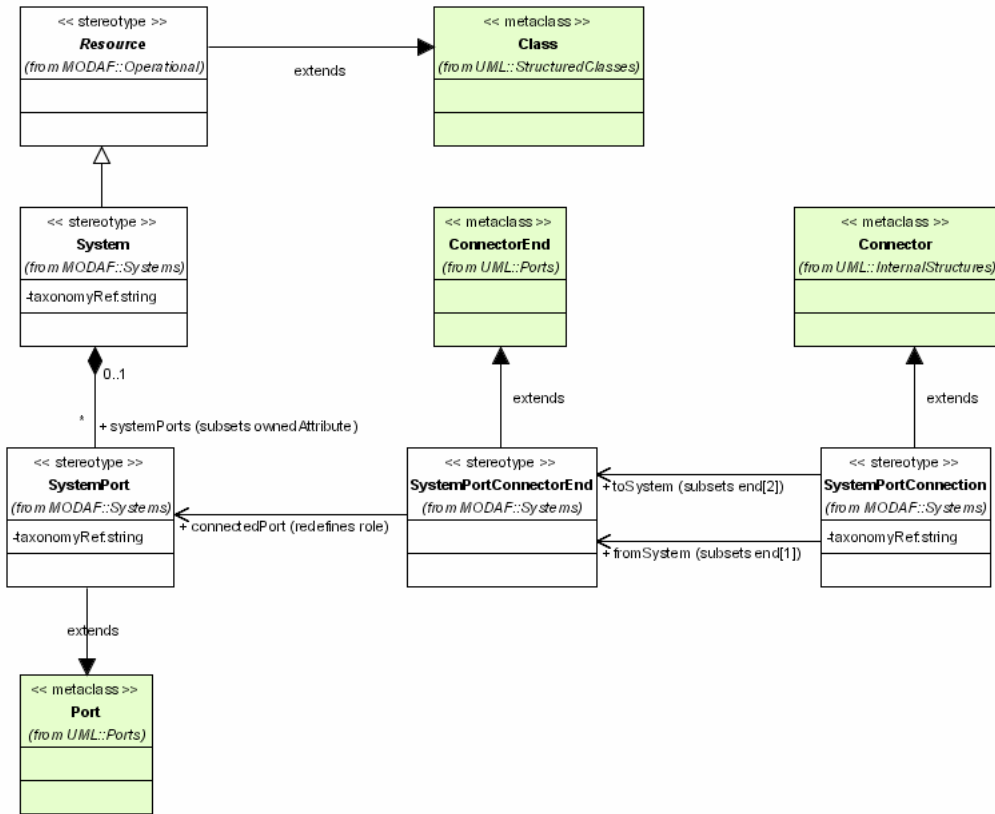


Figure 9– MODAF Meta Model Excerpt for SV-2b

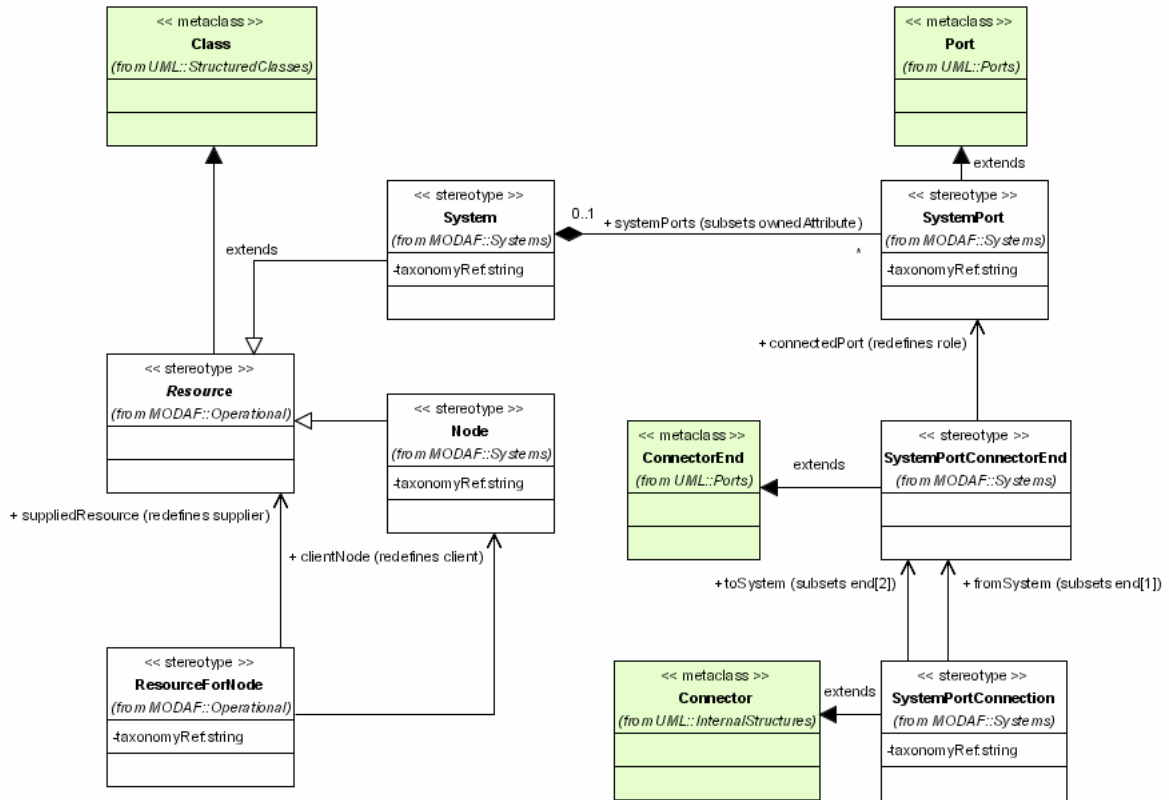


Figure 10– MODAF Meta Model Excerpt for SV-2c

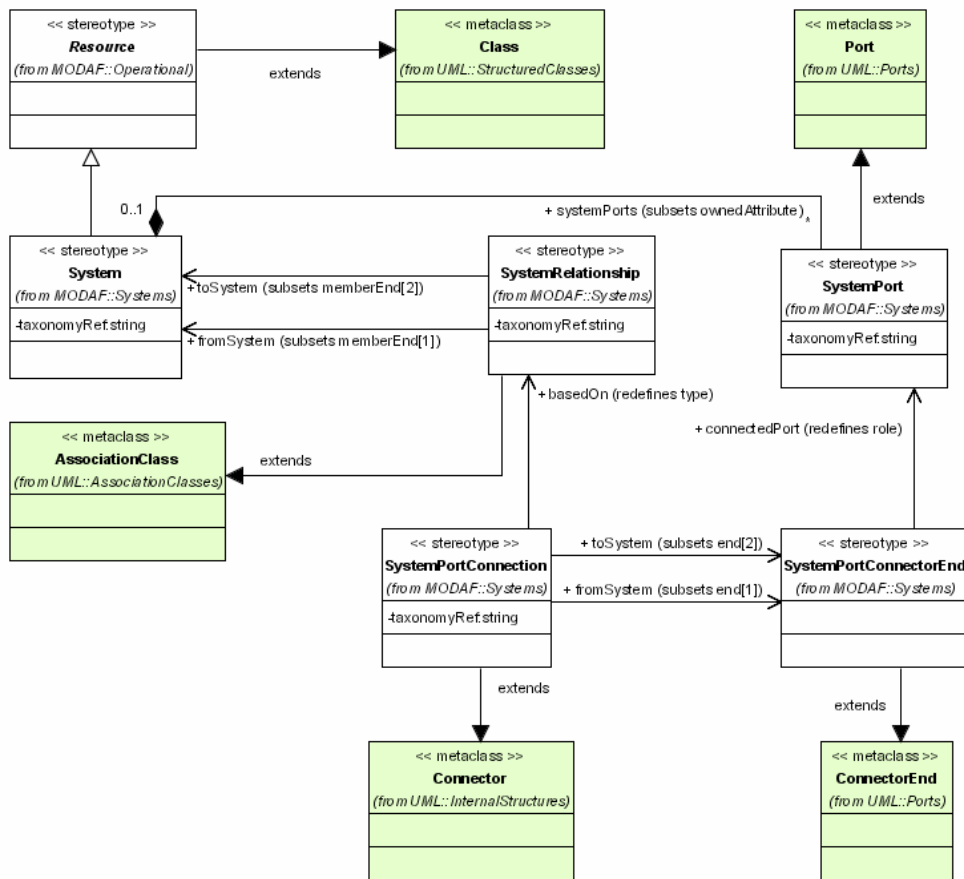


Figure 11– MODAF Meta Model Excerpt for SV-2d

1.1.2 Model Element Definitions for SV-2

Node – A grouping of organizations and systems (and other nodes) for a particular purpose. In SV-2, allowable types of node are “System Node” and “Operational Node”.

Resource – Something that is able to supply functionality, information or material. ABSTRACT.

ResourceForNode – An assertion that a resource is provided to a node.

System – A coherent combination of physical artefacts, energy and information, assembled for a purpose.

SystemRelationship – An assertion of a relationship between two systems. In SV-2, the relationship is only used to assert that a connection can exist between the two systems.

SystemPort – An interface (logical or physical) provided by a system.

SystemPortComposition – Asserts a parent-child relationship between ports, to build a stack.

SystemPortConnection – A connection between two systems via ports on those systems.

SystemPortConnectorEnd – The end of a port-to-port system connection – i.e. the attachment of the connector to the port.

MODAF Partners

This document has been prepared by MODAF partners with contributions from David Mawby (PA Consulting Group), Fariba Hozhabrafkan (Cornwell Associates), Ian Bailey (Cornwell Associates), and David Pile (PA Consulting Group)