A Methodology for Developing Integrated Multi-domain Service Management Systems

Vincent Wade Trinity College Dublin, Mark Sheppard Broadcom Eireann Research Ltd, Michael Tschichholz GMD Fokus, Jane Hall GMD Fokus, David Lewis University College London
Contact: Vincent.Wade@cs.tcd.ie

Abstract

This paper presents a methodology which facilitates the modelling of Inter and Intra Domain (end-to-end) service management systems. In particular the methodology considers the design of the integration of different management service offerings from different service providers. The methodology uses object oriented design and enterprise modelling techniques for system development, implementation and deployment and facilitates the generation of service management system specifications based on ODP viewpoints. The methodology also integrates TINA C service models and service architecture components in developing, implementing and trialling the service management systems. To illustrate this methodology a case study is presented based on the development of subscription and accounting management services where the final delivered management services is based on the integration of provider organisation service and management offerings. The methodology was developed and is being trialled within the PROSPECT ACTS project. This methodology also represents a major contribution to the Network Management Interoperability (NIM) chain recommendations.

1. Scope

With the deregulation of telecommunication network services in Europe, there is increasing interest in telecommunication services being offered by third party service providers over different network service providers. The benefit of such an open service environment would be the 'one-stop-shopping' delivery of customised services to end customers without these customers having to deal with the multiplicity of underlying telecommunication services and network providers. The difficulty with such an environment is the complexity of managing the end-to-end integration of services i.e. integrating co-operative management services spanning individual service and network providers, value added service providers and final end users. This paper describes a methodology which facilitates the modelling and development of integrated end-to-end service management systems for an open services environment. The design facilitates both the design and development of individual management services and their co-operation and interoperation to support source-to-destination telecommunication services. It also customises the use of Open Distributed Processing & TINA C standards for the generation of system specification based on the design models and implementation.

2. Overview of Methodology for design of Multidomain Management Services

In order to capture the idea that the (management) Services can be modelled independently of each other as well as being modelled in cooperation, the System Model is decomposed into the following set of models:

1. *General Model*: This models the **management services working together** to support end-to-end management services. Thus the General Model describes the *inter domain management interactions and interfaces*.
2. *Service Specific Models*: These models describe **the management services of each of the services** in the Open Service Market e.g. management services of VPN, MultiMedia Mail, MultiMedia Conferencing, HyperMedia Information Service. Thus the Service Specific Models describe the *intra domain service management interactions and interfaces*.

The reason for this decomposition is that each tele-service could exist on its own (i.e. is a usable service regardless of its integration with other services) and that the value added tele-services are based on the re-use of such underlying tele-services/connectivity services. This reflects the view of the Open Service Market where a tele-service has its own customers/consumer and that these customers may infact integrate the tele-service with other tele-services and offer a new service to other customers. Thus the General Model captures the end-to-end service and management chain while the tele-service specific models capture the management services of each individual service in isolation.

3. A Service management System Development Design Cycle from which Viewpoint Models can be derived

The ODP viewpoints provide an well established approach to system model description. However, they do not provide a prescriptive methodology that can be followed to developing management systems [ITU-96]. In order to develop both the management services and the value added services (and tele services), the PROSPECT System design cycle has been devised. Rather than developing new modelling or systems specification techniques, the methodology harnesses existing modelling tools and concepts into a design cycle which facilitates the development of the General and Service Specific Systems. The methodology supports each stage of a system design and is capable of developing both the inter and intra domain components of the cooperative management services. Figure 1 illustrates the design cycle, which at its centre is concerned with the design, development, implementation, testing & trialling of inter/intra domain management system.

Unlike previous design methodologies which have attempted to specify design steps which allow the generation of one ODP viewpoint from a previous viewpoint, the PROSPECT design cycle sees the development of a full Object Oriented Model as central to the overall design process. The design cycle provides a structured way of developing, implementing and testing these object designs. It specifies the design sets from developing multi domain business models (which include representation of stakeholders, responsibilities, roles, obligations and activities), use case definition analysis, object identification and relation representation, definition of computational components (with an emphasis on assisting the definition of reusable components), distributed placement of computational components, definition of platform architecture and platform services (e.g. Common Object Services used by component objects), generation of test sets and trial execution. The methodology is focused on developing service management systems and identifies candidate re-usable components offered by various standardisation bodies e.g. TINAC (S.A. components), OMG (Common Object Services).

The design cycle also identifies key places in the development process from which specific viewpoint models can be generated and prescribes the contents of each (of the 5 ODP) viewpoint model specifications and illustrates how these can be generated. The information needed to generate the specifications are a subset of the information needed to design and implement the actual systems.

The design cycle ensures the consistency between each stage of the system model development and therefore provides a means of tracing the interrelationships between the ODP viewpoints. The benefit of generating the ODP viewpoint specifications is that a clear separation of the different aspects of the system can be captured. Also it provides a structured means of comparing different subsystems and services. This design cycle is iterative, allowing progressive deepening of the system models (General & Service Specific) by iterating several times through the design cycle.

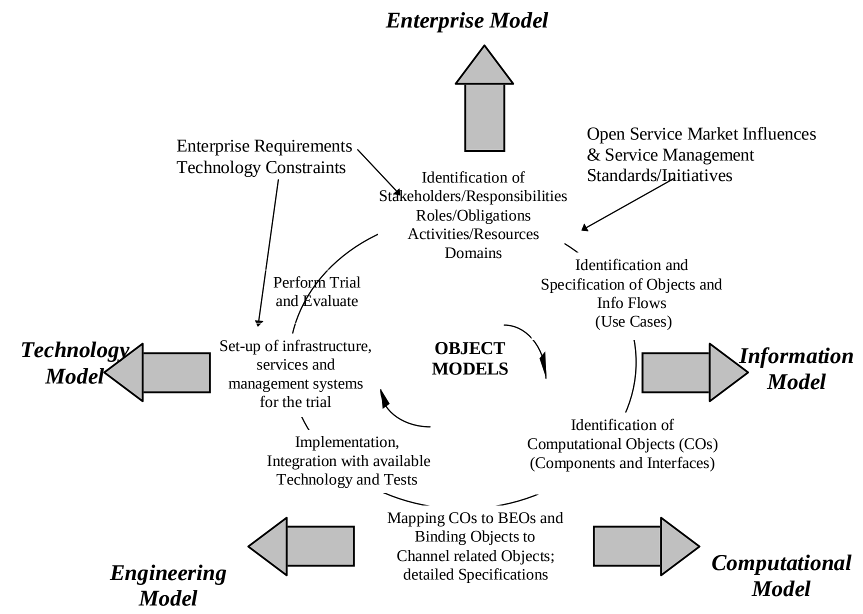

Figure 1: PROSPECT Design Cycle

3.1 System Modelling Techniques and Notations

Modelling concepts of the *Organisational Requirements Definition for Information Technology* [ORDIT], PREPARE [PREP-96] and PRISM [PRISM-96] projects have been combined to develop a suitable method for the system design.

The System Model is developed using several modelling notations and interface definition languages. The principle modelling techniques used in the modelling methodology are Object Modelling Technique (OMT) [Rumb-91], ORDIT, and Interface Definition Language/notation (IDL). The system model has also been influenced by the TINA-C Service Architecture [TINAC-94]. This paper illustrates how the design cycle can be followed to produce the system model and describes how each of the viewpoints can be specified. Each viewpoint specification uses the most appropriate notation for that viewpoint's characteristics.

4. Guidelines for specification of ODP based System Models

The complete paper will provide definitions of the components of the various system viewpoint specifications. It will prescribe the elements from the design cycle which must be specified in the Enterprise, Information, Computational, Engineering and Technology viewpoints and the notations used for those specifications. These notations are summarized below.

Enterprise Model	ORDIT Method to describe (in text form) - Stakeholders, - Relationships, - Roles, - Obligations, Activities & Resources OMT Object Notation diagramatically these stakeholders & named relationships
Information Model	Use OMT Object Model diagrams e.g. class,

	aggregation, associations, generalisation, etc…..
Computational Model	Identify Computational Object Identify Jacobson USE CASES (text based descriptions of user interactions) describe what actions need to be carried out by the Object Classes to satisfy these USES (Use Event traces) to describe and detail the interactions between OBJECT CLASSES
Engineering Architecture	Block diagram for describing platform Architectures
Technology Model	Block diagram for describing reference configuration (protocol reference point identification between service specific management platforms) & technologies used in implementation

5. Iterating the Inter Domain System Development Methodology

This section will illustrate the design decisions and experiences encountered when applying the design cycle. The example for the illustration is the design of multi domain management services for a tele-educational service (which is itself composed of several teleservices e.g. Hypermedia information service, video conferencing service) which makes use of connectivity services (VPN service and ATM service). The example is based on the work of the PROSPECT ACTS project ACT 052. The systems developed using this methodology are currently being trialled within the PROSPECT project.

Business Model

The methodology for deriving the PROSPECT business model is based on that of the ESPRIT project ORDIT (Organisational Requirements Definition for Information Technology). ORDIT developed an model with roles, responsibilities and obligations that can be used for establishing relationships between the various parties involved in a socio-technical system. The first is the definition of organisational requirements. It can be used at a number of different levels of abstraction and is iterative, allowing for revision and growth [OPM] [MOTT]. Figure 2 illustrates the contractual relationships between the stakeholder organisations for the case study.

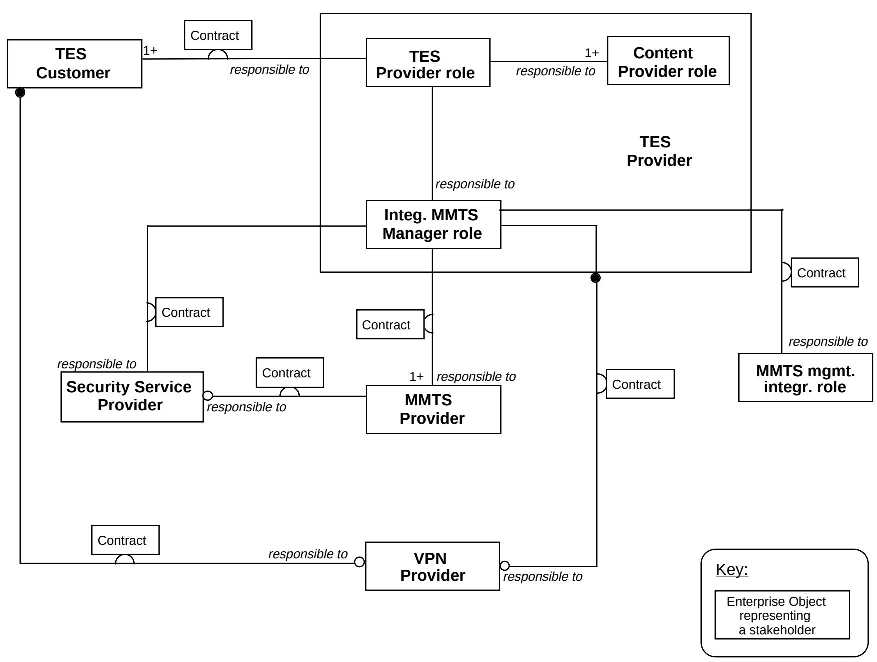

Figure 2 Contractual Relationships between PROSPECT Stakeholder Organisations

The full description of the modelling of the Business model will be provided in the complete paper. The complete paper will also provide an analysis of the issues encountered in developing the object models for inter and intra domain management systems and give guidelines as to the development of reusable components which support these objects. For accounting management and subscription services, the case study will illustrate the choices of re-usable components taken from appropriate industry initiatives and standards bodies e.g. service architecture components and discuss how these were customised to provide solutions for the specific solutions required for the case study management systems. The case study will describe the criteria for choosing a platform architecture implementation and illustrate the platform services which needed to be supported to realise the management system implementations. The case study will also illustrate the testing and trailing procedures needed before final evaluation of the completed systems. The platform issues encountered in vertical integration of the various layers of services as well as the horizontal integration issues involved with integration of the management services on a managers desktop will also be discussed.

6 Conclusions and Further Work

The methodology has concentrated on the design and development process for service management systems. The methodology also provided a means of generating ODP based viewpoint specifications at various stages of the design process. The methodology is being used to develop subscription and accounting service management systems which span multiple administrative and technology domains. The methodology has be very useful in refining the PROSPECT system designs and carrying this design through to implementing, testing and the trialling stages.

References

[NMF-BPM] *A Service Management Business Process Model*, Network Management Forum, Morristown, NJ, 1995.

[CORBA-95] *The Common Object Request Broker: Architecture and Specification*. OMG Document Number 92.12.1, Revision 1.1. Object Management Group, 1992. **And:** *Object Request Broker 2.0*. Object Management Group, 1995.

[ITU-96] Text of draft recommendation G851-01, Study Group 15, ITU June 1996

[Jacob-92] *Object-oriented software engineering: a use case driven approach,* Jacobson Ivar ACM Press Wokingham Addison-Wesley 1992

[Lewis-95] Experiences in Multi-domain Management Service Development, D. Lewis, T. Tiropanis, L.H. Bjerring, J. Hall, Proceedng of the 3rd International Conference on Intelligence in Broadband Services and Networks, Heraklion, Crete, Greece, October 1995, ISBN 3-540-60479-0

[M.3010-92] *Principles for a Telecommunications Management Network*, ITU-T Recommendation M.3010, 1992.

[ODP-94] *Reference Model for Open Distributed Processing*, Part 1 Overview and Part 2 Foundations. ISO/IEC 10746-1 (DIS) and 10746-2 (IS) ITU-T X901 and X902. 1994

[ORDIT-93] *ORDIT* process manual, version 0.5 December 1993

[Pasch -94] *Management of the BERKOM multimedia collaboration service*, proceedings of the fifth IFIP/IEEE International Workshop on Distributed Systems: Operations and Management, Stephen Paschke, 1994

[PREP-96] *'Modelling and Implementing TMN based multi domain management,* PREPARE Consortium, J Hall (ed) 1996

[PROS-95] *The Initial Requirement Analysis*, ACTS Project PROSPECT AC052, technical report project deliverable, ac052/dlt/wp2/sp/p/002/b1 submitted to ACTS research Programme central office, December 1995

[PRISM-96] *Succeeding in Managing Information Highways*, PRISM Consortium, Springer Verlang, Berquist, A. 1996

[Rumb-91] *Object Oriented Modelling and Design*, J Rumbaugh et al, Prentice Hall 1991.

[TINAC-94] *TINA-C Service Architecture*, TINA Baseline document TB_MDC.018_1.0_94, Berndt H, Minerva R,

[TINA-93] *Computational Modelling Concepts*, TINA Baseline document TB_A2.NAT.002_3.0_93, December 1993

[TINA-95] *Information Modelling Concepts*, TINA Baseline document TB_EAC.001_1.2_94, H. Christensen, E. Colban, Version 2.0, April 1995

[Wade-96] *Supporting Tele-Education Service in an Open Service Market*, V Wade, M Riordan, W Donnelly, Tele-Ed/Ed-Media 96, Boston 1996