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Engineering a Co-operative Inter-Enterprise Management Framework Supporting Dynamic Federated Organisations Management

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ABSTRACT

This deliverable presents the final FORM inter-enterprise management system model. It presents the models, which are the final results from the design and development of sets of management services (contracts) and components (building blocks) based on the concepts from the ODF especially system development methodology and logical architecture. The material presented in this deliverable should be seen as a view of the final system prototype, covering specification and development of models according to FORM methodology. All models are specified in a technology independent manner, primarily using UML.

KEYWORDS

Application of the FORM Methodology, Inter Enterprise Service Management, Business Model, Reference Points, Reference Architecture, System Model, Use Case Model, Building Block Contracts, External Information Model.

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Executive Summary

The management of telecommunications services and networks has undergone a major paradigm shift and so has the task of creating the management systems themselves. The challenges of designing, building, integrating and maintaining large scale enterprise management systems are great.

This deliverable presents aspects of the Inter-Enterprise Management System model that is based on the Open Development Framework (ODF), which also has been developed within FORM. An Inter-Enterprise Management System comprises of management services supporting dynamic federated organisations performing businesses across IP based Intranets, Extranets or Internets, such as business-to-business e-commerce or application service providers and their customers. The ODF is based on best practices derived from the software development industry, the work of standards bodies and results from previous European funded projects.

This document presents the models, which are the final results from the design and development of sets of management services (contracts) and components (building blocks) based on the concepts from the ODF especially system development methodology and logical architecture. The material presented in this deliverable should be seen as a view of the final system prototype, covering specification and development of models according to FORM methodology. All models are specified in a technology independent manner, primarily using UML.

The result is a set of system models, which consists of two main parts (i) a model based on business processes, which are used to identify building blocks and specify their contracts i.e. the model focuses on development of new potentially reusable elements. (ii) a model based on business processes, which are mapped to existing contracts, which in turn are mapped to existing building blocks, i.e. the model describes assembly of a system using existing reusable elements.

The deliverable specifically documents:

- A general business model for a system providing an information retrieval service based on secure, guaranteed quality of service IP VPN.
- Business models for business processes spanning one or more of the TOM Fulfilment, Assurance and Billing areas.
- Reference Model for an Inter-Enterprise Management System.
- Catalogues of reference points, contracts and building blocks developed within FORM.
- External information model.
- XML Schema for Building Block Contract specification.
- Specification of Contracts used in the design of Building Blocks.

1 Introduction

1.1 Purpose

The aim of this document is to present the final FORM system models, which demonstrates the application of the FORM Open Development Framework (ODF) [FORM D9] to the Inter Enterprise Service Management Domain.

The FORM system models cover the Reusable Elements part of the ODF. FORM systems modelling results in catalogues of Reusable Element such as (a) Reference Points describing interfaces between enterprises, and (b) Building Block Contracts describing interfaces of reusable system components. The FORM system models apply the concepts of the Logical Architectures, which is another part of the ODF.

The FORM methodology [FORM D12], which is another of the four portions addressed in the ODF, has been applied directly for guidance in specifying the FORM system models. Thereby the FORM system models show the application of the FORM methodology. Evaluation of the system models and evaluation of the application of the FORM methodology are covered in [FORM D10].

1.2 Scope

The scope of this document is to cover the final results from the application of concepts and principles described in FORM ODF and especially the FORM methodology. The domain chosen for this application is the Inter Enterprise Service Management domain, and the business processes described by TeleManagement Forum [TOM].

The system models, covered in this deliverable, are purely behavioural model driven [1] and technology neutral. Architectural issues such as e.g. integration approaches between building blocks and how to enable the fulfilment of the non-functional requirements are sketched in the Technology Architecture, which is the fourth part of the Open Development Framework [FORM D9]. The implementation specific issues such as the design of prototypes, and the evaluation of the system models, are covered in Deliverable D10 [FORM D10].

1.3 Document Structure and Overview

D11 consists of a main document (this document), five supplementary annexes, and a set of Building Block Contract specifications that are delivered online using Web based technology [FORM Contracts].

The main document gives a short introduction to the ODF in Section 2. The system modelling approach is described in Section 3. Section 4 covers a general description of the FORM Business Model. Section 5, 6, and 7 demonstrate the application of the FORM Methodology "Business Process Driven System Modelling Guideline" to the Inter Enterprise Service Management Domain. Section 8 contains the External Information Model showing the contracts specified for the system. Section 9 contains the Reference Point Catalogue, and Section 10 contains the Building Block Contract Catalogue. Section 11 covers the conclusion. In section 12 an Acronym List for the entire deliverable is included. The Reference list is presented in Section 13.

[1] Behavioural driven means mainly driven by the functional requirements, and less by non-functional requirements as e.g. performance, and availability.

Annex A, B, C and D contain the system models that demonstrates the application of the FORM Methodology “Building Block Development Guideline” to the Telemanagement Forum Processes Fulfilment, Assurance and Billing. Annex A covers the Fulfilment Process for the Inter Enterprise Service Provider Domain. Annex B covers the Fulfilment process for the VPN Provider Domain. Annex C covers the Assurance Process and Annex D covers the Billing Process. Finally Annex E covers the XML Schema for Building Block Contract specification.

2 Open Development Framework

2.1 ODF Overview

2.1.1 Overview

The communications industry has long developed Operational Support Systems (OSSs) that employ individual management systems from separate vendors in an integrated fashion. This integration has relied heavily on the definition of open interfaces between systems, particularly at the network and element management levels. Deregulation, and the resulting emphasis on highly competitive value-added services and fluid multi-organisation value chains, has resulted in pressure to develop OSS that flexibly support business process integration within and between provider organisations. Competitive pressure generates an increasing need to develop the required flexible and integrated management systems quickly and at low cost. In other software dependent sectors, component-based development is being proposed as a way to reduce cost and increase reliability and flexibility through reuse of off-the-shelf software components. Applying this to the communication management sector, the size and complexity of OSSs means that system builders will continue to source components from separate vendors. This, in addition to the need to integrate systems across organisational boundaries, will require an open approach to integrating components and the services they provide. The FORM project therefore proposes that a common framework is required to develop and exploit open interfaces in developing component-based management software. This is termed Open Development Framework (ODF).

The ODF has the goal of supporting the construction of management systems from separately sourced software components. To help refine this goal a set of stakeholders has been defined which represent the principle organisation types involved in developing management systems from components.

- **Standards Bodies**, which produce the industry agreements that underpin interoperability and integration of separately sourced software components.
- **Independent Software Vendors (ISV)**, which produce and market software components.
- **System Integrators**, which produce management system constructed from separately sourced software components, including ones that are developed internally.
- **Service Providers**, which possess the business requirements for management systems and operate them.

There may be occasions where organisations take on more than one role represented by these stakeholders, e.g. a large service provider may produce standards for procurement purposes and may have internal divisions producing management system or components. However, these stakeholders provide a relatively simple but comprehensive model for the market interactions the ODF must address. These interactions include:

- The use of standard specifications by Service Providers for procurement, by System Integrators and ISVs for software development and by other Standards bodies.
- The use of software components from one or more ISVs, as well as software components developed internally, for management systems development by System Integrators.
- The procurement by a Service Provider from a System Integrator of a management system that must integrate with management systems from other sources, already present in its own OSS and those of other Service Providers.

Considering the needs of these stakeholders, the scope of the ODF is further refined by the following aims:

1. Support common mechanisms for the communication of products (both spec-ware and software) between these stakeholders.
2. Ensure the processes for developing the products exchanged between stakeholders converge with industry best practise such as model-based development and the use of UML.
3. Support the management of products once they have been made available by a stakeholder in order to facilitate their later reuse by others.
4. Encourage the separation of techniques for integrating between different technologies from those for integrating between different models.

The resulting ability to readily exchange models, related to software interoperability and integration, in a non-proprietary form is regarded as key to enabling an open market in off the shelf components.

The ODF does not explicitly aim to support automatic model checking or code generation, but does aim to exploit the current capabilities of widespread modelling tools, e.g. Rational Rose. Additionally, it is not an aim to endorse any particular technology, though guidance is given in the issues related to technology selection.

The ODF is structured into four portions: a Logical Architecture, a Development Methodology, a Technology Architecture and a Set of Reusable Elements. This breakdown follows a pattern observable in other management related frameworks, e.g. ITU-T's Telecommunications Management Network architecture, the OMG's Open Management Architecture etc.

The concerns addressed by the four portions of the Framework are:

- **Logical Architecture:** The Logical Architecture describes the structural concepts of the ODF and their relationships. This is described in terms of a meta-model that is used to ensure consistency of the models generated when applying the guidelines present in the rest of the ODF. The core structural concept is the software Building Block (BB), which is an atomic unit of software deployment and management. A BB implements a number of Contracts that are the sole medium via which BBs interact with their environment. Management systems are built primarily from assemblies of BBs. Systems can be modelled at a business level in terms of Business Processes and Business Roles. Reference Points exist between Business Roles and are realised through Contract implementations. To promote their reuse, a Contract may be described in a technology neutral format which can be transformed to one or more technology specific versions for implementation in BBs. Contract definitions also include specifications of the information passed via the Contract by reference to an explicit information model.
- **Development Methodology:** The Development Methodology describes the processes and notations needed to design Contracts, develop Building Blocks and assemble Management Systems, which conform to the ODF. The primary modelling notation used is UML, though XML is used for packaging UML with other model formats in Contract and BB specifications. The methodology integrates a number of existing modelling techniques such as use case modelling, business process modelling and Jacobson's [Jacobson 1992] [Jacobson 1999] analysis modelling plus the variety of other modelling approaches supported by UML. The Rational Unified Process (RUP) [Kruchten 2000] is used as a partial template to integrate these techniques. The Methodology contains two Guidelines, one for the development of Building Blocks, and the other for the development of business processes into management systems that are mostly assembled from of Building Blocks.
- **Technology Architecture:** The Technology Architecture addresses how the concepts expressed in the Logical Architecture can be implemented using individual technologies. It diverges from the technology related portion of most other frameworks in that it does not attempt to promote the use of a specific technology or integration technique. Instead, it addresses of issues to be considered when making a technology selection for a specific Management System, a set of Contracts or a group of BBs. This includes issues related to functional capabilities of technologies (e.g. data handling capabilities, security, transaction support) and non-functional capabilities (e.g. availability, scalability).

- **Reusable Elements:** This portion of the ODF is the repository for reusable products that result when the ODF is applied to a particular application domain, e.g. the IES Management domain addressed in FORM. The principle types of reusable entities are: Business Role definitions; Reference Point specifications; Contract specifications and their grouping into BB Specifications and BB implementations. Other types of reusable elements, such as policy and business process definitions are also being investigated.

The ODF is intended to be generic and extensible. The ODF has a core generic part, which in FORM is extended with specific to a domain selected for applying and evaluating the ODF within the project. This domain addresses a service chain involved in providing a service, termed the Inter-Enterprise Service (IES), which enables enterprises to create, reconfigure and dissolve business collaborations rapidly and flexibly. The IES domain addresses how an IES Provider may manage the dynamic relationships and the quality of service of electronic business interactions between groups of customer enterprises, the Application Service Providers (ASPs) they use and the Internet Service Providers (ISPs) providing communications infrastructure. This exploit the use of end-to-end network QoS and security management service offered by a VPN provider.

This generic part consists primarily of the Logical Architecture, the Development Methodology and aspects of the Technology Architecture. The IES specific part consists of the set of Reusable Elements developed for the IES domain in FORM. It is anticipated that future users of the ODF will extend the generic part to other domains, e.g. optical network management or mobile service management, and possibly reuse some of the IES Management specific parts also.

2.1.2 Further information

The ODF is described with some further detail in [FORM D9]

2.1.3 Relationship to this document

This document represents the output of the application of the ODF to the IES Management problem domain. The Contract, Building Block and Reference Point Catalogues presented in this document represent the Reusable Elements generated by applying the ODF to the IES Management domain. They, in combination with the Logical and Technological Architectures presented in [FORM D9] and the Development Methodology presented in [FORM D12], make up the IES Management Framework. In addition, this document presents how the Reusable Elements have been used in Trials within FORM to develop Management Systems addressing specific business process flows within the IES business area. The relationship of this deliverable to the ODF is depicted in Figure 2-1.

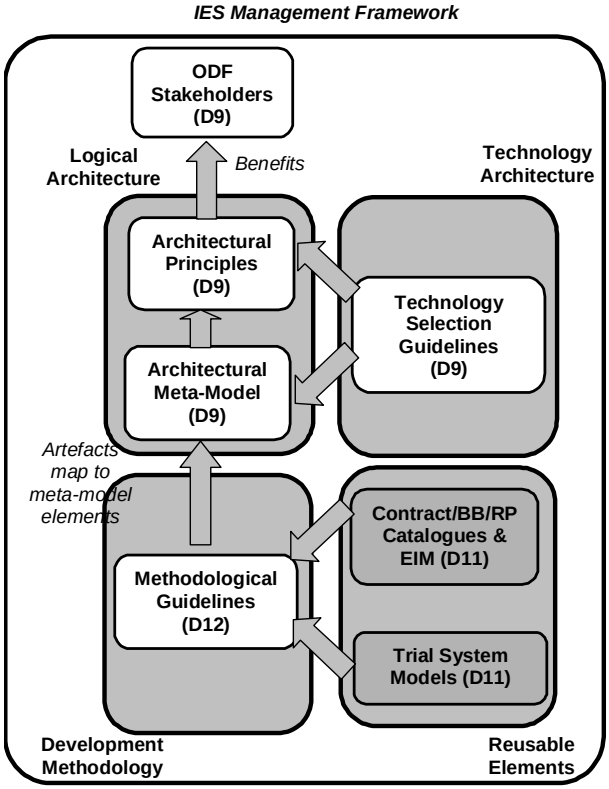

Figure 2-1 Overview of relationship of this document to ODF

2.2 Logical Architecture

2.2.1 Overview

The Logical Architecture defines the architectural principles that underpin the rest of the ODF. It also defines an architectural meta-model that define the various models used when applying the ODF and the relationships between those models that must be maintained to reap the full benefits of the ODF. The architectural principles and the architectural meta-model form the prescriptive part of the Logical Architecture. The Logical Architecture also contains some descriptive elements included to help in the understanding of the prescriptive parts and their application. These descriptive elements include the definition of a set of abstract roles representing potential users of the ODF at different points in the lifecycle of its main structural elements. This approach is taken because a key feature of a component-based architecture is that it addresses a broad range of the software development lifecycle and therefore brings together concerns that are only relevant to certain roles in the overall software lifecycle. These user roles are used to describe the different way in which the model elements defined in the meta model would be used and exchanged by the ODF stakeholders.

The architectural principles are based on an analysis of the state-of-the-art in management software architectures and component based development, in particular the NGOSS architecture being developed by the TM Forum. These principles can be summarised as follows:

- The core component structure is modelled as a Building Block that offers one or more interfaces called Contracts.
- Building Blocks and Contracts are packaged with business requirements and system analysis models.
- The modelling of a Contract may be performed independently of implementation technologies, including the explicit modelling of the information that passed by a Contract.

- The modelling of Building Blocks and Contracts should support the separate expression of any Business Logic that may be configured after implementation.

The full description of these principles is accompanied by the associated benefits each principle imparts to the different ODF stakeholders.

The main structural concepts present in the Framework are grouped in terms of the models generated by the ODF user roles and thus used in exchanging information between those roles. The models are:

- **Business Context Model:** This captures the requirements for an area of concern, models its organisational environment and defines a business-level model of its externally observable functionality and internal business processes.
- **Domain Model:** This analyses an area of concern, defining a system analysis level model of its externally observable functionality, process behaviour and logical decomposition
- **Contract Set Specification:** This is a set of interface specifications that may be utilised in designing BB software. It provides the primary means of interoperability in the Architectural Model by detailing sets of interfaces that can be used for interacting with BBs.
- **External Information Model:** This is a technology neutral expression of the information that is potentially passed via a range of Contracts. This provides an important aid to ensuring interoperability between Contracts defined in different technologies
- **Building Block Group:** This is a set of Building Block implementations and its accompanying documentation.
- **Management System Model:** This is the description of a Management System's design, some portion of which uses Building Blocks.

The relationships between these model are depicted in the following figure.

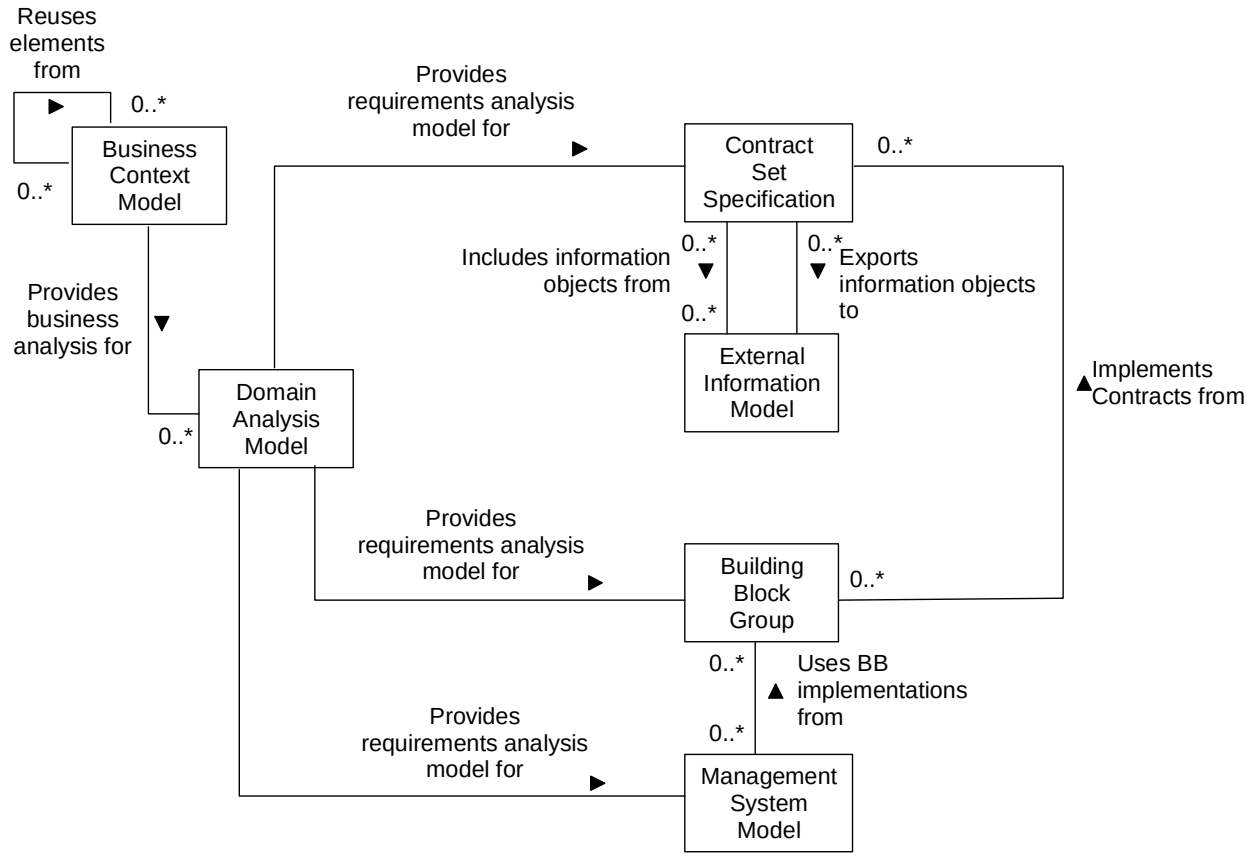

Figure 2-2 High-level meta model for ODF Logical Architecture

Though these models are described separately, the building of reusable software and management systems that use them relies on managing links between elements of these models. For instance a Management System Model will refer to elements of one or more Building Block Group models, which in turn will reference one or more Contract Set Specifications. The structure of the above models and the links between elements in the different models are captured as a set of linked meta-models. Elements of this meta-model are the basis for the modelling artefact defined in the Development Methodology portion of the ODF.

2.2.2 Further information

The Logical Architecture is defined in much greater detail in deliverable [FORM D9]. [FORM D9, Section 3] provides a full description of the architectural principles mentioned, a fuller description of the individual elements of the Architectural Model identified above and a detailed description of how the ODF stakeholder would make use of these elements. [FORM D9] presents a mapping of the elements of the Architectural Model to the artefacts generated when following the Development Methodology. It is these artefacts, which are used in presenting the models here in [FORM D11], so this mapping is needed to fully understand the relationship of the models in [FORM D11] to the Logical Architecture. [FORM D11] provides a descriptive overview of how the Architectural Model was applied in the FORM development trial, presented with some examples. [FORM D9] specifies the full details of the meta-model.

2.2.3 Relationship to this document

As described, the models presented in this document represent Reusable Elements from the IES Management Framework, and their application to Management System that implement specific business process flows from the IES business domain. Though the models are presented primarily in a form defined by the methodological guidelines of the ODF's Development Methodology, they can also be related back to the individual elements of the ODF's Architectural Model. This mapping is described at the beginning of each relevant section and is summarised as follows:

- Each Building Block Contract in the Building Block Contract Catalogue presented in section 10 and referenced on-line specifications [FORM Contracts], packages together the following Architecture Model elements, details of which can be found in [FORM D9, Sections 3 and 8]:
    - A Contract Specification as defined in the Contract Set Specification, including the Information Model related strictly the Building Block Contract.
    - System level Use Cases, as defined in the Domain Model, which addresses the functionality provided by the Building Block Contract.
- Contracts are not grouped into Contract Sets as defined in the Architectural Model, and therefore Information Models spanning Contract Sets are not defined.
- Each Building Block specification in the Building Block catalogue presented in Section 10, simply provides references to the Building Block Contract that it offers. Building Blocks are not Grouped, as defined in the Architectural Model, nor are Building Block deployment descriptors, Building Block software or run-time configuration details provided.
- The Reference Points defined in the Reference Point Catalogue presented in section 8, correspond to the Reference Points in the Business Role Model defined in the Business Context Model. They are mapped to Building Block Contracts according to which of the Business Roles associated by the Reference Point the Contracts support.
- The External Information Model, presented in Section 8, is the aggregation of the Information Models accompanying each of the Building Block Contracts and represents the External Information Model for the IES Management Framework, to the extent it has been modelled and tried in FORM.

- The General System Model for the IES Management Framework presented in section 4 represents the following elements of the Business Context Model:
    - The business use cases correspond to the Business Use Case Model.
    - The General Business Model maps to the Business Role Model and the instantiation of the Reference Points and Role into a specific Business Organisation Model.
    - The Reference Architecture corresponds to a mapping of the Business Organisation Model to a static model of business process areas, termed the Business Process Model.
- The various Business Process-driven System Models presented in sections 5, 6, 7 and Annexes A, B, C and D contain similar mapping to the Architectural Model identified above for the General System Model. In addition the following mappings are identified:
    - System-level Use cases which map to the Domain Use Case Model present in the Domain Model.
    - System-level process models and information model which map to Business Process and Information Modelling elements of the Domain Model.

2.3 Development Methodology

2.3.1 Overview

The methodology tackles the twin challenges of designing reusable components and the construction of business processes driven management systems. The methodology recognises these as two different development process – namely component design and systems construction using (existing) components. Typically, such development processes are carried out by different types of organisations, or roles within an organisation, e.g. component developer and systems integrator. Thus the methodology is presented as two *Development Guidelines* that specify the 'what', 'how' and 'when' of the development processes. Each Development Guideline consists of a co-ordinated set of development workflows. Each Guideline prescribes the modelling notations and artefacts to be produced by its development workflows. However, although the methodology is presented as two separate Guidelines, compatibility of the artefacts, notations and models developed by each has been achieved. The two Development Guidelines are called the ***Building Block Development Guideline*** and the ***Business Process Driven System Development Guideline***. Full details of these Guidelines are given in [FORM D12].

The objective of Building Block Development Guideline is the development of re-usable management Building Blocks Contracts and Building Blocks. The Guideline not only provides advice as to how to model Building Blocks Contracts but also prescribes how such Building Blocks Contracts should be represented so as to ensure that the Contracts could be reusable by other developers.

More specifically, the objectives of the Building Block Development Guideline are to:

- Guide the design activities in developing Building Blocks Contracts and Building Blocks.
- Specify the development workflows required to design Building Block Contracts.
- Identify modelling notations and the models to be developed during each development workflow. Indicate the traceability of artefacts developed across the development workflows.
- Prescribe sets of artefacts[2] to characterise and communicate usage of Building Block Contracts.

The guideline focuses primarily on the development of the Building Block Contract. The guideline does not, therefore, fully prescribe implementation and testing workflows.

[2] An artefact is a piece of information that is created, changed and used by actors when performing development activities. An artefact can be a model, a model element or a document.

The objective of the Business Process Development Guideline is to provide support for a 'Business Process Driven' approach to management system construction from re-usable Building Blocks Contracts.

2.3.2 Overview of Building Block Development Guideline

This Guideline adopts a Business Model/Use Case Driven approach to represent the management functional areas of interest (e.g. Fulfilment, Assurance, Billing etc.). The principle development workflows are listed below:

1. ***Perform Business Modelling Workflow*** – This workflow facilitates the definition of business model(s) based upon management business processes. This involves identifying Business Roles, Business information entities, Business Use Cases and Organisational Units and Business Workers.
2. ***Define Reference Architecture Workflow*** – This workflow specifies the development of a Reference Architecture that identifies reference points between organisational boundaries, the placement of process areas within these boundaries and the relationships between these process areas across organisational boundaries.
3. ***Perform Requirements Analysis Workflow*** – This involves such development activities as performing requirements analysis, development of use cases and supplementary requirements specification, use of activity diagrams to model the various control and data flows in the use cases.
4. ***Develop Analysis Object Models Workflow*** – This involves the development of analysis objects and associated collaboration models.
5. ***Model (Re)Organisation*** – This workflow guides the re-organise the development classes and models developed in the previous workflow and advises on their potential groupings. This workflow specifies the modelling and specification of Building Blocks Contracts. The Building Block Contracts are specified using an XML based description.
6. ***Implement Building Blocks and perform testing*.** This workflow describes the development activities required for Building Block implementation and testing.

The approach taken in developing this Guideline was to use best practice in software development and add new workflows, model, artefacts and specifications where required. The initial documentation of the Building Block Development Process was loosely based on the Rational Unified Process (RUP). Although generally useful, RUP does not support some key modelling artefacts and design activities, which are fundamental to the Guideline.

2.3.3 Overview of Business Process Driven System Development Guideline

The goal of the Business Process System Development guideline is to facilitate the construction, by management systems integrators, of management solutions from Building Block Contracts. The Guidelines takes a 'Business Process Driven' approach to management system construction from re-usable Building Blocks by explicitly modelling the required system processes and their constituent system activities. The guideline uses these system activities to determine the Building Block Contracts needed to implement these processes.

The Guideline itself is divided into eight process workflows. Each workflow has a specific objective and produces or refines model(s) or artefacts. These workflows involve business modelling, requirements capture & management, system analysis and design modelling, implementation and testing.

The Guideline specifies the mapping of the management system activities (in the management system processes) to Building Block Contracts. This supports the reuse of existing Building Block Contracts in implementing the management system processes. This mapping is at the heart of the reuse of Building Block Contracts in the implementation of management processes. A second part of the mapping of management activities to Building Block Contracts is the reconciliation of External Information Model(s) of the Building Blocks Contracts to the information flows in the system processes.

Figure 2-3 identifies the principle development workflows involved in the Guideline. These involve:

1. ***Performing Business Modelling****:* This workflow facilitates the definition of Business Roles, business use cases and organisational units. The key results of this workflow are the development of Business Use Case Model(s), Business Model (representing the business roles and organizational units), and a definition of the Reference Architecture for the problem area, indicating the management processes and reference points to be used.
2. ***Define Requirement Analysis:*** This workflow facilitates the identification of candidate behaviour of the management business processes, software requirement specifications and supplementary specifications. The key result of this workflow is the system use cases and supplementary use case specifications
3. ***Perform System Process and System Information Modelling*:** In this workflow the required system process(s) are represented as system activity diagrams. Thus this workflow facilitates the modelling of system activities, their control flows and their information flows. The key results of this workflow are system activity diagram(s) representing the system processes to be implemented.
4. ***Re-Model System Processes and Map to Building Block Contracts:*** This workflow allows the mapping of system activities (and information flows) to be mapped to Building Block contracts. This is one of the most important workflows in the Guideline. In this workflow the system activities are decomposed or aggregated to match, as closely as possible, available Building Block Contract interface specifications. This involves matching the BB Contract interface function(s) as well as their information requirements. Where matching is possible, the system activities are annotated with the Building Block Contracts that support it. Where the matched Building Block Contract requires extra information, the extra information objects have to be included in the system process. Where matching is not possible, the system activities will be modelled as bespoke system objects, which require separate design and implementation. The key result of this workflow is the system process modelled as activity diagrams, with the activities annotated with the Building Block Contract associated with them. The information objects in the activities diagrams are a combination of information objects drawn from the Building Block Boundary Information models and Information Objects developed specially for the process (i.e. bespoke information objects).
5. ***Model Missing Objects and Information Workflows:*** This workflow supports the modelling of system objects and information, which are not supported by the chosen Building Block Contracts and therefore require bespoke development of management system functionality/objects. The system objects are modelled as use cases, activity diagrams, and class diagrams. Where a system activity involves the design of several system objects, they are grouped together in a subsystem package.
6. ***Implement Building Block Integration:*** This workflow facilitates the implementation of the integration of the Building Blocks so that the intended system processes are executable. This step may be automated if the design tool used for modelling the system activity diagrams is capable of generating an XMI description of the system activity model. Such an XMI description can be used to determine the control flow, data flow and appropriate Building Block Contract invocations. Depending on the integration implementation approach, such an XMI description could be used to populate a Business (Logic) Object capable of making the necessary decisions and invocations on the appropriate Building Block Contracts, or could be used to populate workflow specifications

for a workflow execution environment. The key result of this workflow is the implementation of the control and information flow for the business process.

7. ***Map Building Block Contracts to Building Blocks and Deploy BBs:*** This workflow facilitates the selection of Building Blocks to be deployed in the system if they had not yet been previously deployed. This workflow can also involve identification and placement of technology and data gateways where Building Blocks are implemented using different technologies. This would be needed if the Building Block Contracts were technology neutral, i.e. the interface descriptions of the Building Block Contracts were not described in a particular distributed implementation technology. In this way the technological or information representation heterogeneity of the Building Blocks can be hidden from the integration business logic. Where the Building Block Contracts are specified using technology specific interfaces, there is no need for these gateways as the Business (Logic) Object or workflow engine would be generated with the required technology specific invocations.
8. ***Perform testing and Deployment:*** This workflow defines and executes the testing necessary for the management process execution. This involves generating test plans and execution of those plans.

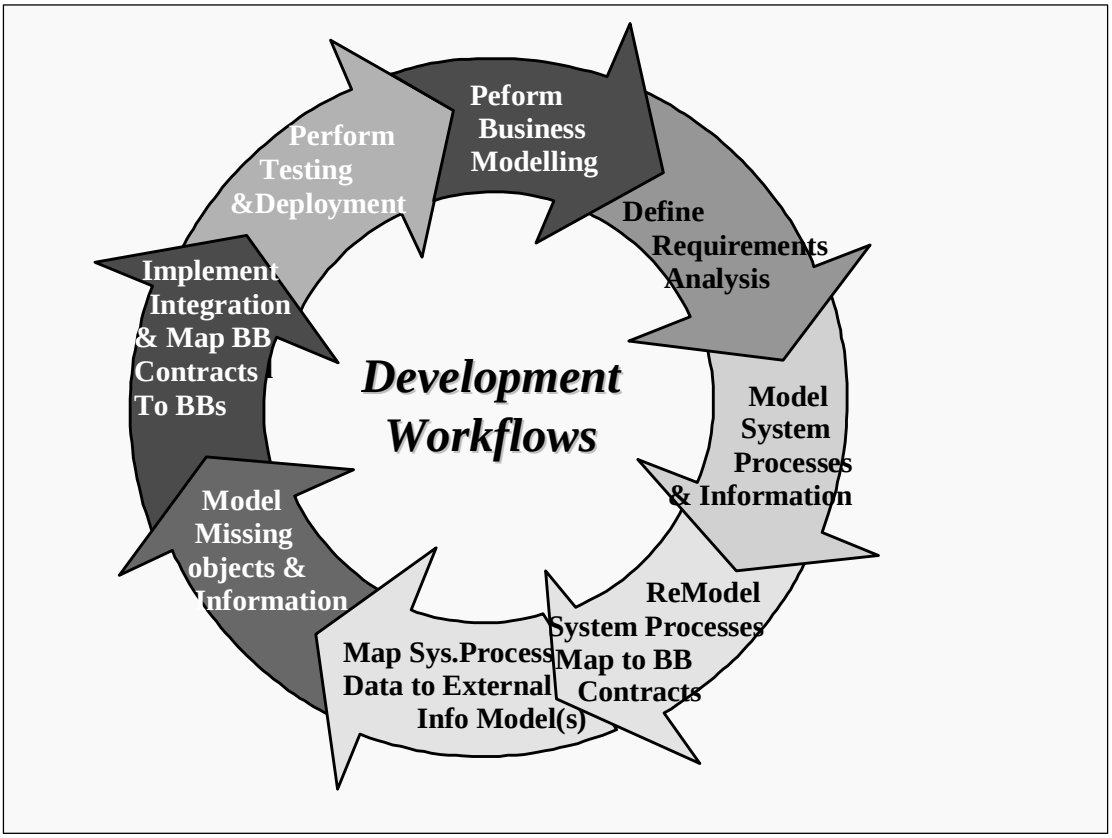

Figure 2-3 Overview of Process Driven System Development Guideline

2.3.4 Relationship to this document

The methodological Guidelines were followed in developing the Building Blocks, Contracts and systems. The BB Contract, BB and Reference Point Catalogues represent the output of the Building Block Development Guideline, with the central Contract specification format being the XML-based. This is shown in Annex A-D. Sections 5, 6, and 7 presents models generated by following the workflows of the Process Driven System Development Guideline.

2.4 Technology Architecture

2.4.1 Overview

The Technology Architecture/Guidelines of the FORM Open Development Framework is presented in details in [FORM D9, Section 5]. It focuses on providing mechanisms for selecting one or more technologies for the implementation of specific applications for management systems. Selecting a technology is not a trivial task and will constitute a strategic decision for most organisations.

Because the ODF aims to achieve technology neutrality, the objective is not to present and compare technologies but rather to raise awareness about the different criteria to be considered in the technology selection process.

The precognition of a Building Block based system architecture means that a number of quality requirements must be met. These requirements, expressed mostly by the TMForum Application Component Team, play an important role in the selection process.

Criteria for the technology selection process can be divided into three different categories. The first criterion is purely functional and corresponds to the set of functionalities (business processes) that the management system is to fulfil. The second criterion is associated with the FORM Architecture principle and relates essentially to non-functional system requirements. Finally the last criterion in the technology selection process is more external to the technology features and focuses on corporate strategy, developer's training, technology trends, etc… An organisation should be aware that technology decisions must be part of a broader and long-term strategic plan. Performing a selection for implementation and integration technologies requires an organisation to marry a number of internal business requirements with a myriad of vendor attributes that relate to both performance as well as the ability to effectively provide long-term value to the organisation.

2.4.2 Relationship to this document

[FORM D11] shows the application of a process that is driven by the fulfilment of the functional requirements. [FORM D9] focuses on providing mechanisms for selecting one or more technologies for the implementation of specific applications for management systems, it focuses on the technology architecture, which should enable the fulfilment of both functional and especially the non-functional requirements.

The development within the FORM project was for focused toward achieving "proof-of-concepts" prototypes of Building Blocks rather than finished products. Therefore the need for a BB to meet certain generic requirements such as unity, release and resource independence, recoverability and other non-functional requirements [FORM D9], may have been considered less important than achieving functional goals. Further the technology architecture does not present Building Block design patterns, mainly because those patterns represent a technological competitive advantage for the partners involved in the FORM consortium.

3 FORM System Modelling Overview

FORM builds on the TeleManagement Forum's [TOM] business process framework and addresses the integration of the Fulfilment, Assurance, and Billing business processes in order to support automated end-to-end service provisioning. The objective being to enable service providers to achieve:

1. Provisioning of the services ordered by the customer.
2. Response and resolution of customer or network triggered problems. Problems tracking, reporting, managing and taking action to improve the performance for all aspects of a service.
3. Accurate bills, knowledgeable and responsive billing inquiry support, including adjustment handling, payment collections.

These are the general type of process flows that will be addressed in business modelling. The approach taken to business modelling is to define a general e-business management business model and derive a set of partial business models, which focus on the different aspects of management integration.

The General Business Model defines a set of generic organisation types involved in the e-business value chain e.g. Application Service Provider, Internet Service Provider etc. and management services to be offered across these providers. However, it is beyond the scope of the FORM project to fully design all aspects of these management services. The General Business Model sets the context, organisational types and the management processes involved. The general business model is concrete in that it identifies (a) the general application service, (b) the management services to be offered to the customer, and (c) the providers who will support those services.

- The General Business Model together with the FORM Reference Architecture is specified in Section 4.

The approach taken by FORM, to illustrate integration between business processes has been to focus on two of the three management process areas identified by TM Forum (Fulfilment, Assurance, and Billing). The integrated models contain some of the organisational types from the General Business Model. The integrated models are specified using the FORM methodology "Business Process Driven System Development Guideline" [FORM D12].

- Systems Models for Fulfilment-Billing are presented in Section 5.
- Systems Models for Fulfilment-Assurance are presented in Section 6.
- Systems Models for Assurance-Billing are presented in Section 7.

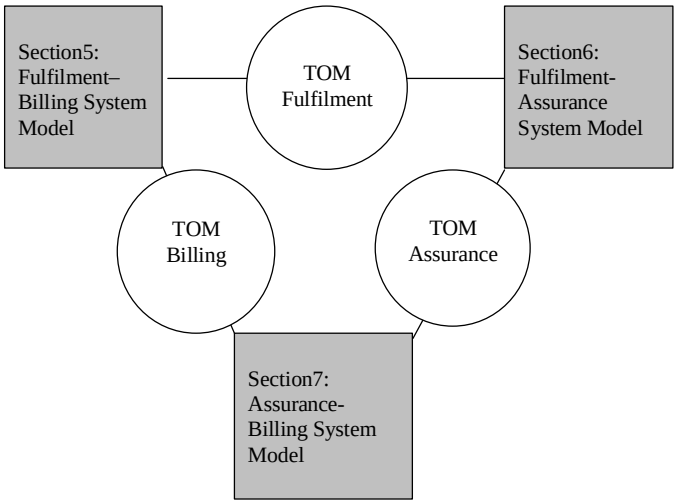

Figure 3-1 Relationship between System models and TOM processes.

The System Models in Section 5, Section 6, and Section 7 are assembled using catalogues of reusable elements, (a) reference points, and (b) contracts. The Business Model Driven approach suggested in [FORM D12] helps to model the necessary management business processes, which span several organisational domains and involves several actors and roles in the Inter Enterprise Domain.

The External Information Model (EIM) of a domain captures an aggregation of the information models representing the information passed by the Contracts in the domain.

- The External Information Model for each domain identified in FORM is described in Section 8.

The reusable elements used in Section 5, 6 and 7 are the results from system modelling in the Annexes. These are presented as catalogues. The reference point catalogue is a list of reference points from the reference architecture, which have been identified through business modelling. The building block contract catalogue contains a summary of the contracts, which has been designed as part of systems modelling.

- The Reference Point Catalogue is presented in Section 9.
- The Building Block Contract Catalogue is presented in Section 10.

Section 11 concludes the main document of FORM system modelling.

In the Annexes the system models for each business process: Fulfilment, Assurance and Billing are specified using the FORM methodology "Building Block Development Guideline" [FORM D12]. The Fulfilment part is divided into two Annexes.

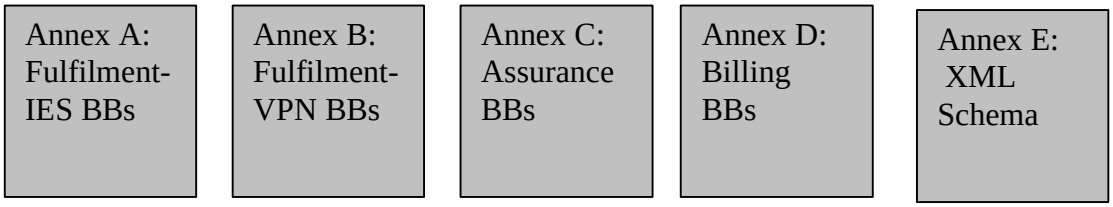

Figure 3-2 Contents of the Annexes

- The Fulfilment IES System Model is designed in Annex A.
- The Fulfilment VPN System Model is designed in Annex B.
- The Assurance System Models are designed in Annex C.
- The Billing System Models are designed in Annex D.

Finally,

- The XML Schema for building block contract specification is explained in Annex E.

4 General Business Modelling

The general Business Model defines the organisations, human actors, management services, network and application services, and responsibilities involved in a specific example of an e-business.

4.1 General Business Use Case Model

The FORM general business use case is that of a customer organisation seeking a secure, reliable VPN service between itself and some partner organisations. The customer also seeks a reliable multi-domain internet service between itself and a Web based digital content provider (i.e. a Web based application service provider). The customer expects billing for the service to reflect service level agreements for the VPN and application service. Therefore the business use case is that of a customer organisation seeking guaranteed quality of service for (a) secure IP VPN service with QoS guarantees and (b) multi domain internet access to an information retrieval service, also with QoS guarantees.

The management services to be provided to the customer involve the fulfilment of a request for a VPN service and for the information retrieval service. The customer also expects that a bill for service and network usage is provided that reflects both the usage and quality of services consumed.

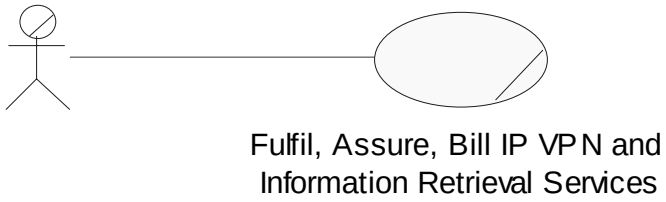

Figure 4-1 General Business Use Case Diagram

The general business use case description in terms of the service provided to the customer is as follows:

1. A prospective customer negotiates a SLA (Service Level Agreement) for a information retrieval service. This involves initiating Fulfilment processes to perform the required SLA negotiations, the process concludes by storing the agreed SLA and initiating subscription processes.
2. When the subscription processes are completed, the agreed SLA is made available to the assurance processes, which are initiated to set up the necessary monitoring and others processes to assure the service. Also the subscription processes initiate Billing processes to start up accounting.
3. The customer starts using the service.
4. The monitoring of the SLA is initiated. While the customer's SLA is violated, due to performance problems, the Assurance processes are initiated.
5. The Assurance process communicates the SLA violation to the billing process.
6. The billing process investigates the billing consequences of the violation and calculates discount for the user based on the SLA.

Services to be Managed

There are two services to be managed in the general business use case, namely

1. IP VPN connectivity services

These involve the definition of the network topology (service access groups and service access points), the configuration of network links based on QoS parameters and the required IPsec security features, the reservation of resources as well as the activation of the IP VPN service.

2. Information Retrieval Service.
This involves the navigation and retrieval of, and interaction with digital Web based multimedia content across the Internet.

4.2 General Business (Object) Model

In accordance with the ODF, the Business Model must identify Business Roles that are played by the organisations in the business use case. An organisation may play more than one role and more than one organisation in the business use case may play the same role. These roles are interconnected by a set of reference points. Roles and Reference Points together make up a Business Role Model. The Business Role Model in the IES Management Framework is shown in the figure below together with the cardinalities that may exist for Reference Points between Business Roles.

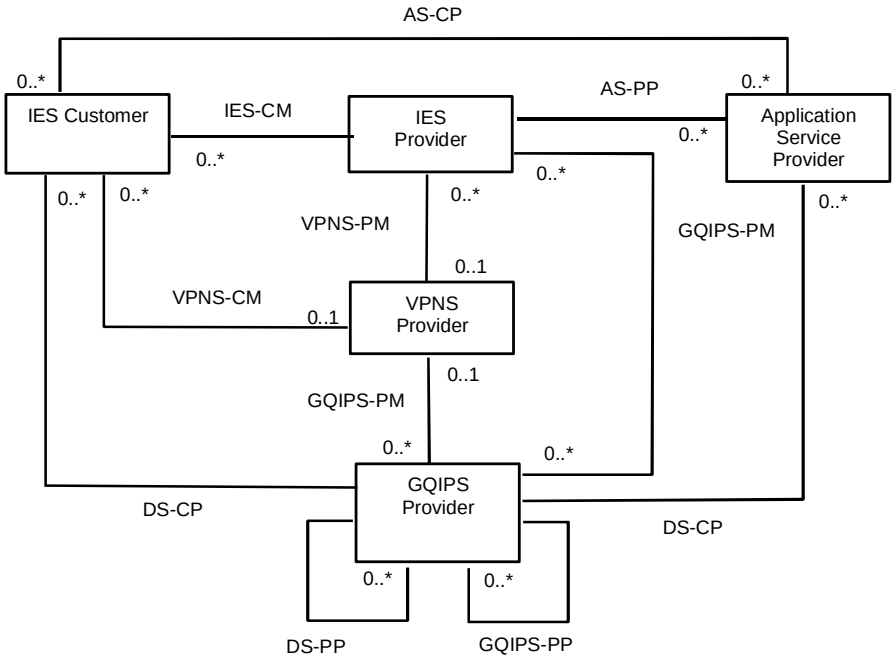

Figure 4-2 IES Management Framework Business Role Model

The Business Roles in the model are:

- **IES Customer**, which pays for and uses the IES and associated services and management services, including Application Services (AS), a Virtual Private Network Service (VPNS) and a Guaranteed QoS IP Service (GQIPS).
- **Application Service Provider (ASP)**, which makes ASs available to IES Customers and exchanges accompanying service management services with an IES Provider.
- **IES Provider**, which coordinates and manages the provision of the IES and associated management services to IES Customers. The IES Provider may make use of the service offered by a single VPNS Provider and potentially several ASPs.
- **VPNS Provider** which providers VPN services and accompanying management services between several IES Customers under the management of a single IES Provider
- **GQIPS Provider** which provides guaranteed QoS IP connectivity between the IES Customers under the management of a VPNS Provider or an IES Provider.

The FORM general business use case identifies several organisations in an e-business delivery chain. These are:

1. **Customer organisation (called IES-Cust)** which plays the IES Customer Business Role.
2. **IES Provider organisation (called IESP)**, which plays the IES Provider Business Role.
3. **VPN Service Provider organisation (called VPNSP)**, which plays the VPNS Provider Business Role
4. **Two Internet Service Provider organisations (called ISP-A and ISP-B),** which both play the GQIPS Provider Business Role.
5. **An Information Retrieval Service Provider (called IRSP)** which plays the Application Service Provider (ASP) Business Role

As each organisation only support one Business Role we can represent the relationships between the organisations as an UML object diagram where the objects are instances of the Business Roles and the relationships between them are (anonymous) instances of the Reference Points in the IES Business Role Model.

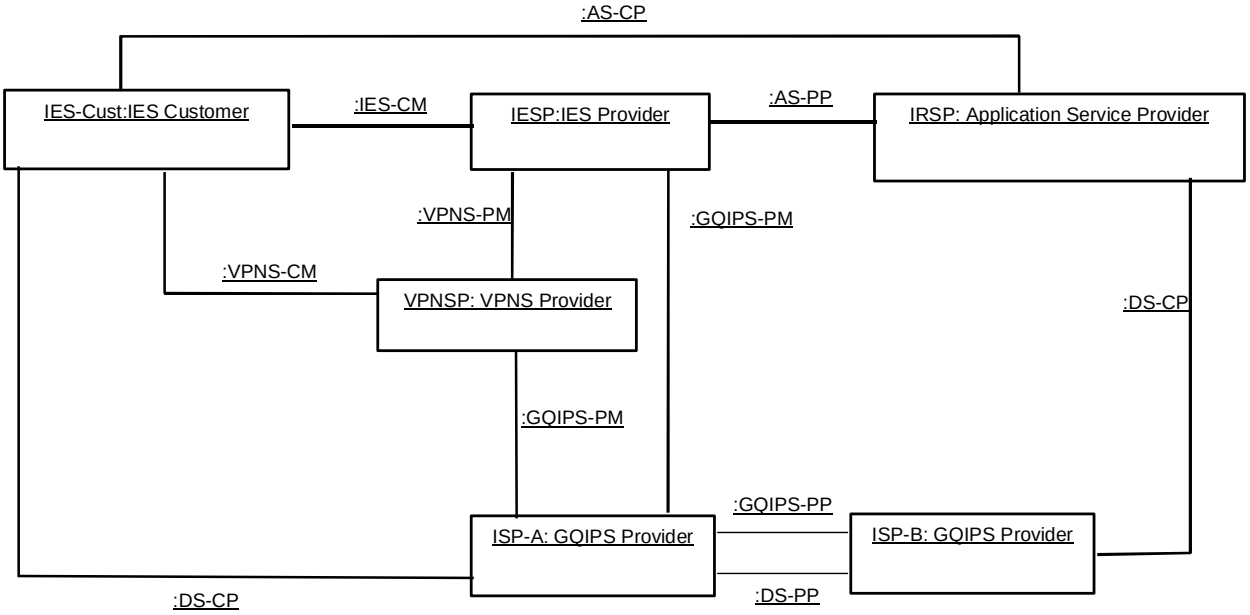

Figure 4-3 Overview of generic business model used in FORM

The instances of reference points broadly perform the following functions in the business use cases enacted over the business model:

- The IES-CM (Customer Management) instance supports management interactions for the IES-Cust's of the IES and its constituent services.
- The AS-CP (Application Service – Customer to Provider) supports information retrieval interactions between the IES-Cust and the IRSP.
- The VPNS-PM (Provider Management) instance supports VPNS fulfilment interactions.
- The AS-PP (Application Service – Provider to Provider) instance supports interactions to pass billing and assurance information from the IRSP for the outsourced billing/assurance management of the IRS by the IESP.
- The VPNS-CM (Customer Management) instance supports the configuration of IPsec parameters in the customer premises networks.
- The GQIPS-PM (Provider Management) instance between the VPNSP and the ISP-A supports interactions to configure QoS guaranteed IP data paths across ISP-A and ISP-B.

- The GQIPS-PM (Provider Management) instance between the IESP and the ISP-A supports interactions passing QoS assurance reports on QoS guaranteed IP data paths across ISP-A and ISP-B.
- The GQIPS-PP (Provider to Provider) instance supports interactions for the configuration and assurance reporting of QoS guaranteed IP data paths.
- The DS-CP (DiffServ – Customer to Provider) instances support QoS guaranteed IP data paths between IES-Cust and the IRSP.
- The DS-PP (DiffServ – Provider to Provider) instance supports QoS guaranteed IP data paths between ISP-A and ISP-B

The human actors associated with each of the organisations in the business use case are:

- IES-Cust: **IES Customer Manager**
- IRSP: **Application Service Manager**
- IESP: **QoS Manager, Accounting-Billing Manager**
- VPNSP: **VPN Service Manager**
- ISP-A: **ISP-A Service Manager**
- ISP-B: **ISP-B Service Manager**

4.3 The Reference Architecture

The Reference Architecture used to model the IES Management domain for the system is given in overview in the figure above and with a more detailed view below.

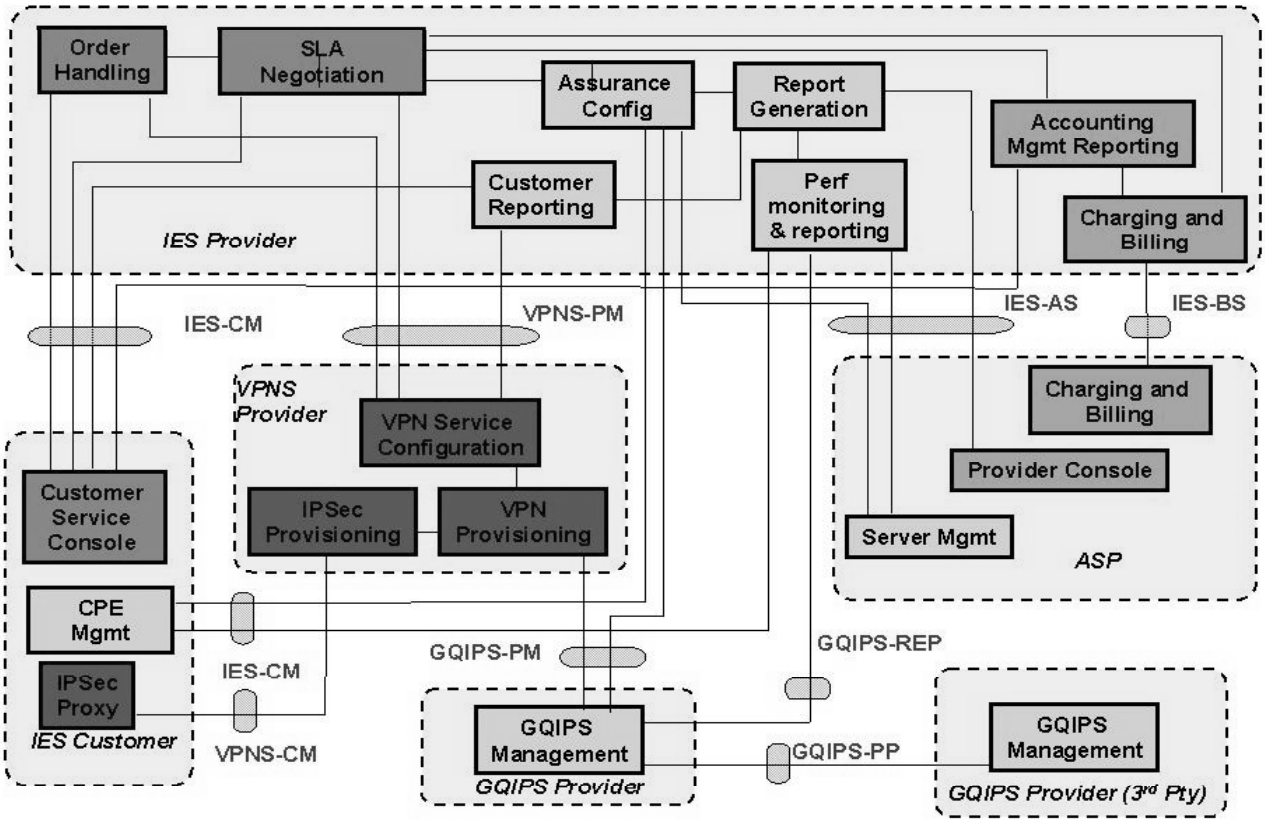

Figure 4-4 Overall Reference Architecture for the IES Management Domain.

The Reference Architecture represents a mapping of business processes identified within the IES Management domain and the business organisations, business roles and reference points identified for the domain in the General Business Model. The Reference Architecture presented in this section represents the aggregation of the various Reference Architectures that have been used in understanding and analysing the business requirements for the different IES Management business scenarios addressed by the FORM project. This Reference Architecture has been refined over time, as a better understanding of the business needs of the domain has been developed by the analysis, design and implementation conducted to exercise and evaluate the different scenarios.

The business roles identified reflect the nature of the IES and partners exploitation interests and includes:

- Guaranteed QoS IP Service (GQIPS) Providers, which are ISPs that deliver IP connectivity with QoS guarantees (we assume a diffserv capable backbone)
- a VPN Service (VPNS) Provider which delivers multi-network configuration, multi-domain security and CPE outsourcing management
- an Inter-Enterprise Service (IES) Provider roles that offers enterprise group service management
- ASPs which use the IES to manage customer connectivity and aspects of customer care.
- IES Customers that use the IES.

The Business Processes mapped onto these Business Roles are not all used in each trial system. Instead the four planned trial systems each address a subset of the Business Processes as follows:

Assurance Trial System:

- Customer Service Console
- Report Generation
- Assurance Configuration
- Performance Monitoring and Reporting
- Server Management
- GQIPS Management

Billing Trial System:

- Customer Service Console
- Accounting Management Reporting
- Charging and Billing

Order Handling/SLA Negotiation Trial System:

- Customer Service Console
- Order Handling
- SLA Negotiation

VPN Service Provisioning Trial System:

- VPN Service Configuration
- VPN Provisioning
- IPSec Provisioning
- IPSec Proxy
- GQIPS Management

5 Business Process Driven Systems Modelling for Fulfilment-Billing

The aim of this Section is to show how the FORM Fulfilment and Billing processes can be integrated by having the Fulfilment processes inform the Billing processes about the creation of a new service agreement with a customer for which billing has to be activated.

Another aspect of this Section concerns the integration of the two separate Fulfilment process parts, i.e. the IESP Fulfilment processes (SLA Negotiation and Order Handling) and the VPNSP Fulfilment processes were also integrated.

This Section demonstrates the application of the FORM methodology "Business Process Driven System Development Guideline" [FORM D12] to the Inter Enterprise Service (Fulfilment and Billing) Management Domain.

Business Process Driven System Development Guideline [FORM D12] – Workflows:	**System Models [FORM D11] – FORM Methodology applied in Sections:**
1. Perform Business Modelling and Reference Architecture Refinement Workflow	5.1 Business Use Case Model 5.2 Business Object Model 5.3 Reference Architecture
2. Define Requirements Analysis Workflow	5.4 Use case Model
3. Perform System Processes and Information Modelling Workflow	5.5 System Process and Information Model
4. Re-model System processes and Map to Building Block Contracts Workflow	5.6 Mapping to Building Block Contracts 5.7 External Information Model
5. Model Missing Objects and Information Workflow	5.8 Model Missing Objects
6. Implement Building Block Integration	5.9 Implement Building Block Integration

Table 5-1 Mapping between FORM Methodology and FORM System Models

5.1 Business Use Case Model for Fulfilment-Billing

The F-B business use case is based on one-stop shopping. The Inter-Enterprise Service Provider (IESP) offers a package of services from various service providers and maintains the relationship with the customer on behalf of these service providers. The services offered by the IESP in this business use case are a VPN Service by a VPN Service Provider (VPNSP) and an Information Retrieval Service by an ASP. The IESP has already negotiated service contracts with the VPN Service Provider and the ASP and so is in a position to offer these services as a package to customers. The IESP informs the VPN Service Provider and the ASP about any new customer wishing to use a service they offer and also provide any necessary information, such as addressing information for the VPN service provider. This is the Fulfilment part of the business use case. In order to interact with Billing, information about the customer and the tariff details for the services ordered by the customer are sent to Billing so that usage information can be collected and charged for.

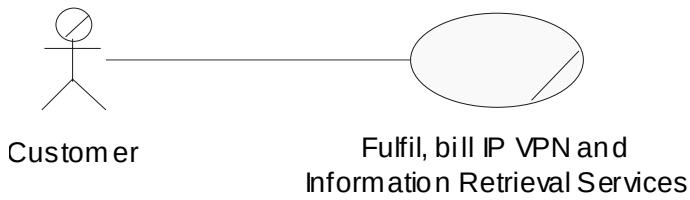

Figure 5-1 Business Use case Diagram for Fulfilment-Billing

The business use case description in terms of the service provided to the customer is as follows:

1. The customer wishes to order a service package offered by the IESP consisting of a VPN service and an IRS service. The customer selects on-line a variety of Class of Service (CoS) parameters, negotiates the SLA for this service package with the IESP and agrees a particular SLA for the service package. The customer orders this service package and the order for the service package is accepted by the IESP.
2. The IESP provisions the service for the customer so that the customer can start using the service. This requires information about the customer and the tariffs of the services ordered by the customer to be stored and billing for the customer's services to be activated.
3. The IESP sends the necessary information to the VPN service provider with the request to create the appropriate service instance for the IESP customer. The VPN service provider sends a connection request to the GQIPS provider to guarantee the QoS of the connection.
4. The IESP sends the necessary information to the ASP with the request to create the appropriate service instance for the IESP customer.
5. By the end of the business use case the customer has had the order for the service package of VPN and Information Retrieval Service fulfilled. This means that the customer can start to use the services and will be billed for this use. The billing process is supported by the IESP as the ASP has outsourced the billing service to the IESP.

5.2 Business (Object) Model for Fulfilment-Billing

As shown in the figure below, the following business relationships exist:

1. The IES Customer negotiates and buys a service package from the IES Provider consisting of a VPN service and an Information Retrieval service. A SLA is negotiated and a contract with details of the service ordered is concluded between the IES Customer and the IES Provider. The relationship between the IES Provider and the IES Customer is concerned with the customer relationship management processes, which in this business use case are SLA negotiation, order handling, and billing.
2. The IES Provider and the ASP have concluded an agreement whereby the IES Provider is responsible for managing the services provided by the ASP. The relationship between the IES Provider and the ASP is concerned with providing enough information about the new customer/service to allow the ASP to create a service instance for the IES customer and to provide usage data to the IES Provider for billing purposes.

3. The VPN Service Provider is providing a VPN service to the IES Provider and a contract, including a SLA, has been signed between them to this effect. The relationship between the IES Provider and the VPN Service Provider is concerned with providing enough information about the new customer/service to allow the VPN Service Provider to create a service instance for the IES Customer and to provide usage data to the IES Provider for billing purposes.
4. The GQIPS Provider has signed an agreement with the VPN Service Provider to provide end-to-end links at the specific QoS requested by the VPN Service Provider. The relationship between the VPN Service Provider and the GQIPS Provider is concerned with providing enough information about the links and QoS to allow the GQIPS Provider to provision the required links at the required QoS.

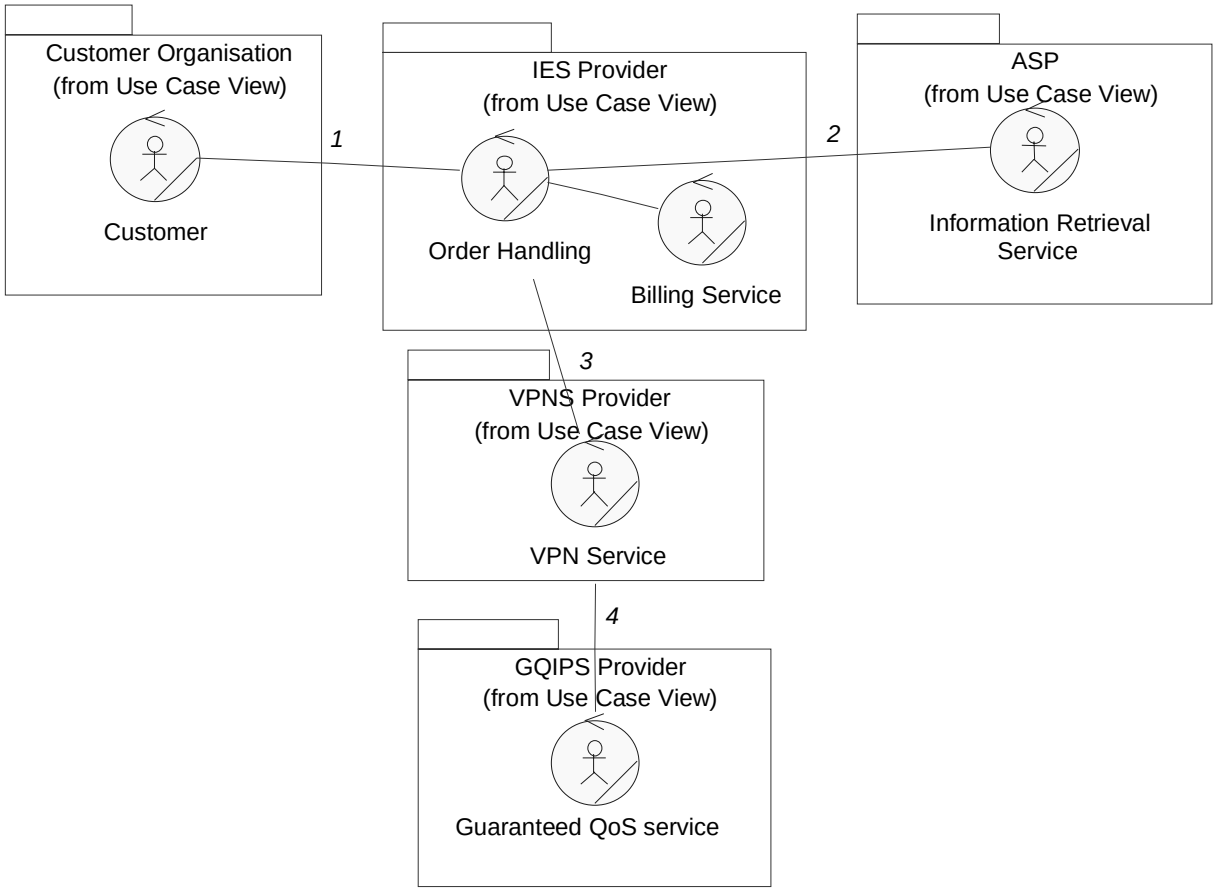

Figure 5-2 Business Object Model for Fulfilment-Billing

5.3 Reference Architecture

The Reference Architecture figure below presents the Business Processes involved in each domain as well as the reference points defined between Business Processes over different domains.´

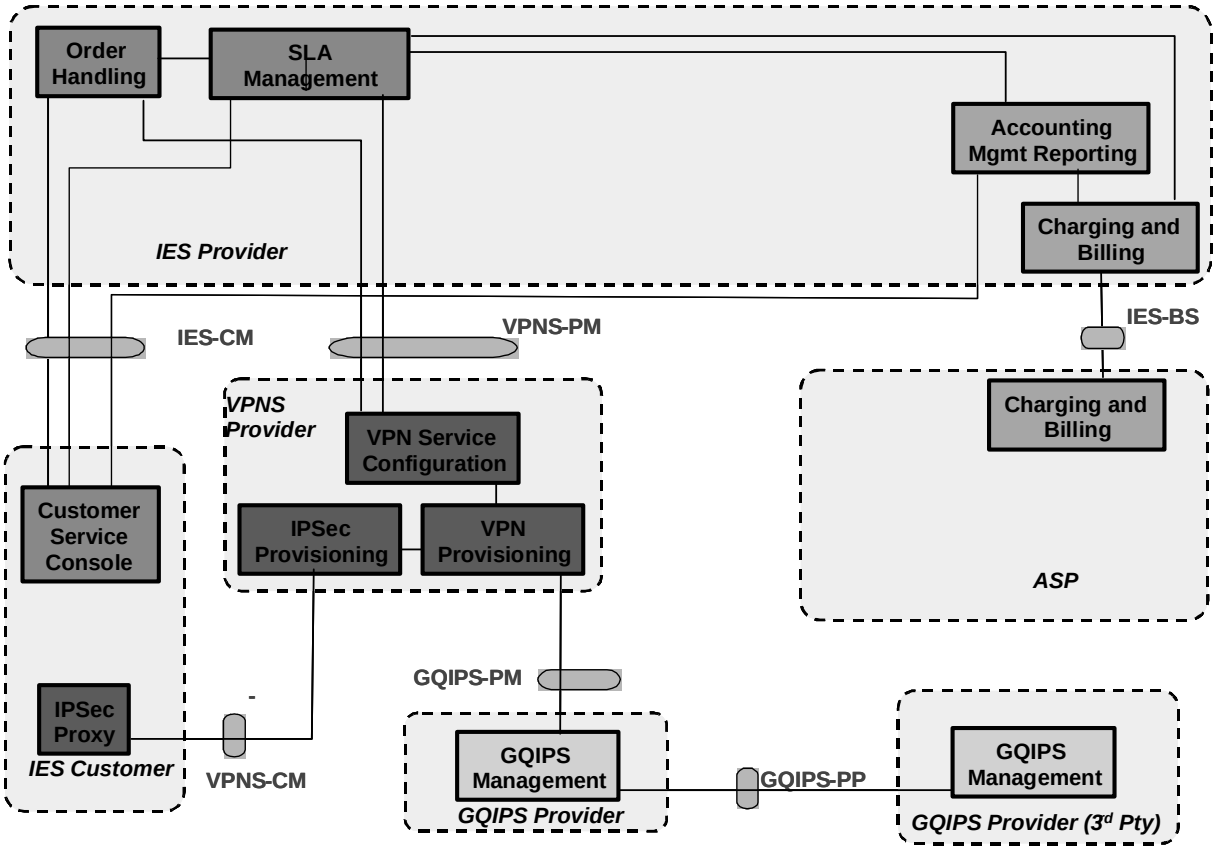

Figure 5-3 The Fulfilment-Billing Reference Architecture

As shown in the figure above the business processes included in Fulfilment-Billing are mapped to the following business roles as follows:

IES Provider

- Order Handling
- SLA Management
- Charging and Billing

IES Customer

- Customer Service Console

VPNS Provider

- VPN Service Configuration
- VPN Provisioning
- IP Sec Provisioning

GQIPS Provider

- GQIPS Management

ASP

- Charging and Billing

These business processes interact over reference points located between the business roles. The reference points in Fulfillment-Billing serve two purposes:

1. They serve as logical demarcation lines (boundaries) between management/administrative domains within which the business processes of the business roles can be placed.
2. The reference points are sets of coarse-grained integration points for business entities and model the business-level relationships that a business role maintains with other business roles.

The following reference points are of concern to Fulfilment-Billing:

5.3.1 IES-CM

This reference point is located between the IES Provider and the IES Customer. It represents a business-to-customer relationship between the IES Provider and the IES Customer for order handling and SLA management.

5.3.2 VPNS-PM

This reference point is located between the IES Provider Domain and the VPNS Provider Domain.

5.3.3 GQIPS-PM

This reference point is located between the VPNS Provider and the GQIPS Provider.

5.4 Use Case Model for Fulfilment-Billing

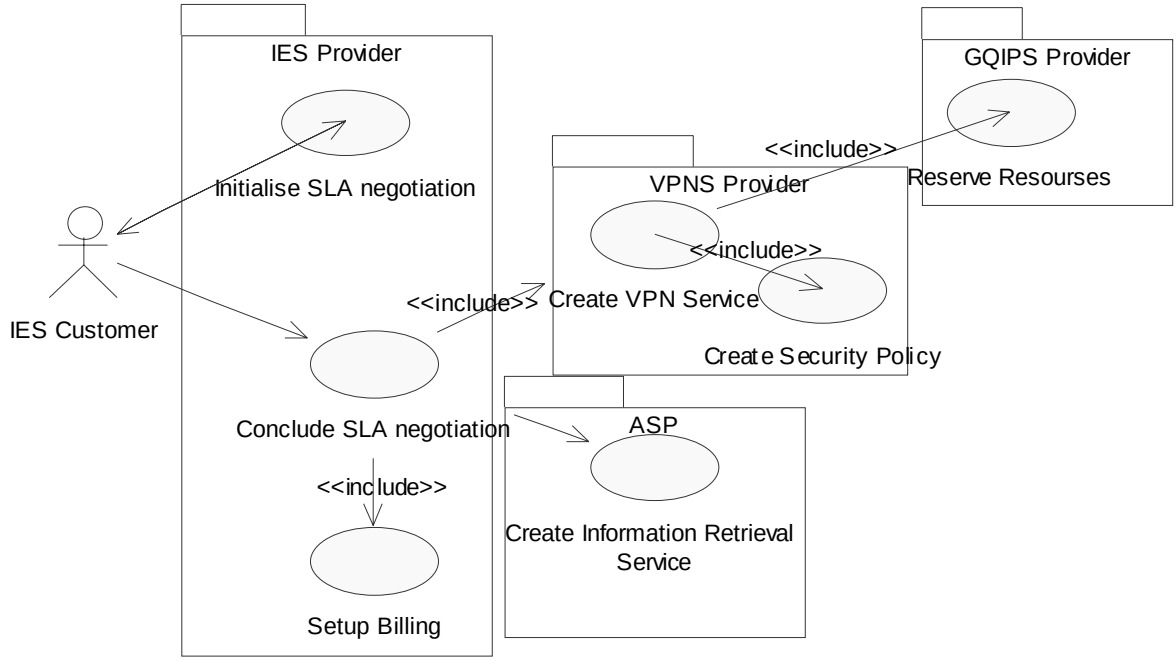

Figure 5-4 Use case diagram for Fulfilment - Billing

The specified business processes are intended automated, we therefore identify candidate system use cases. The system use cases are identified for each organisation in the business object model e.g. the IES Provider should automate the SLA negotiation and billing processes.

Each of these use case are shortly described as follows:

Initialise SLA Negotiation: This use case represents the initial phase of SLA negotiation and comprises the activities of the end customer requesting and receiving an SLA proposal from the IESP.

Conclude SLA Negotiation: This use case covers the process of the IES Customer and completes the proposed SLA by adding customer details and returning the SLA to the IES provider as an indication that the SLA has been accepted.

Create VPN Service: This use case covers the process of establishing the VPN for the selected service, based on parameters from the agreed SLA.

Reserve Resources: This use case covers the process of reserving, with the GQIPS provider, the necessary network resources for the requested service.

Create Security Policy: This use case covers the creation of the security policy necessary for implementation of the specified VPN service.

Create Information Retrieval Service: This use case covers the process of establishing the application service that the end customer has subscribed to, based on the contents of the SLA.

Setup Billing: This process involves extracting billing-relevant information from the agreed SLA, informing the billing service that the IES customer has accepted the application service and that billing of the service can start.

5.5 System Process and Information Model – Activity Diagram for Fulfilment-Billing

The use cases are mapped into an activity diagram.

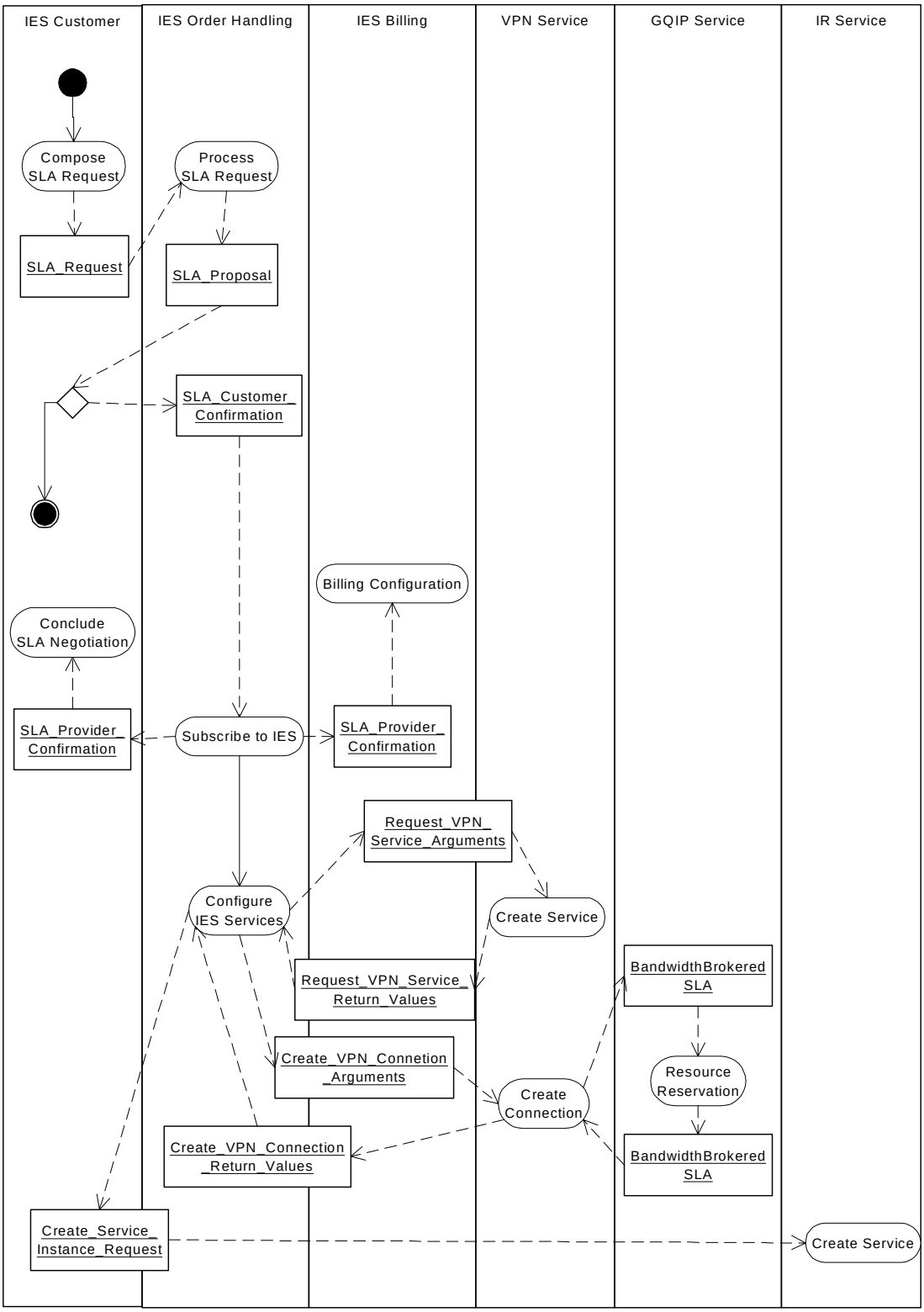

Figure 5-5 Activity Diagram for the Fulfilment-Billing Sub-Scenario

5.6 Mapping to Building Block Contracts for Fulfilment-Billing

The following sections detail the activities shown in the activity diagram. The building block contracts specified in [FORM Contracts], and shortly described and listed in Section 10, that are able to support the activities listed and the information passed between them are identified.

- The customer negotiates and orders on-line via the IESP Order Handling Customer Interface a service package offered by the IESP consisting of a VPN service and an Information Retrieval service. Once the sale is agreed and confirmed the IESP Order Handling Process ensures that the subscription details are recorded and that the customer's service instances are provisioned.
  - Building block contracts involved:
    - SlaNegReq
    - SLAHandlingService
  - Information required:
    - Customer details
    - Service package details
    - Class of Service ordered by the customer.
- The IESP Order Handling Process sends a request to the IESP Billing Process to activate billing for the customer's services.
  - Building blocks contracts involved:
    - SLAHandlingService
    - Rating Bureau Service (This building block is an enhanced version of the *Rating Engine* building block, which was used in Trial 1.)
  - Information required:
    - Customer details (name, addresses, etc.)
    - End-user details (userID, etc)
    - Service package details (serviceID, activation time, etc)
    - CoS level (a numeric value denoting CoS level)
    - Tariff type (private, business, day-of-the-week, time-of-the-day, etc.)
    - Discount type
- The IESP Order Handling Process sends a request to the Service Configuration Process of the VPN service provider to create the appropriate service instance for the IESP customer.
  - Building block contracts involved:
    - VPN-SC (Service Configuration)
  - Information required:
    - Customer contact
    - Service Class List
    - Alias Name
    - Access Points

- The IESP Order Handling Process sends a request to the Service Configuration Process of the VPN service provider to create a VPN connection for the IESP customer.
  - Building block contracts involved:
    - VPN-SC
  - Information required:
    - Parameters for creating the VPN connection (Customer_Contact, Alias_Name, VPN_ID, Connection)
- The Service Configuration Process of the VPN service provider sends a reservation request to the Service Configuration Process of the GQIPS provider to guarantee the QoS of the connection.
  - Building block contracts involved:
    - VPN-P
    - GQIPS
  - Information required:
    - List of RARs
- The Order Handling Process of the IESP sends a request to the Service Configuration Process of the ASP to create the appropriate IR service instance for the IESP customer.
  - Building block contracts involved:
    - SLAHandlingService
  - Information required:
    - Customer and service details

5.7 External Information Model for Fulfilment-Billing

This section details the information objects that are passed between the different organisations in the model.

5.7.1 IES Order Handling

A list of the information objects exchanged between the IES Customer and the IES Order Handling system is given below. For each interaction that appears in the activity diagram a list of the corresponding information objects is provided.

Activity Diagram Interaction	Information Objects exchanged
SLA_Request	SLA_Request
SLA_Proposal	SLA_Proposal
SLA_Customer_Confirmation	SLA_Customer_Confirmation
SLA_Provider_Confirmation	SLA_Provider_Confirmation

Table 5-2 Information object exchanged in the Activity Diagram

A textual description of the information objects exchanged between the IES Customer and the IES Order Handling system follows.

SLA_Request: This object contains an initial request from a prospective IES Customer to the IES Provider for a quote. Service level parameters are specified; these are called service level objectives (SLO). The contact details of the prospective IES Customer are optional so that an anonymous request can be accommodated here.

SLA_Proposal: The SLA_Proposal has a more complete SLO specification than the SLA_Request such as tariffs, actual activation times, penalties, etc.

SLA_Customer_Confirmation: This object contains a confirmation that a prospective IES Customer accepts one of the SLA proposals offered by the IES Order Handling system. This confirmation contains the contact details of the prospective IES Customer, which are compulsory here.

SLA_Provider_Confirmation: This is a confirmation from the IES Order Handling system that details the SLA established in its final form. This SLA forms a legally binding document between the two parties.

A number of UML class diagrams are employed to describe the information objects of the table above [FORM Contracts]. The following diagram the SLA Customer Confirmation information object.

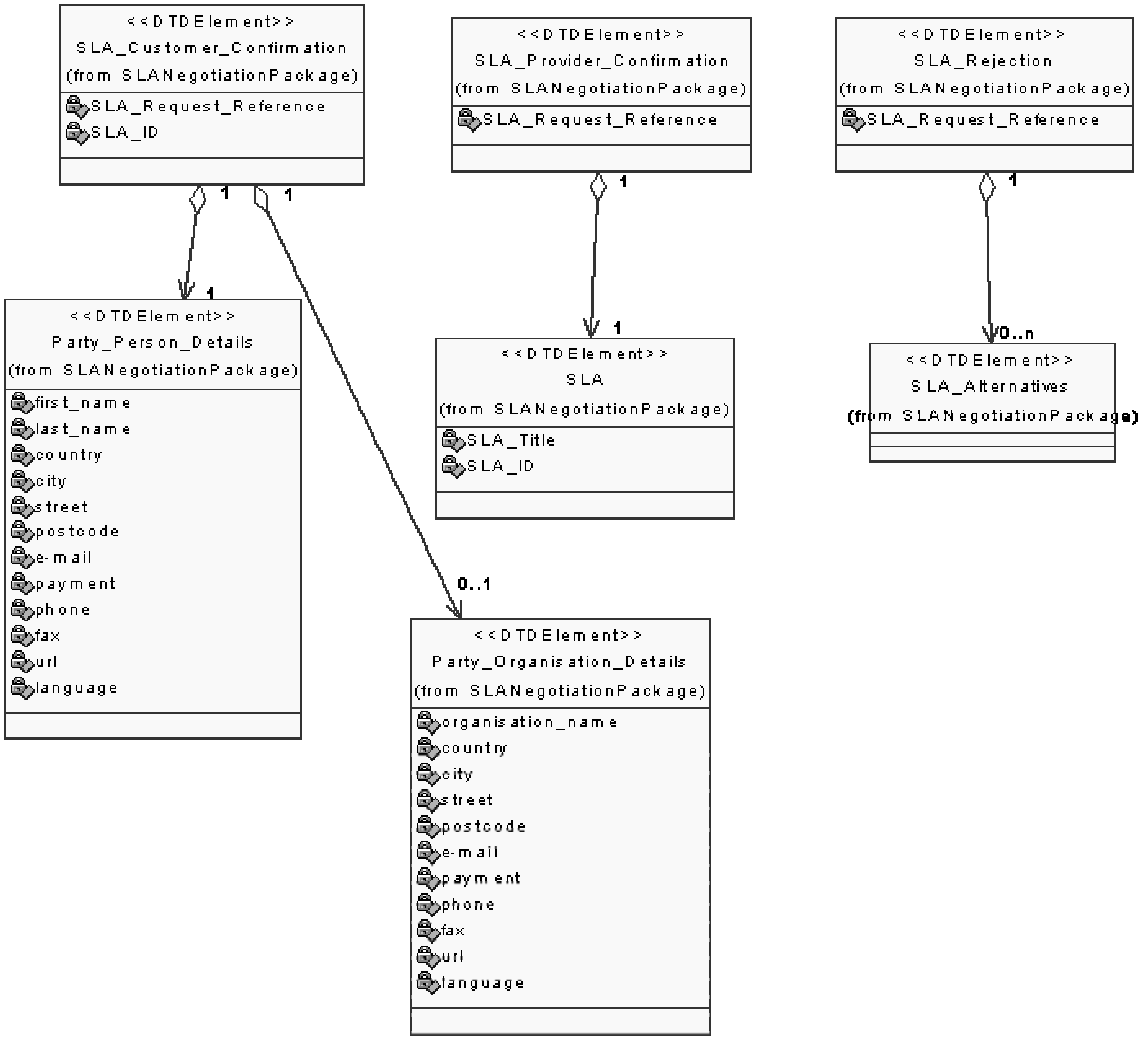

Figure 5-6 SLA_Customer_Confirmation

5.7.1.1 IES Billing

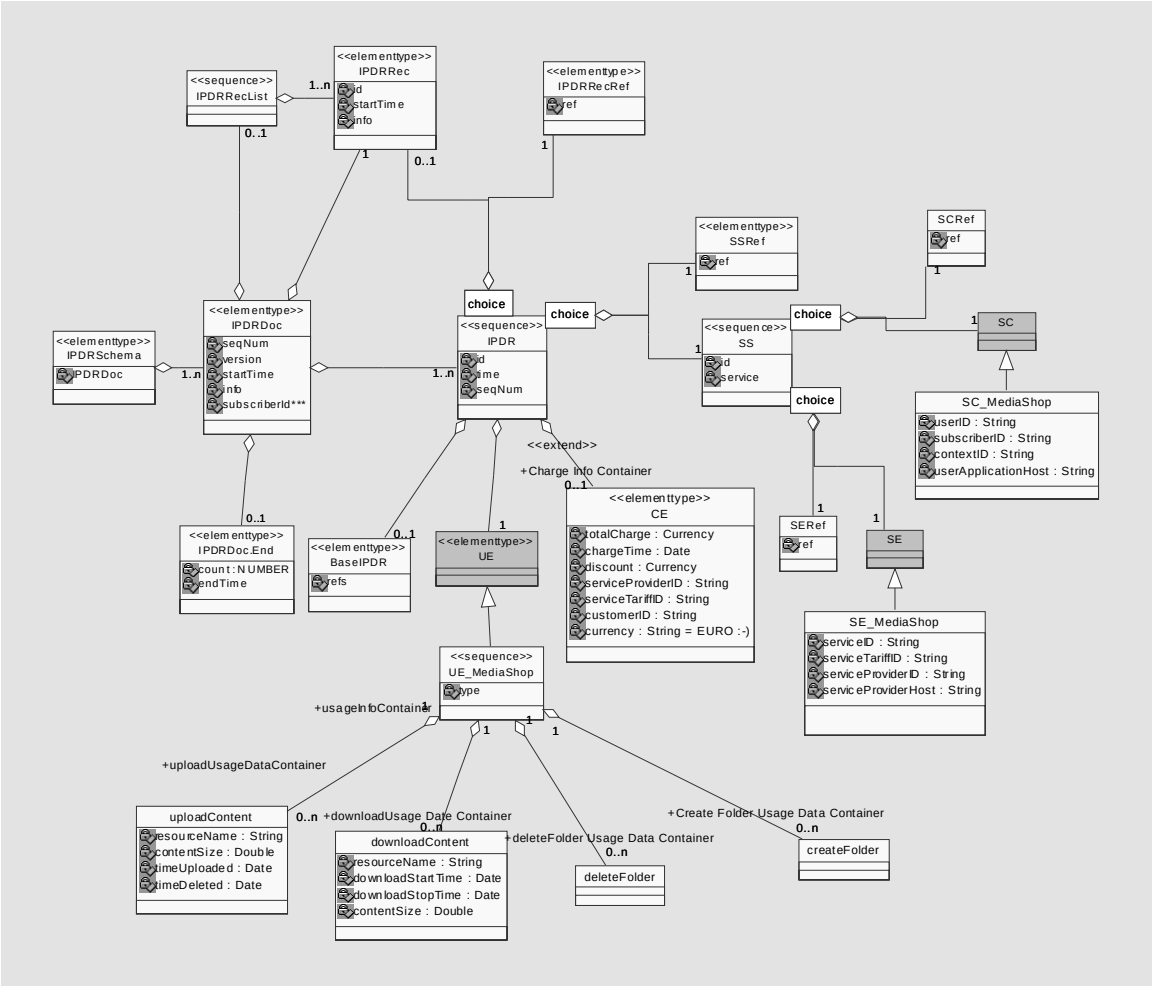

Figure 5-7 Billing Group Information Model

The Billing group information model is illustrated above. The core elements are described below:

- **IPDRDoc**: This is the top-level container of a set of IPDRs elements.
- **IPDRRec**: Describes the service or network element that is responsible for creating the IPDRDoc.
- **IPDR**: This element records the event describing the actual service usage.
    - It contains pairs of SE (Service Element) and SC (Service Consumer) elements under SS (Service Session) element.
    - Describes an event between a SC and a SE.
    - Details of the usage (that is the data such times-stamps, file size, etc) are contained in the UE (Usage Entry).
- **Service Session (SS):**
    - Groups SC and SE information for structural convenience
    - Repeated pairs of SC and SE can be used in an on-going session.
- **Service Consumer (SC): Describes the Service Consumer.**
    - Examples: subscriberID, ipAddress
- **Service Element (SE): Describes the Service Element**

- Examples: VoIP Server Address, MediaShop Server Address, etc.

- **Usage Entry (UE): Describes the usage data.**
  - Examples: startTime, endTime, CallDuration, movieName, TerminationStatus, numberOfVideoStream, etc.
- **Charge Entry (CE): Describes the charge details**
  - Examples: charge, discount, currency, etc.

The following table shows the SLA information on which the Billing group relies for the calculation of charges and presenting the bill to the customer.

Activity Diagram Interaction	Information Object Exchanged
SLA_Customer_Confirmation	serviceID
	serviceTariffID
	customerID
	userID
	CoS (Class of service)
	discountType

Table 5-3 SLA information

5.7.2 VPN Service

A list of the information objects exchanged between the IES Order Handling system and the VPN Service (VPN Service Configuration BB) is given below.

Activity Diagram Interaction	Information Objects exchanged
Request_VPN-Service_Arguments	Request_VPN-Service_Arguments
Request_VPN_Service_Return_Values	Request_VPN_Service_Return_Values
Create_VPN_Connection_Arguments	Create_VPN_Connection_Arguments
Create_VPN_Connection_Return_Values	Create_VPN_Connection_Return_Values

Table 5-4 VPN information

A textual description of the information objects exchanged between the VPN Service Customer and the VPN Service system follows.

Request_VPN_Service_Arguments: This argument list contains objects to be sent by the VPN customer to the VPN SP when requesting creation of a VPN service. The objects passed are: Customer_Contact, Service_Class_List, Alias_Name, Access_Points (including SAG, SAPs in SAG).

Request_VPN_Service_Return_Values: This argument list contains objects returned by the VPN SP to the VPN customer after a Request_VPN_Service. The objects passed are: VPN_ID, Customer_Contact, Alias_Name, Service_Class_List, SP_Contact, Created SAGs and SAPs.

Create_VPN_Connection_Arguments: This argument list contains objects to be sent by the VPN customer to the VPN SP when requesting creation of a VPN connection, based on a VPN already created. The objects passed are: Customer_Contact, Alias_Name, VPN_ID, Connection.

Create_VPN_Connection_ Return_Values: This argument list contains objects returned by the VPN SP to the VPN customer after a Create_VPN_Connection. The objects passed are: Customer_Contact, Alias_Name, SP_Contact, VPN_ID, Connection.

The Figure below provides a detailed definition of information objects to be exchanged as a UML class diagram.

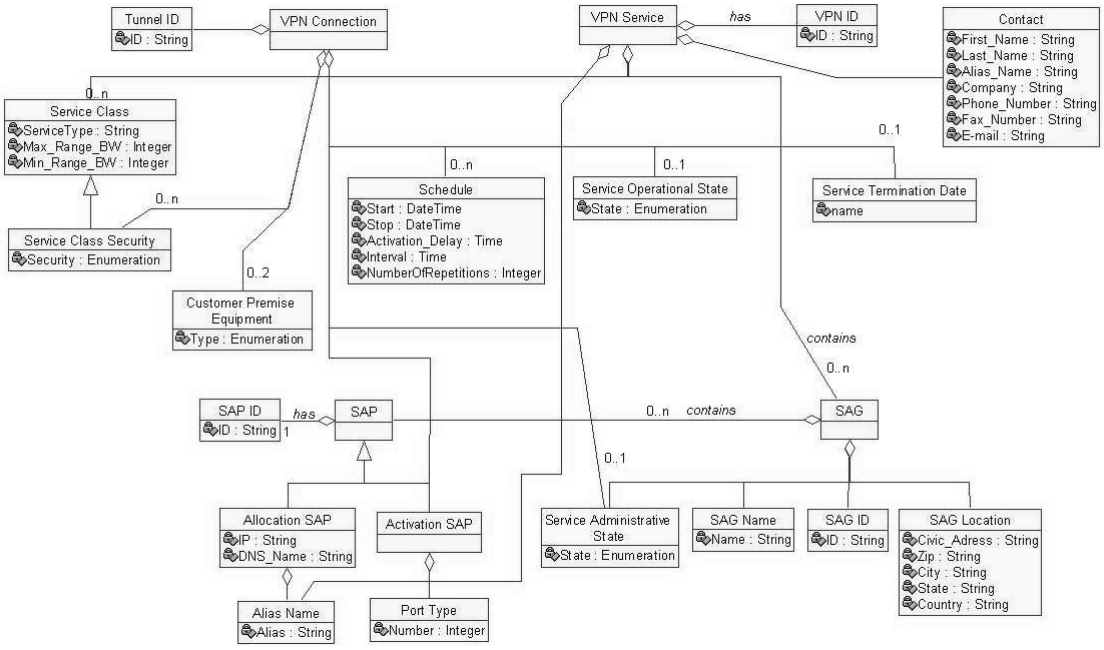

Figure 5-8 VPN Service Information Objects Exchanged

5.7.3 GQIP Service

A list of the information objects exchanged between the VPN Service system (VPN Provisioning BB) and the GQIP Service system (ResourceAllocationManager) is given below.

Activity Diagram Interaction	Information Objects exchanged
RequestReservation	BandwidthBrokeredSLA
Reservation Answer	BandwidthBrokeredSLA

Table 5-5 GQIPS Information

A textual description of the information objects exchanged between the VPN Service system and the GQIP Service system follows.

BandwidthBrokeredSLA: Main information contained in this object is: sLAId, sLAName, state (requested, activated, altered, denied error) and a list of RARs (Resource Allocation Request).

The Figure below provides a detailed definition of information objects to be exchanged as a UML class diagram.

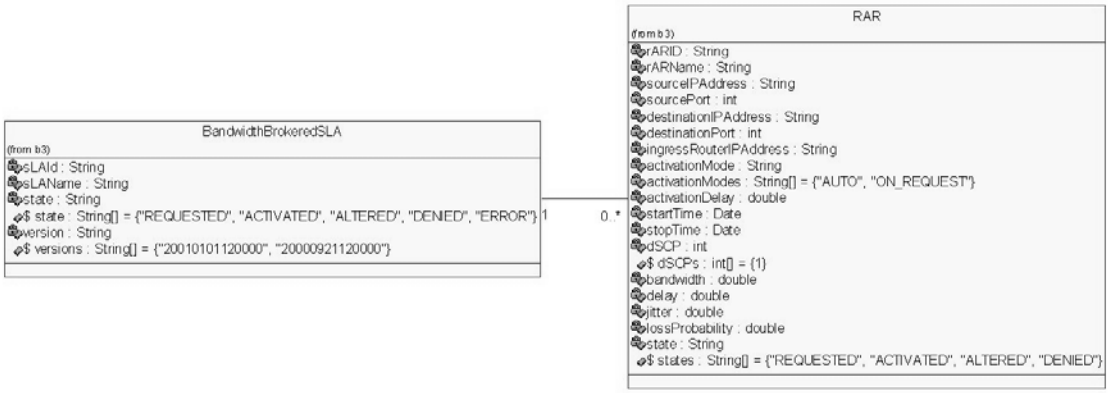

Figure 5-9 GQIP Service Information Objects Exchanged

5.7.4 IR Service

The following table shows the information that the ASP requires to create an instance of the IR service for the customer.

Activity Diagram Interaction	Information Object Exchanged
Create_Service_Instance_Request	service_templateID
	customerID
	providerID

Table 5-6 IR Service Information

service_templateID: The service ID, SLA parameters selected, when to activate (and/or terminate) the service instance

customerID: Customer details required to activate the service instance

providerID: Reference to the service provider offering the service to the customer

5.8 Model Missing Objects

The next step of the process was to check necessary information to be exchanged between Fulfilment BBs and Billing BBs regarding defined BB contracts and information models.

This section examines the effects that such a flow-through sub-scenario has had on the information models of the individual building blocks and contract specifications that were designed for Trial 2.

IES SLA Negotiation – IES Order Handling

The external information model used to support the interactions between the SLA Negotiation Engine and the SLA Handling Service was intended for the Fulfilment group scenarios. However, the model has been able to incorporate interactions with the Billing group as information required by the Billing group was originally included in the specification of the SLA information model. This information includes customer and service details as well as the tariff that is being applied to the customer's subscription.

IES Order Handling - VPN Service

The external information model used to support the interactions between the IES Order Handling system and the VPNS system, based on the scenario defined by the Fulfilment-Billing Group, corresponds to the VPN-SC Contract specification. The basic design premises are (a) the capabilities provided by the IES should be transparent to the IES customer and (b) it should be one-stop shopping from the point of view of the IES customer. When the IES Provider establishes services for a new ASP a number of design choices have to be made:

- How dynamic should the service provided to the ASP be?
- How much information should go into the SLA between ASP and IESP?

How dynamic the service is depends on the needs of the ASP. If the ASP is an information retrieval service, where it is possible to download music, video, etc. it is a critical requirement that the ASP can establish VPN connections dynamically between the ASP server and the customer's machine. If on the other hand the ASP is a storage area network provider and the service offered is incremental backup performed at regular intervals, e.g. each night between 3am and 5am, then the need for dynamic establishment of connections is low if the SLA can contain data access point data, e.g. IP-addresses for originating and terminating end-points, and service activation data, e.g. schedules for reoccurring services. So for each concrete ASP system that wants to use the IES service, there is a need to balance the degree of dynamic establishment of service with the amount of information put in the SLA.

Another design issue is how high-level SLA parameters, e.g. service class, are mapped to more concrete VPN parameters. To give an example of how this would be done the service class in an information retrieval service is used. The customer can choose between "Gold", "Silver" and "Bronze" service class when subscribing to the ASP, the IES in turn offers a larger number of service classes with fixed bandwidth and security parameters to the ASP, while the VPNS operates with a more complex service class concept, where a number of parameters can be specified. So the ASP has to map its service class concept to that of the IES, which in turn has to decide on parameters to give the VPN. A scenario: The customer chooses "Gold" as the service class (SC) in its SLA with the ASP. The ASP has mapped its own "Gold" SC concept to the IES "Multimedia - High security" SC concept, which states that bandwidth should be between 128 Kb/s and 256 Kb/s with "High security". The IES in turn has to map this to the VPN SC concepts, detailing even more what "High security" means in the VPN concepts for a specific VPN-tunnel paradigm.

VPN Service – GQIPS

The external information model used to support the interactions between the VPNS system and GQIPS system in the fulfilment-billing integrated sub-scenario corresponds to the GQIPS BB contract specification. No change of this contract has been necessary for adaptation to the sub-scenario.

IES Order Handling – IES Billing

The Billing information model used in the Billing group contracts has not been modified for the definition of the Fulfilment-Billing sub-scenario. However, it must be noted that Billing group and the Fulfilment-Billing sub-scenario have chosen different models to structure their information. The Billing group uses the IPDR information model to structure its information. The Billing group and the Fulfilment-Billing sub-scenario share a small proportion of information (a well-defined set of information). This set of information is syntactically and semantically identical in the Billing group and the Fulfilment-Billing sub-scenario and contains mainly the details of the end user, customer, and service being offered. It is used primarily for the calculation of charges and preparation of bills. The information that the Billing group does not share with the Fulfilment-Billing sub-scenario concerns mainly the actual use of service.

5.9 Implement Building Block Integration

The VPN business logic is part of the VPN Service Configuration Building Block. It has not been decided to have a separate business logic part to be implemented in e.g. a work flow engine. The reason is that the VPN building blocks reside in a hierarchy applying a layered architectural style. There are no two building blocks residing in the same layer. If there were more building blocks on the same layer, the option of having separate business logic in a separate building block should be considered.

6 Business Process Driven Systems Modelling for Fulfilment-Assurance

The aim of this Section is to show how the FORM Fulfilment and Assurance processes can be integrated by having the Fulfilment processes inform the Assurance processes about the creation of a new service agreement with a customer for which assurance of the service has to be activated.

This Section also demonstrates the application of the FORM methodology "Business Process Driven System Development Guideline" [FORM D12] to the Inter Enterprise Service (Fulfilment and Assurance) Management Domain.

Business Process Driven System Development Guideline [FORM D12] – Workflows:	**System Models [FORM D11] – FORM Methodology applied in Sections:**
1. Perform Business Modelling and Reference Architecture Refinement Workflow	6.1 Business Use Case Model 6.2 Business object Model 6.3 Reference Architecture
2. Define Requirements Analysis Workflow	6.4 Use case Model
3. Perform System Processes and Information Modelling Workflow	6.5 System Process and Information Model
4. Re-model System processes and Map to Building Block Contracts Workflow	6.6 Mapping to Building Block Contracts 6.7 External Information Model
5. Model Missing Objects and Information Workflow	6.8 Model Missing Objects
6. Implement Building Block Integration	6.9 Implement Building Block Integration

Table 6-1 Mappings between FORM Methodology and FORM System Models

6.1 Business Use Case Model for Fulfilment-Assurance

The FORM Fulfilment-Assurance business use case is that of a Customer seeking an Information Retrieval e-Learning Service from a multimedia Educational Service Provider. In this business use case, the Customer is seeking (a) the delivery of the multimedia e-Learning service over a VPN, plus (b) monitoring for the quality of service (QoS) of the e-Learning multimedia service. The Customer agrees a SLA, which encompasses the VPN connection parameters as well as the QoS assurance parameters for the e-Learning service. In this model, the Assurance Service is carried out by the IESP.

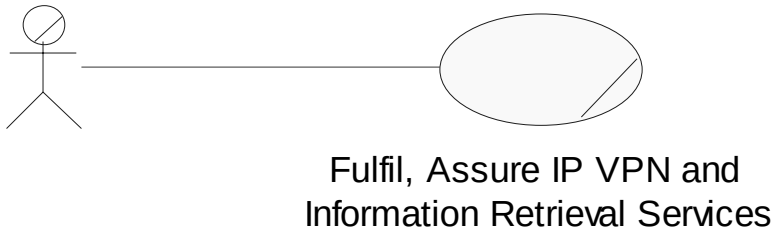

Figure 6-1 Business Use case Diagram for Fulfilment-Assurance

The business use case description in terms of the service provided to the customer is as follows:

Pre-requisites:

1. The IESP has a prior agreement with the Educational Service Provider that it can configure its service monitoring equipment with various profiles in order to monitor the multimedia e-Learning service.
2. The IESP has an agreement with the Customer Organisation so that it can configure the service monitoring equipment at the customer site.
3. When a Customer subscribes to an e-Learning Service with a request for particular quality of service, the Customer initiates the VPN and Assurance Service order to the IESP (either automatically or implicitly).

Business use case description:

1. Customer requests an e-Learning service at a particular QoS, and for this service to be offered over an IP based VPN. The IESP Order Handling Process handles the VPN and Assurance services.
2. The IESP Order Handling agrees to the SLA and initiates the fulfilment of the VPN connection and the QoS assurance of the multimedia e-Learning service.
3. The Assurance service gets the e-Learning QoS parameters and configures the customer monitoring and service provider monitoring services.
4. The VPN service accepts the VPN service parameters and configures this VPN service accordingly.
5. When both the VPN and Assurance configurations are complete, a notification is sent to the Order Handing process to indicate that service is ready for activation.

6.2 Business (Object) Model for Fulfilment-Assurance

The figure below depicts the Business Object Model for the Fulfilment-Assurance business use case. Each organisation is represented as a package. The business use case is implemented as worker classes, namely VPN Service, Order Handling, Assurance Service, CustomerServiceMonitor and ServiceProviderMonitor. It is assumed that the end point connections of the VPN service are located in the ServiceProviderMonitor and the CustomerServiceMonitor.

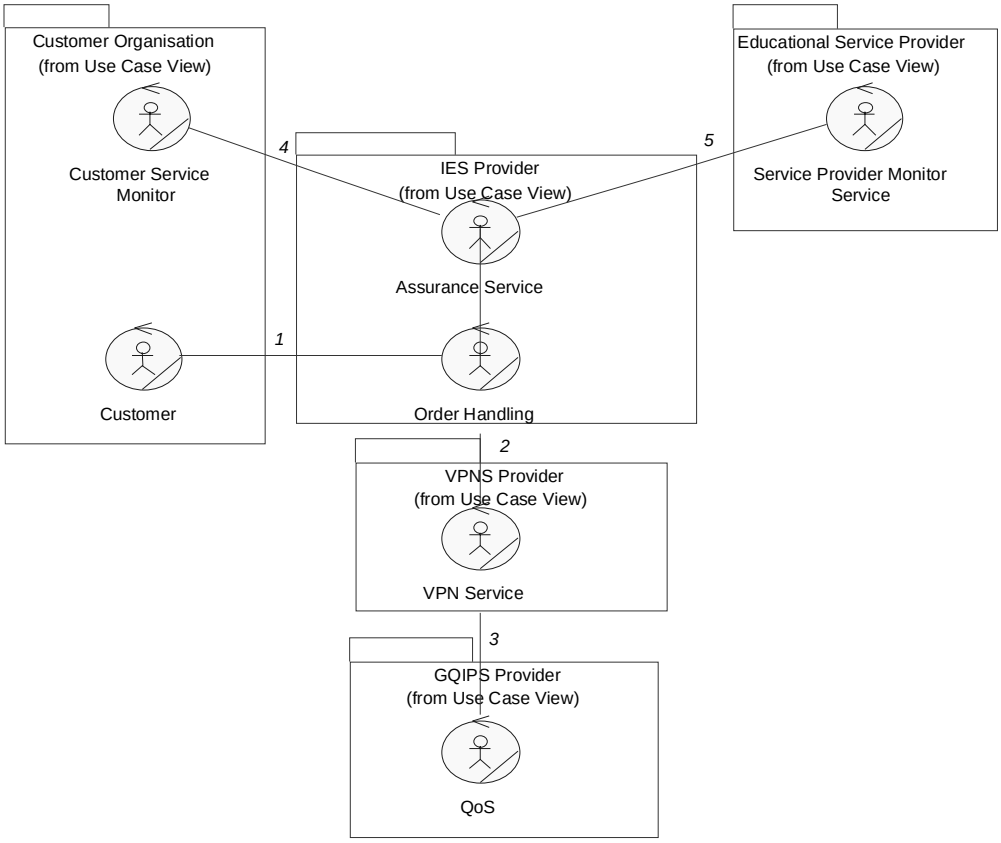

Figure 6-2 Business Object Model for Fulfilment-Assurance

As shown in the figure, the following business relationships exist:

1. The Customer negotiates and buys an e-Learning service package from the IES Provider consisting of a VPN service, e-Learning service and Assurance service. The result of this negotiation is an SLA, which details the e-Learning service package ordered. The relationship between the IES Provider and the IES Customer is concerned with the customer relationship management processes, which in this business use case is Order Handling.
2. The VPN Service Provider is providing a VPN service to the IES Provider and a contract, including a SLA, has been signed between them to this effect. The relationship between the IES Provider and the VPN Service Provider is concerned with providing enough information about the new customer/service to allow the VPN Service Provider to create a service instance for the IES Customer and to provide usage data to the IES Provider for billing purposes.

3. The GQIPS Provider has signed an agreement with the VPN Service Provider to provide end-to-end links at the specific QoS requested by the VPN Service Provider. The relationship between the VPN Service Provider and the GQIPS Provider is concerned with providing enough information about the links and QoS to allow the GQIPS Provider to provision the required links at the required QoS.
4. The IES Provider's contract with the Customer enables installation of Customer Service Monitoring software at the Customer domain. The IES Provider Assurance Service configures the Customer Service Monitor to monitor and process all customer server statistics necessary for calculation of SLA QoS assurance parameters. The Customer Service Monitor reports all required statistics back to the Assurance Service.
5. The IES Providers contract with the Educational Service Provider enables installation of Service Provider Monitoring software at the Educational domain. The IES Providers Assurance Service configures the Service Provider Monitor to monitor and process all service provider server statistics necessary for calculation of SLA QoS assurance parameters. The Service Provider Monitor reports all required statistics back to the Assurance Service. Notification events are generated by the Assurance Service if SLA QoS parameters are violated.

6.3 Reference Architecture for Fulfilment-Assurance

The reference architecture shown below describes the interactions that occur between the management processes involved in the Fulfilment–Assurance scenario. The management processes involved in the scenario are the following: (a) in the IES Provider domain there is Order Handling, SLA Management, Assurance Configuration and Performance Monitoring, (b) in the ASP domain is Server Management, (c) in the VPNS Provider domain is VPN Service Configuration and VPN provisioning (d) in the GQIPS Provider domain is GQIPS Management and (e) in the IES Customer domain is Customer Service Console and Customer Premises Equipment Management. The inter domain reference points are IES-CM, VPNS-PM, IES-AS, and GQIPS-PM. The lines connecting management processes represent interaction between these process groups.

The Customer Service Console contains processes enabling a Customer to place an order with the IES Provider. This involves sending SLA proposals and confirmations to Order Handling over the IES-CM reference point. Order Handling manages Customer orders. It interacts with SLA Management, VPN Service Configuration and Assurance Configuration. SLA Management handles SLA negotiation and VPN Service Configuration and Assurance Configuration generate system configurations based on the service details contained in the SLA. Order Handling initiates VPN Service Configuration over the VPNS-PM reference point. Assurance Configuration deploys policies to Server Management over the IES-AS reference point, and deploys policies to CPE Management over the IES-CM reference point. Performance Monitoring collects statistics from Server Management and CPE Management.

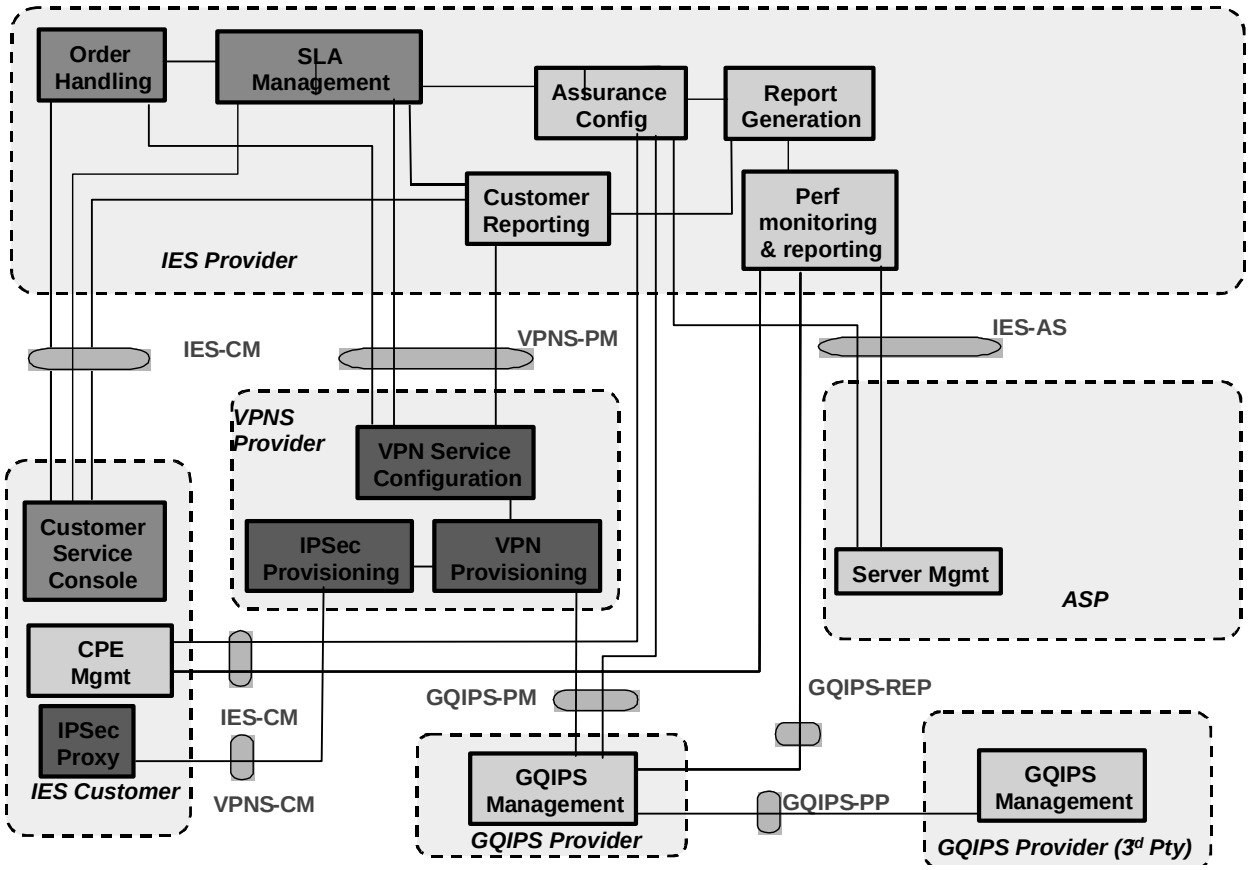

Figure 6-3 Reference Architecture for Fulfilment-Assurance

6.4 Use Case Model for Fulfilment-Assurance

The business model is used to identify the system use cases.

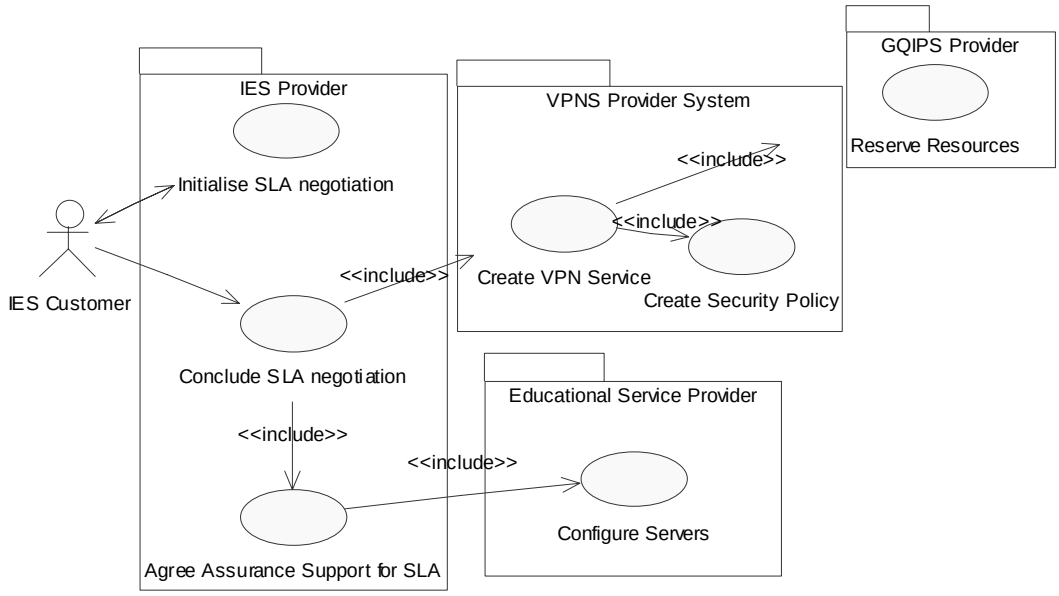

Figure 6-4 Use case diagram for Fulfilment Assurance

Each of these use cases are shortly described as follows:

Initialise SLA Negotiation: This use case represents the initial phase of SLA negotiation and comprises the activities of the end-customer requesting and receiving an SLA proposal from the IESP.

Conclude SLA Negotiation: This use case covers the process of the IES Customer and completes the proposed SLA by adding customer details and returning the SLA to the IES provider as an indication that the SLA has been accepted.

Create VPN Service: This use case covers the process of establishing the VPN for the selected service, based on parameters from the agreed SLA.

Reserve Resources: This use case covers the process of reserving, using the GQIPS provider, the necessary network resources for the requested service.

Create Security Policy: This use case covers the creation of the security policy necessary for implementation of the specified VPN service.

Agree Assurance Support for SLA: This use case details configuration of the Assurance service based on the QoS parameters agreed upon in the SLA.

Configure Server Monitor: This use case details the configuration of a server monitor using a service configuration policy.

6.5 System Process and Information Model – Activity Diagram for Fulfilment-Assurance

The use cases are mapped into an activity diagram shown below. Following the diagram is a brief description of each activity.

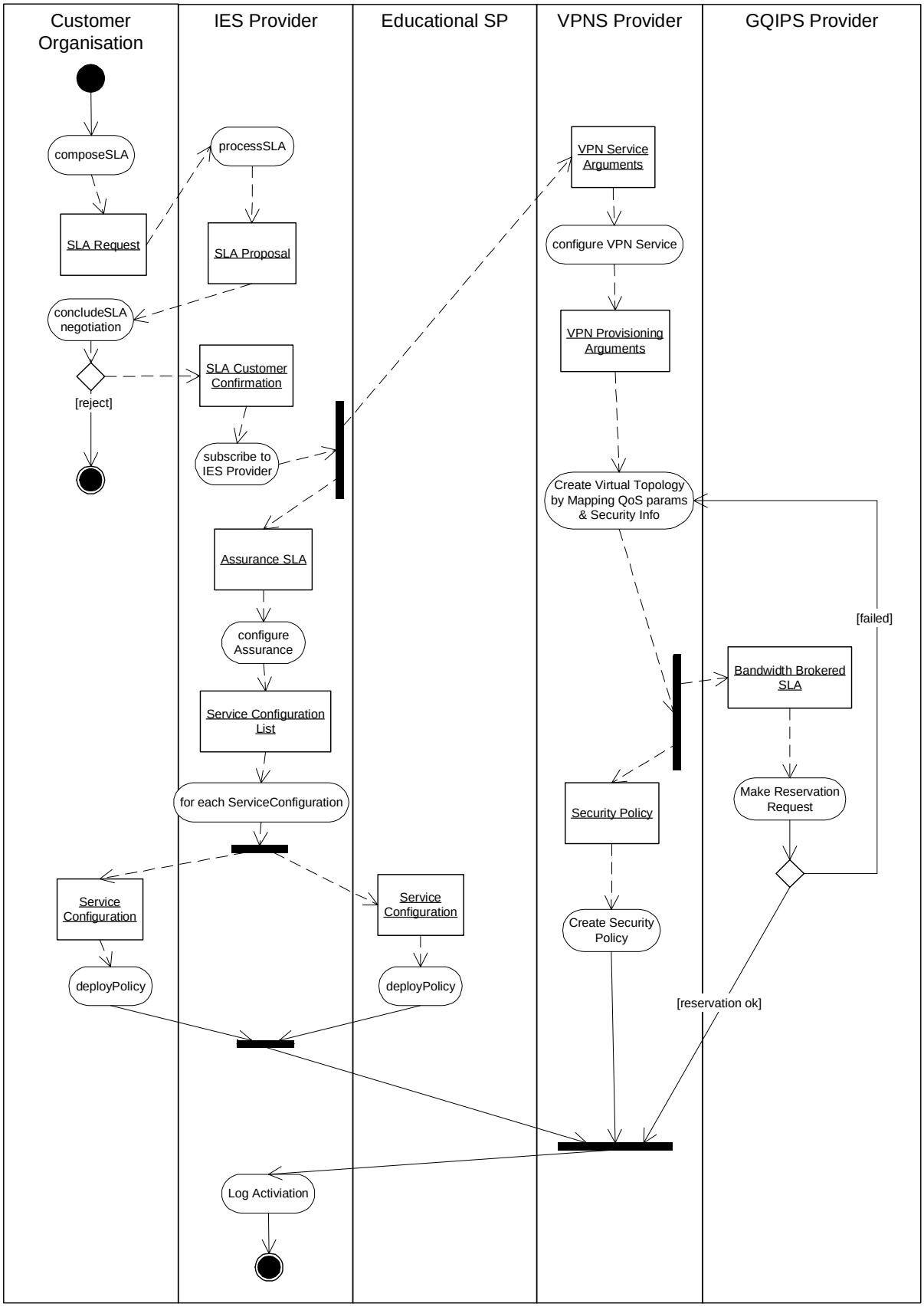

Figure 6-5 Activity diagram for Fulfilment-Assurance

Compose SLA: The Customer composes an SLA request for the e-Learning multimedia service using the customer service console and sends it over the Internet (HTTP protocol) to the IES Provider.

Process SLA: The IES Provider receives the SLA request, processes it and sends back a SLA proposal. These first two activities map to the Initialise SLA Negotiation use case.

Conclude SLA negotiation: The customer is happy with the proposal and confirms the order by sending back a SLA customer confirmation to the IES Provider.

Subscribe to IES Provider: The IES Provider receives the SLA customer confirmation, registers it in the SLA database and invokes configuration of the VPN and Assurance services with the relevant SLA parameters. These previous two activities map to the Conclude SLA Negotiation use case.

Configure VPN Service: The configuration process of the VPN Service uses the VPN Service arguments to configure the customer's required VPN service.

Create Virtual Topology by mapping QoS parameters & Security Info: A virtual topology is created by the VPN Provisioning using VPN Provisioning parameters. These parameters are mapped to policies ready for deployment. These previous two activities map to the Create VPN Service use case.

Make Reservation Request: A request is made to reserve the resources necessary for provisioning the VPN service. If the request is rejected the virtual topology will have to be revised. This maps to the Reserve Resources use case.

Create Security Policy: A call is made to implement the security policy necessary for the VPN service. This maps to the Create Security Policy use case.

Configure Assurance Service: The configuration process of the Assurance Service uses the Assurance SLA parameters to configure the service. A service configuration policy is generated for each of the assurance monitoring systems. This activity maps to the Agree Assurance Support for SLA use case.

Deploy Policy: Each service configuration policy is deployed to its monitor to implement the monitoring of low level data which is relevant to the specified QoS assurance parameters. These monitors reside at both ends of the VPN connection (i.e. at the Customer Organisation and at the Education Service Provider). This activity maps to the Configure Server Monitor use case.

Log Activation: The fulfilment of the order is logged by the IES Provider.

6.6 Mapping to Building Block Contracts for Fulfilment-Assurance

The following figure shows the final iteration of the activity diagram where the activities are decomposed to the Building Block Contract level. Notes attached to activities are used to specify the BB Contract that implements the activity. The *processSLA* activity is decomposed to *receiveSLAOrder* and *processSLA*, *subscribeToIESProvider* decomposes to *receiveConfirmataion* and *processConfirmation*. No Building Block Contract functionality was found for the L*og Activation* activity. It is also noted that the *Foreach ServiceConfiguration* activity is used to express control flow that could not be represented properly by the UML activity diagram constructs.

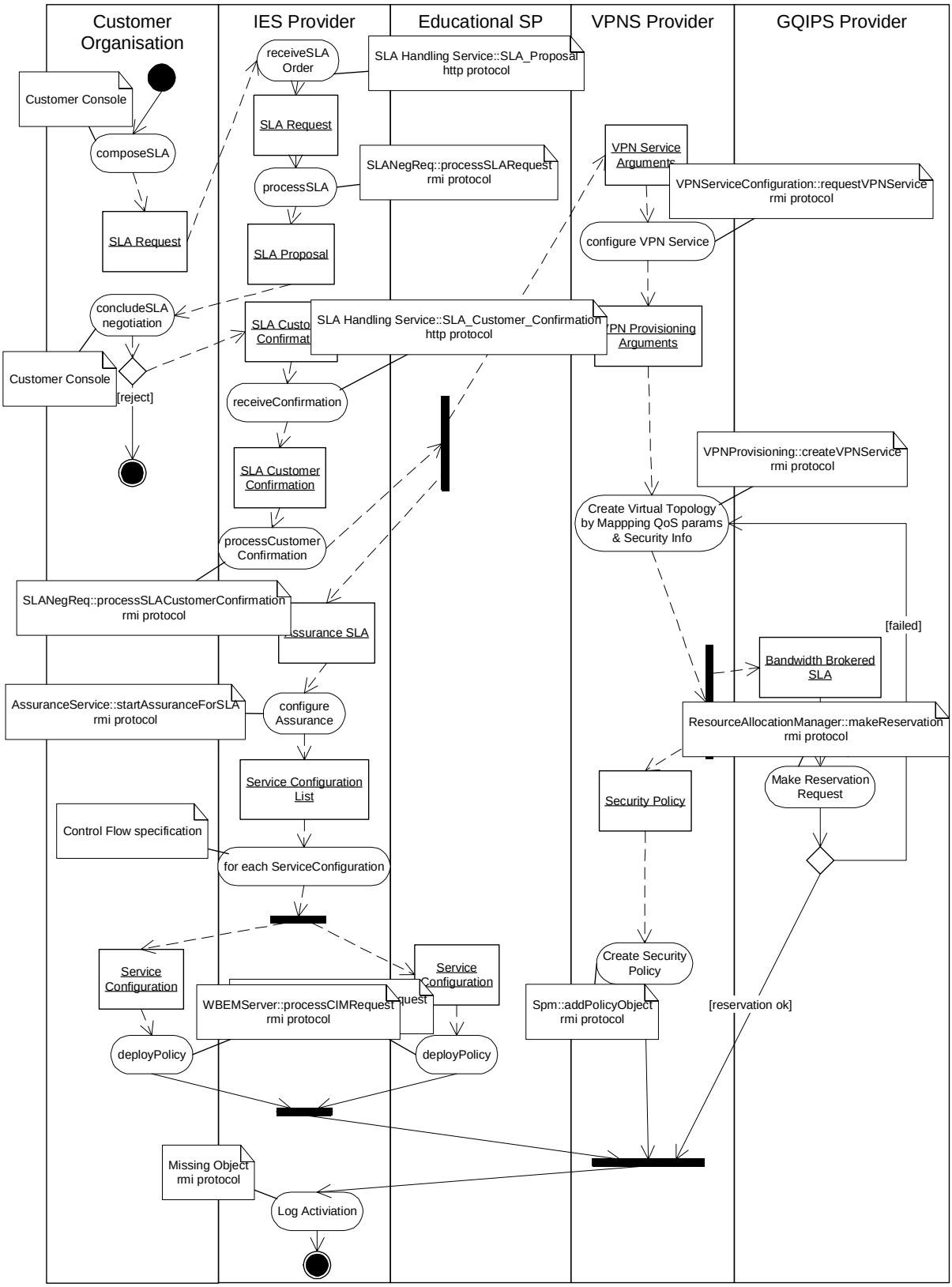

Figure 6-6 Final iteration of Activity Diagram with mapping to BB Contracts

6.7 External Information Model for Fulfilment-Assurance

This section details the information objects that are passed between the Building Block Contracts that are involved in the process.

6.7.1 SLA_Request

This object contains an initial request from a prospective Customer to the IES Provider for a quote. Service level parameters are specified; these are called service level objectives (SLO). The contact details of the prospective Customer are optional so that an anonymous request can be accommodated here. See Boundary Information Model in [FORM Contracts, SLANegReq].

This object is passed from the Customer Console to SLA Handling Service, and from SLA Handling Service to SLANegReq.

6.7.2 SLA_Proposal

The SLA_Proposal has a more complete SLO specification than the SLA_Request such as tariffs, actual activation times, penalties, etc. See Boundary Information Model in [FORM Contracts, SLANegReq].

This object is passed from the SLANegReq back to the Customer Console.

6.7.3 SLA_Customer_Confirmation

This object contains a confirmation that a prospective Customer accepts one of the SLA proposals offered by the IES Provider system. This confirmation contains the contact details of the prospective Customer, which are compulsory here. See Boundary Information Model in [FORM Contracts, SLANegReq].

This object is passed from the Customer Console back to the SLA Handling Service and then onto the SLANegReq for recording the confirmation.

6.7.4 Assurance SLA

The Assurance SLA details a list of metric names and threshold values for the assurance service to monitor. This object is passed from the SLANegReq to the AssuranceService. There is also a Rule Specification part to this information model that has not been used in this scenario. See below for details.

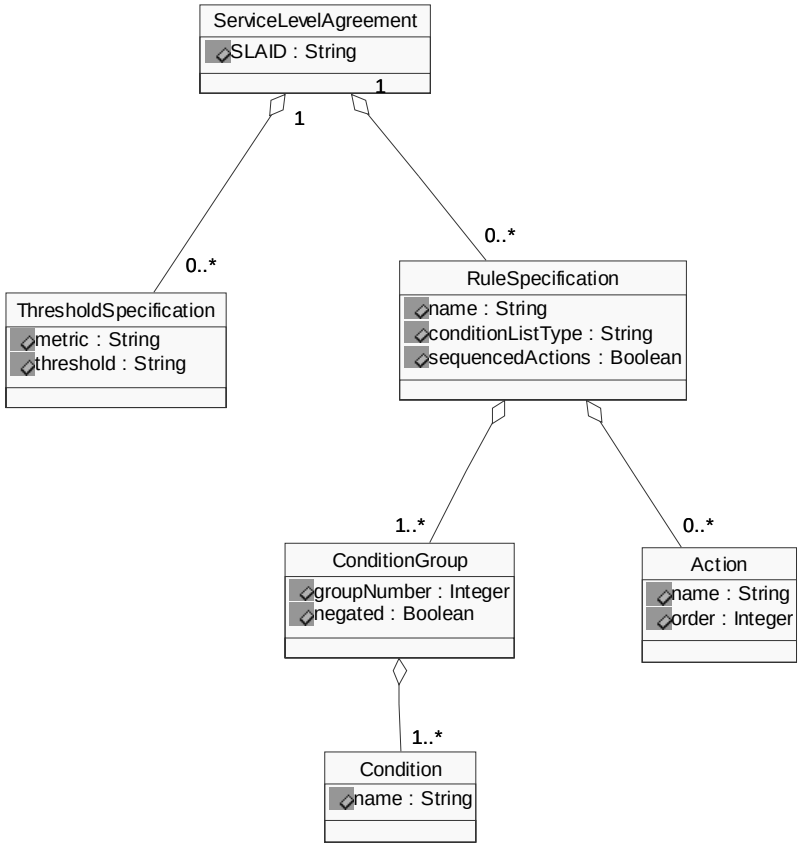

Figure 6-7 Assurance SLA

6.7.5 Server Configuration

Based on the Assurance SLA, the Assurance Service creates Service Configuration 'Policies' for each of its Server Monitor deployments in the Customer and Educational Service Provider domains. This information is used to configure each Server Monitor to monitor the appropriate server statistics. See below for details of the Service Configuration information model.

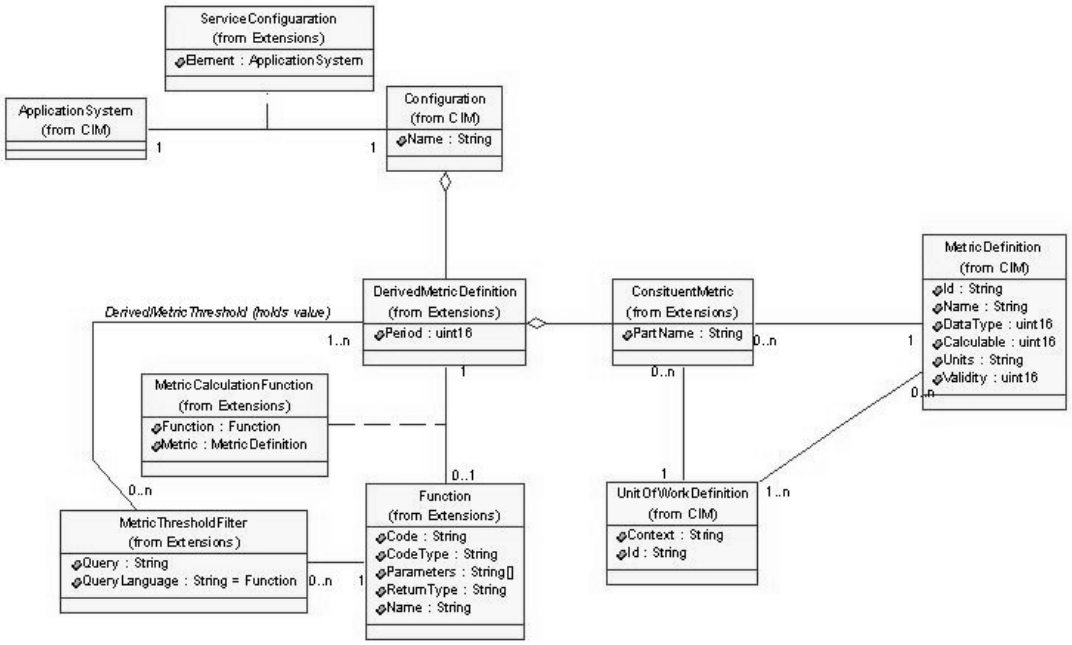

Figure 6-8 Service Configuration Information Object

A server configuration is passed to each of the relevant server monitors in the assurance system.

6.7.6 Request_VPN_Service_Arguments

This argument list contains objects to be sent by the VPN customer to the VPN Service Configuration when requesting creation of a VPN service. The list of objects to be passed are: Customer_Contact, Service_Class_List, Alias_Name, Access_Points (including SAG, SAPs in SAG). See Boundary Information Models in [FORM Contracts, VPNServiceConfiguration] for more details. This object is passed from the SLANegReq to the VPN Service Configuration.

6.7.7 VPN Provisioning Arguments

The VPN Provisioning arguments are passed from the VPN Service Configuration to VPN Provisioning. These are used to create the VPN Virtual Topology. See Boundary Information Models in [FORM Contracts, VPNProvisioning] for more details.

6.7.8 Security Policy

The security policy object is passed from the VPN Provisioning to the Spm to enable implementation of this policy. The information objects that comprise the security policy are detailed in [FORM Contracts, ipsec-pContract].

6.7.9 BandwidthBrokeredSLA

This object is passed from VPN Provisioning to ResourceAllocationManager to enable the network bandwidth to be reserved. The main information contained is: sLAId, sLAName, state (requested, activated, altered, denied error) and a list of RARs (Resource Allocation Request). [FORM Contracts] provides a detailed definition of this information object.

6.8 Model Missing Objects

In this scenario the *Log Activation* activity requires new system functionality to be modelled and implemented. The system use case is identified and shown below.

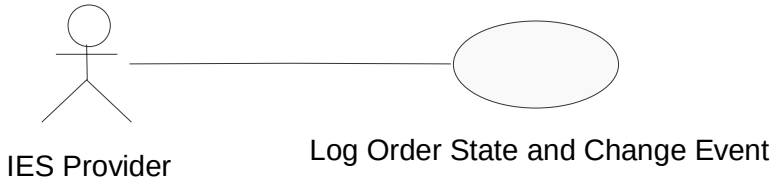

Figure 6-9 System Use Case covering the Log Activation functionality

The development of this use case into further system models was not carried further as it is not considered essential to validating the scenario.

6.9 Implement Building Block Integration

In this scenario a workflow engine approach is used to implement the Building Block Contract integration. The process control and data flow is semi automatically generated from the previous system process activity diagram. It is still necessary to hand code some complex control flow rules that cannot be specified fully in the UML activity diagram. The invocation code for each Building Block Contract can also be auto generated.

7 Business Process Driven Systems Modelling for Assurance-Billing

The aim of this Section is to show how the FORM Billing and Assurance processes can be integrated by having the Assurance processes inform the Billing processes about the periodic statistics for a particular service and SLA parameter violations during a service usage.

This Section also demonstrates the application of the FORM methodology "Business Process Driven System Development Guideline" [FORM D12] to the Inter Enterprise Service (Assurance and Billing) Management Domain.

Business Process Driven System Development Guideline [FORM D12] – Workflows:	**System Models [FORM D11] – FORM Methodology applied in Sections:**
1. Perform Business Modelling and Reference Architecture Refinement Workflow	7.1 Business Use Case Model 7.2 Business object Model 7.3 Reference Architecture
2. Define Requirements Analysis Workflow	7.4 Use case Model
3. Perform System Processes and Information Modeling Workflow	7.5 System Process and Information Model
4. Re-model System processes and Map to Building Block Contracts Workflow	7.6 Mapping to Building Block Contracts 7.7 External Information Model
5. Model Missing Objects and Information Workflow	7.8 Model Missing Objects
6. Implement Building Block Integration	7.9 Implement Building Block Integration

Table 7-1 Mappings between FORM Methodology and FORM System Models

7.1 Business Use Case Model for Assurance-Billing

The Assurance-Billing business use case is that of a consumer seeking a reliable MediaShop service. The customer expects billing for the MediaShop service to reflect the Service Level Agreement (SLA) negotiated with an IESP for the MediaShop service (the IESP will have established a Service Level Specification contract with the MediaShop provider that can fulfil this SLA). Therefore the scenario is that of a customer organisation seeking guaranteed quality of service for the MediaShop service. The management services to be provided to the customer involve the monitoring of QoS parameters for a MediaShop service usage along with the federated mediation of usage and assurance data. The customer also expects the provision of a bill for service usage that reflects both the usage and quality of the service consumed (i.e. any SLA violations/service outages result in service discounts for the consumer). Monitoring of the service is performed on two levels; (a) the actual service itself is constantly monitored for periodic statistics such as mean availability and (b) each individual service usage is monitored against SLA parameters such as MinimumBandwidth.

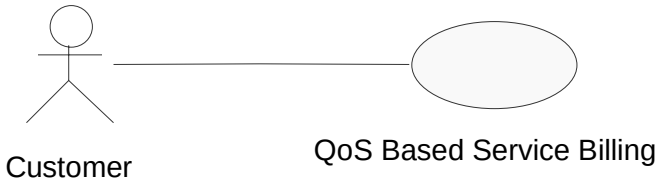

Figure 7-1 Assurance-Billing Business Use Case Model

Pre-requisites:

1. The IES Customer has agreed a SLA for the MediaShop service with the IES Provider.
2. The IES Provider has agreed a Service Level Specification (SLS) with the MediaShop provider that supports the Customer SLA.
3. The MediaShop provider has registered with the Assurance system provider.
4. The Assurance system has registered with the IES Subscription system and can retrieve SLA information from the system.
5. The IES Billing system has registered with the Assurance system in order to retrieve usage and periodic SLA parameter details /reports.

Business Case Description:

1. The Assurance system constantly monitors the MediaShop service for statistics such as MeanAvailability.
2. An Inter Enterprise Service Customer (IESC) attempts to initiate the MediaShop service through the IESP.
3. The IESC is authorised & authenticated against subscription/SLA details.
4. The IESP then initiates the MediaShop service.
5. The IESC performs a MediaShop operation.
6. The MediaShop provider instructs the Assurance system to monitor this service usage against the customers SLA usage QoS parameters.
7. Any SLA Parameter violations details are passed to the Federated Mediation Adapter in the IES Billing system after the service usage is complete.
8. A Service statistics report is periodically (e.g. monthly) retrieved from the Assurance system.
9. The periodic statistics and the usage QoS violations are then factored into the rating process and are discounted according to those parameters specified in the SLA.

7.2 Business (Object) Model for Assurance-Billing

The figure below depicts the Business Object Model for the Assurance-Billing business use case. Each organisation is represented as a package.

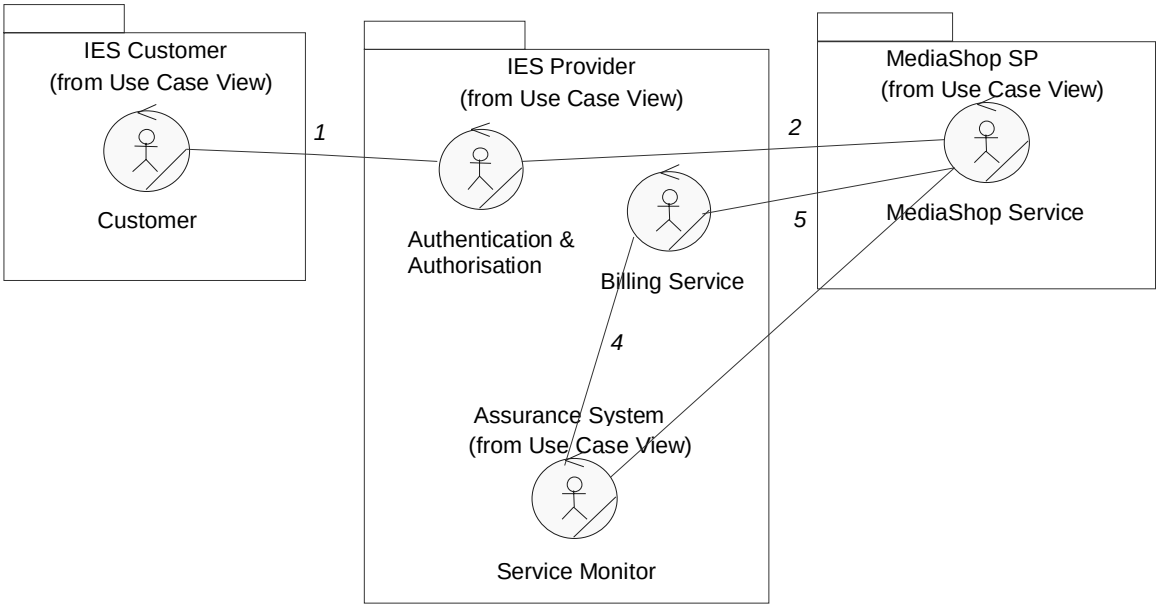

Figure 7-2 Assurance-Billing Business Object Model

The business relationships shown in the Figure can be described as follows:

The MediaShop Service Provider outsources its service Assurance Monitoring to the IESP. The Assurance monitoring system receives all consumer related SLA details from the IESP SLA/Subscription Manager. When a service consumer attempts to use the MediaShop service, the Assurance system is notified that this particular user has attempted to use the service, and assures the service against those SLA parameters that it has received for the user for this particular service. The Assurance system sends assurance details to the FederatedMediationAdapter (FMA) in the IESP Billing service after every usage indicating whether or not a violation has occurred. If the SLA parameters specified have been violated, the Assurance system also passes the relevant violated parameter details. The Assurance Monitoring System also compiles a monthly Service Statistics Report that is passed to the IES Billing service to support periodic discounting for SLA parameters such as meanAvailability of service per period.

The FMA mediates SLA violation details into the extended Internet Protocol Detail Record (E-IPDR) that is received from the MediaShop provider, if no violation has occurred then the violation fields remain empty (indicating no violation for rating).

The following activities are not addressed in any of the models etc. but are included for clarification:

After federated mediation, all E-IPDRs are forwarded to the Rating Bureau Service (RBS), where rating and discounting for usage/violations are performed in accordance with the Tariffs and Charging Schemes specified in the consumer SLA. The charges/discounts are then embedded in the original E-IPDR, which is forwarded to the Accounting Data Store (ACS) to be stored pending bill presentment and querying. The consumer, when presented with discounts on their bill, can query exactly to what level, parameters were violated for a service usage, along with all other usage details.

7.3 Reference Architecture for Assurance-Billing

In this architecture the Assurance system and the Billing system exist within the IESP domain. The ASP domain represents the MediaShop Provider domain in the Assurance-Billing interaction scenario. The contracts that support Billing interactions between the IESP and the MediaShop provider reside at the IES-BS reference point. The Assurance system exposes several contracts at the IES-AS to support the MediaShop usage and periodic service performance monitoring. All billing/accounting/usage information is passed over the IES-BS reference point through the invocation of the InterdomainAccountingManagement contract. It is through the Customer Service Console that the IES Customer can interact with the IESP Billing system, to view usage details, charges, discounts etc. The BillingInteractionManagement contract that supports this interaction resides at the IES-CM reference point.

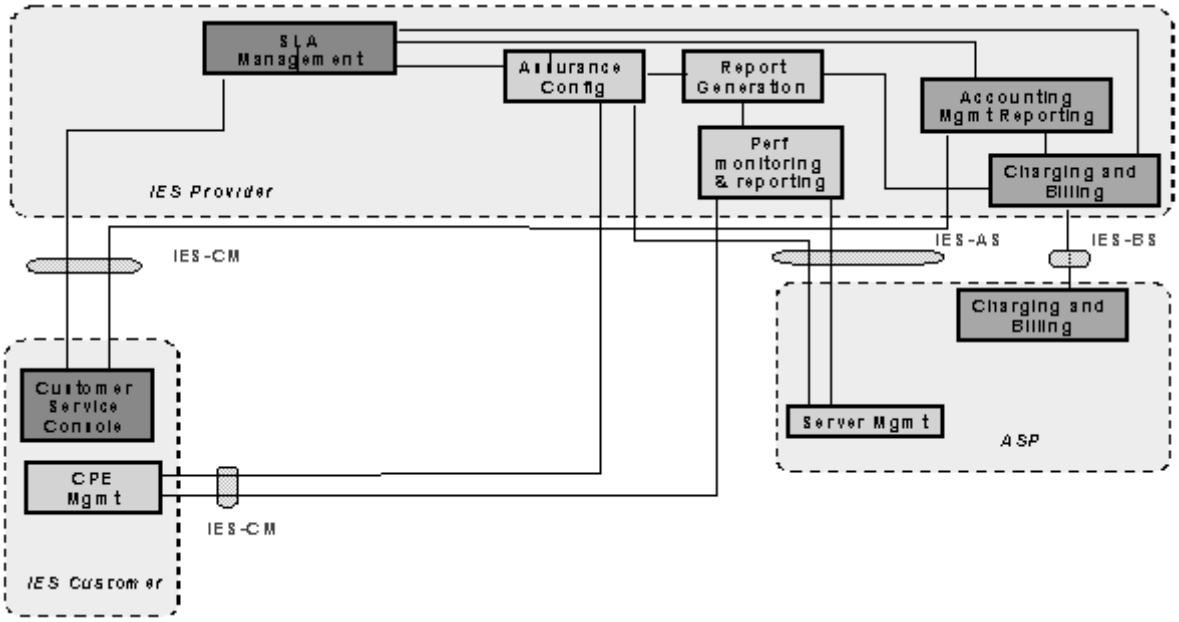

Figure 7-3 Assurance-Billing Reference Architecture

7.4 Use Case Model for Assurance-Billing

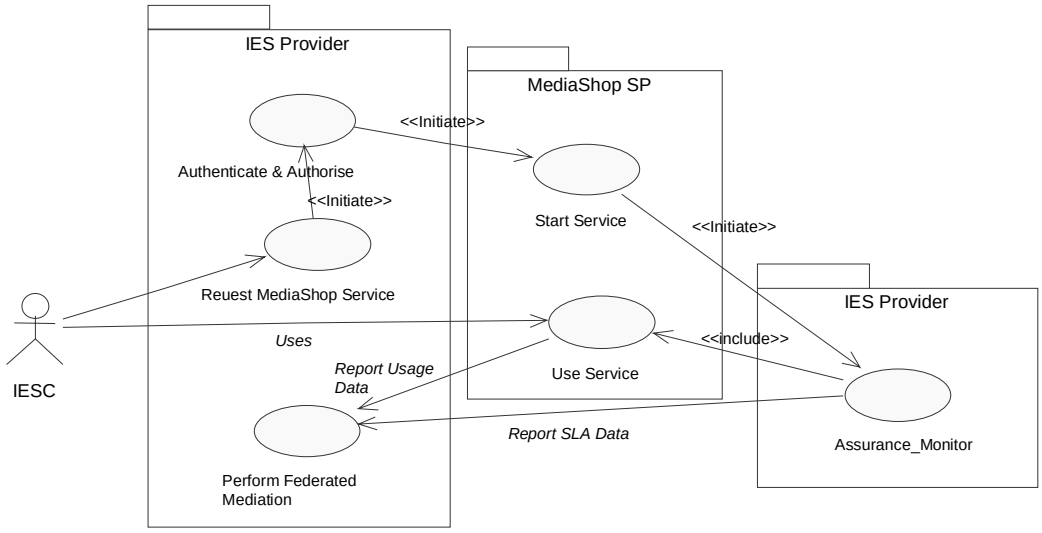

Figure 7-4 Use case diagram for Assurance-Billing

Each of these use case are shortly described as follows:

Request MediaShop Service: This use case represents the initial service initiation request to the IESP from the IESC.

Authenticate & Authorise: The IESC is authenticated as subscribed to the IESP for the MediaShop Service and is Authorised for the different operations that the may be executed.

Start Service: The IESP initiates the MediaShop service under the IESC's context and passes the relevant SLA_ID for that customer along with a serviceusage_ID, customer_ID etc.

Assurance_Monitor: The assurance system performs periodic and usage monitoring of the service. Periodic monitoring is a continuous monitoring of the service while usage monitoring is initiated for each separate IESC usage of the service.

Use Service: This use case represents the execution of various operations (e.g. Download, Upload, CreateFolder) on the MediaShop service.

Perform Federated Mediation: This use case represents the process that embeds the violation parameters for a service usage with the E-IPDR that has been generated for that usage. This use case also supports the composition of multiple service(s) usage E-IPDRs into a single accounting session.

7.5 System Process and Information Model – Activity Diagram for Assurance-Billing

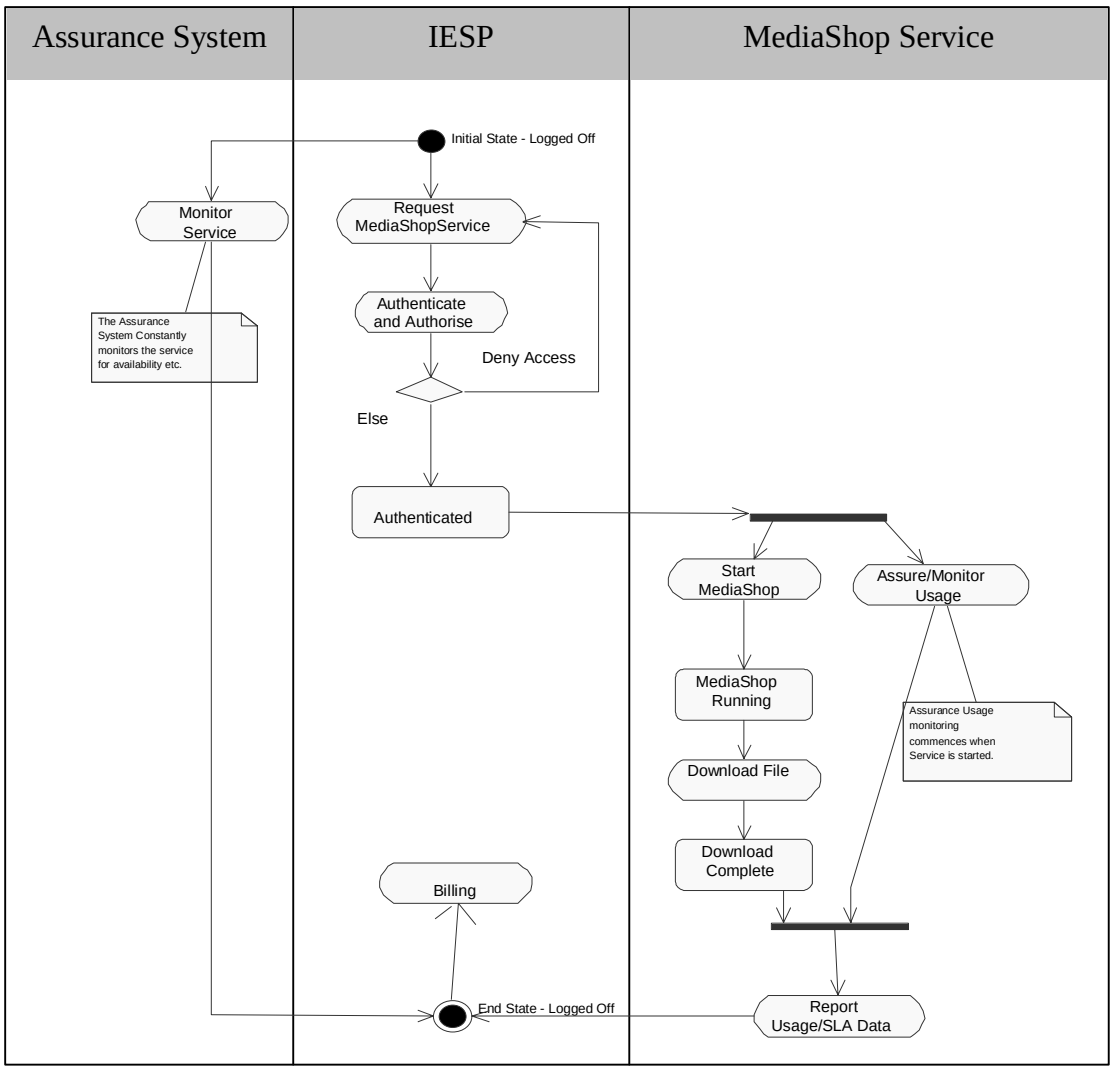

Figure 7-5 Activity diagram for Assurance-Billing

7.6 Mapping to Building Block Contracts for Assurance-Billing

The following sections detail the activities shown in the activity diagram and the building block contracts that support these activities.

Monitor Service: The monitor service activity is reliant upon the following assurance contracts:

AssuranceService - This contract serves two main functions. The first is to allow the MediaShop service to be registered and the second is to allow SLAs to be introduced or removed.

ServerMonitor - This contract allows access to the CIM information base stored in the Server Monitor building block. This building block monitors server statistics, calculating secondary combinatory statistics when necessary.

ReportGenerator - The purpose of this contract is to allow access to XML reports of the statistics collected on the Service Provider.

Request MediaShop Service: Currently no contract exists to support this activity. Such a contract would be supported by an IESP Management BB that has not been developed. This contract would also support the **Authorisation and Authentication** activities.

Start MediaShop: This activity is supported by the InterdomainAccountingManagement contract. The information passed includes the customer ID, desired QoS level etc. and a reference to the respective SLA. The MediaShop service was not developed as a BB and hence has no contracts.

Assure/Monitor Usage: Another contract would have to be implemented to support the service usage monitoring activity. It is perceived that the existing Server Monitor BB could be enhanced to support the contract for this activity, as many of the operations correspond to those for the periodic monitoring of the actual service.

Report Usage/SLA Data: The InterdomainAccountingManagement contract supports the passing of usage data from the MediaShop SP to the Federated Mediation Adapter. Data is passed in the form of an E-IPDR Document, which contains all the data related to the usage of the service e.g. customer ID, Operation Type, Resource Name, Duration etc. The FederatedMediationAdapter does not have a contract to support the passing of SLA usage parameter violations by the assurance monitoring service. The information passed through such a contract would include the violated parameter the related values, the usage ID, the customer ID etc. Nor does a contract exist for the RBS that supports the periodic (e.g. monthly) passing of MediaShop service statistic reports.

7.7 External Information Model for Assurance-Billing

The following information models depict the information objects that are the outputs in the activity diagram above. Firstly the Assurance Usage Violation Report must be passed from the Assurance monitoring service to the E-IPDR Federated Mediation Adapter to be included in the usage element of the E-IPDR to be created for a service usage. The Assurance Monitoring Service must also pass periodic Service Statistics Reports directly to the IESP's RBS for inclusion in periodic discounting for meanAvailability of service etc.

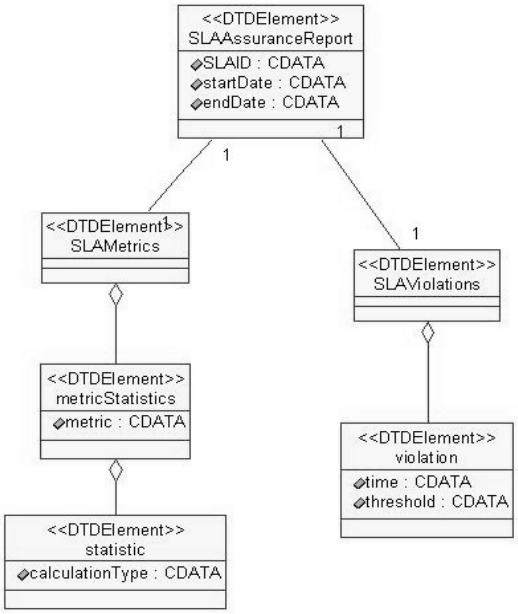

Figure 7-6 Assurance Reporting Model

The violated SLA parameters that are reported by an Assurance Usage Violation Report would be included in the Usage Element of an E-IPDR, modelled below. However, the SLA parameters reported in a periodic Service Statistics Report are directly integrated into the RBS rating system.

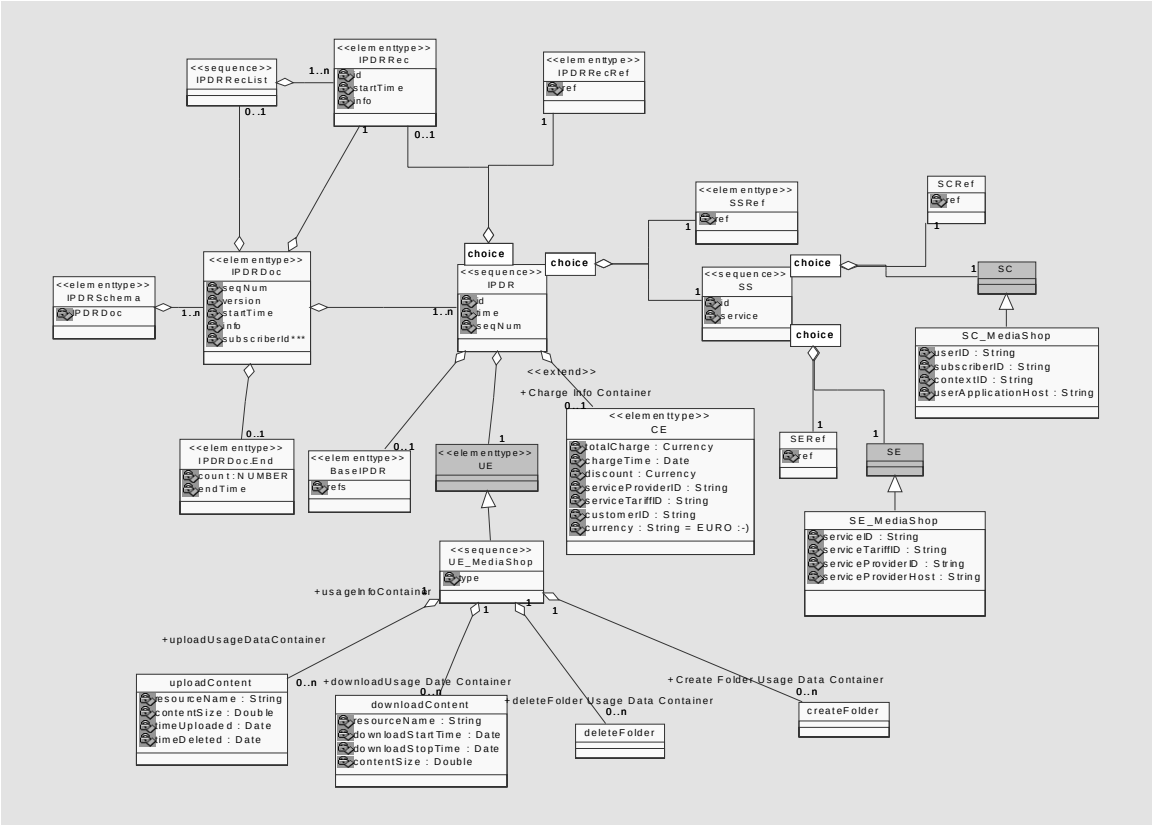

Figure 7-7 Billing E-IPDR Model

The Billing group information model is illustrated above. The core elements are described below:

- **IPDRDoc**: This is the top-level container of a set of IPDRs elements.
- **IPDRRec**: Describes the service or network element that is responsible for creating the IPDRDoc.
- **IPDR**: This element records the event describing the actual service usage.
- **Service Session (SS):**
  - Groups Service Consumer and Service Element information for structural convenience
  - Repeated pairs of SC and SE can be used in an on-going session.
- **Service Consumer (SC): Describes the Service Consumer.**
  - Examples: subscriberID, ipAddress
- **Service Element (SE): Describes the Service Element**
  - Examples: VoIP Server Address, MediaShop Server Address, etc.
- **Usage Entry (UE): Describes the usage data and violated parameters**
  - Examples: startTime, endTime, CallDuration, movieName, TerminationStatus, meanBandwidth, meanPacketLossPercentage etc.
- **Charge Entry (CE) –Describes the charge details**

Examples: Customer Charge/Discount, Settlement Charge/Discount, currency, etc.

7.8 Model Missing Objects

This is addressed above.

7.9 Implement Building Block Integration

The Assurance reporting model is used to exchange assurance information between the Assurance and the Billing systems. All BBs within the Billing system use the E-IPDR model to exchange information between them. Service providers that wish to pass their usage records to the IESP billing system for rating/billing also use this model.

8 External Information Model

The External Information Model (EIM) of a domain captures an aggregation of the information models representing the information passed by the Contracts in the domain. In particular, information that is considered useful in the selection of one of the Contracts in the domain or in the design of new Contract is published in part of an EIM.

The EIM outlined in this section is an aggregation of the information models from Contracts in the IES Management Framework. An overview of this model is given in Figure 8-1.

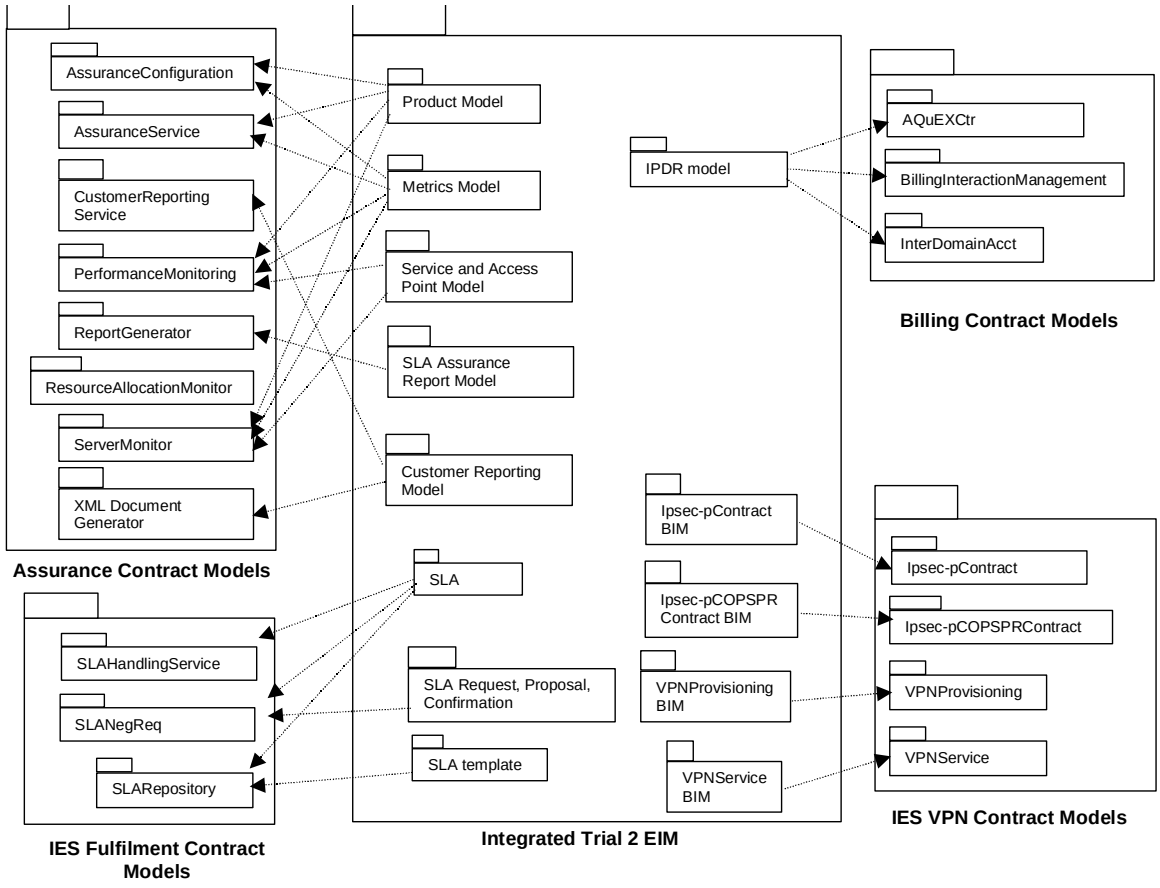

Figure 8-1 EIM for the IES Management Framework

The proposed integrated EIM contains the models from the various Boundary Information Models (BIMs) that make up the Trial 2 Contract Catalogue. The model therefore allows us to identify where BIMs are replicated between Contract Catalogues, this is summarised below:

- The IES Fulfilment Contracts all use the same SLA model, but otherwise contain mutually exclusive information models.
- The IES VPN Contracts all have largely mutually exclusive information models.
- The Assurance Contract share most of their information models
- The Billing Contrats all use exactly the same model.

9 Reference Point Catalogue

These are the Reference Points (RP) currently covered by the contract developed as part of the prototypes.

Reference Point	Description	Contained contracts
GQIPS-PM	This RP logically represents the GQIPS management interactions between the GQIPS Provider role and a value added service provider role in the same organisation or potentially a separate one. In the FORM reference architecture the value added service provider role is the VPNS provider role	AssuranceConfiguration PerformanceMonitor
IES-AS	The main purpose of this RP is to allow the configuration of the management components within the service provider domain and the retrieval of the information produced by these components. This reference point also allows the service provider to obtain reports on how the service is performing.	AssuranceConfiguration PerformanceMonitor
IES-BS	This RP represents a B2B relationship between the Inter-enterprise service provider (SP) domain and the 3rd-party SP domain (e.g., an ASP). There can be many 3rd-party SPs operating independently and supplying their services in bulk to the IESP. The IESP may packages these services and provide them to the customer. This is one of the two main activities taking place at this reference point. The other activity that take place at this reference point is that service provider would already have in place an IPDR standard compliant "charging and billing" process, therefore sending to the IESP through the "IES-BS" reference point standardised accounting information. The IESP role is then to aggregate and settle such accounting information.	InterdomainAccountingManagement
IES-CM	This RP addresses IES order handing, IES QoS assurance and IES charging and billing.	AssuranceConfiguration Customer Reporting Service PerformanceMonitor AQuEXCtr BillingInteractionManagement SLAHandlingService SlaNegReq
VPNS-CM	This RP addresses the management of CPEs and of customer security.	ipsec-pCOPSPRContract

VPNS-PM	This RP is concerned with interaction between the VPNS Provider role and a value added service provider role in the same organisation or a separate one. In our reference architecture this is the IES provider role. The RP addresses VPNS order handing, VPNS customer reports, the management of CPEs and the management of customer security.	Customer Reporting Service VPNServiceConfiguration

10 BB Contract Specification

The contracts currently being implemented have been described based on a template developed as part of the methodology work within FORM. The template is a XML Schema [W3C XML Schema, W3C XML Datatypes] based and is described shortly in the section below. The XML BB Contract Schema can be found in Annex E.

10.1.1 The BB Contract Schema Explained

The XML BB Contract Schema has a root element called BBContract that contains several sub-elements. Each of these sub-elements describes a specific property of the BB Contract. Within FORM we have chosen the following properties as important:

- **Basic properties**. A unique name, version and a general description of the BB Contract are mandatory properties of any BB Contract.
- **Reference Architecture**. A link to the reference architecture that the BB Contract is part of and the reference points it is part of, if it is part of any reference points.
- **Contract scope**. Use cases supported by the BB Contract.
- **Interface interactions**. A description of the interface to the services provided by the BB Contract.
- **Boundary information model**. This part of the schema describes the information objects used in the BB Contracts interface.
- **Technology description**. Textual description of the technologies and standards used in the specification of the contract being described.
- **Dependencies**. If the BB Contract depends on other BB Contract, then it is described in this part of the schema.

10.1.2 Location of the Contract Catalogue

The entire FORM Contract Catalogue can be accessed on-line at the FORM website [FORM Contracts].

The Contract Catalogue has only been tested using Microsoft Internet Explorer-5.0 (IE-5.0), but Netscape Communicator (NC) 6.x should also be able to show the contracts. Versions of NC older than 6.x cannot view the XML specifications as they do not support XML documents and XSL transformations.

From each of the summary descriptions below there is a link to the corresponding Contract description on the web.

10.1.2.1 How the Contract descriptions are transformed into XHTML

All contracts are specified as XML documents. However XML documents by themselves are not very useful, when it comes to viewing them. Therefore a transformation of the XML documents into XHTML [W3C XHTML] is done.

Each XML document that is a contract specification contains two references: (a) to the XML Schema defining the structure that the specification must conform to, and (b) to a XSL Transformation (XSLT) [W3C XSL Transformation], which is used when the XML document is viewed in a web-browser.

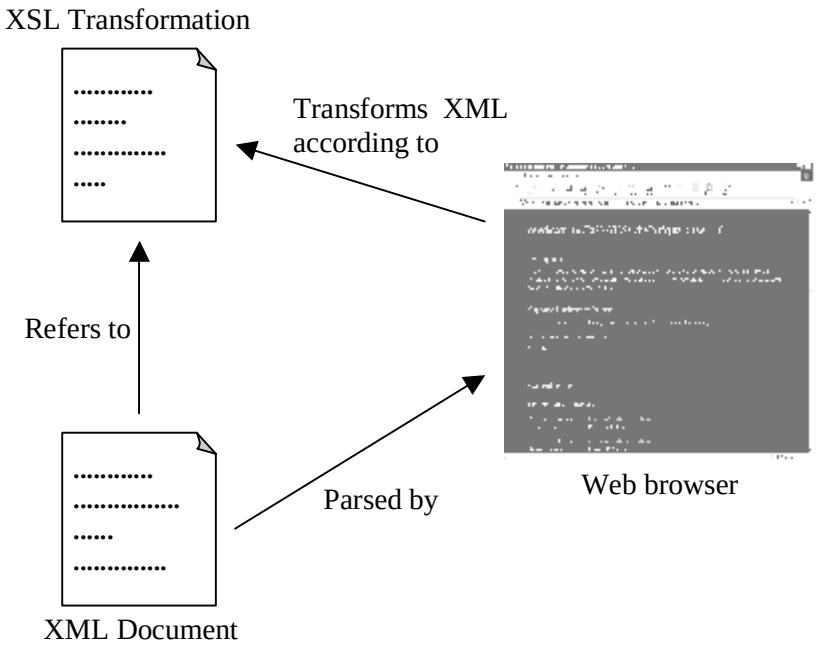

Figure 10-1 Transformation of XML documents into XHTML

The browser parses the XML document when it is downloaded and finds a reference to a XSLT file. This XSLT file is then downloaded and the XML document is transformed according to the rules in the XSLT document. This results in a XHTML file, which is displayed in the browser.

10.1.2.2 Problems when viewing the Contract Catalogue using IE-5.0

If only headings are visible and no text then the IE-5.x browser used does not have an up to date version of Microsoft's XML library installed.

The XML support in Microsoft IE-5.0 is based on W3C drafts for XSL Transformation, which have been superseded by later recommendations. Therefore it probably is necessary to upgrade the XML library used by IE-5.0. How to upgrade is described on a web page on the FORM server reachable from the bottom of the Catalogue index.

10.2 BB Contract and Building Block Catalogue

10.2.1 Assurance Contracts

Contract Name	Description	Partner	Name of BB imple-menting contract
PerformanceMonitor	This contract allows the configuration of the SLA metrics to be monitored. This contract also allows access to the statistics collected during the monitoring of these statistics.	Trinity College	Performance Monitor
AssuranceConfiguration	This contract allows the different components of the assurance system to access their configuration policies and other service information.	Trinity College	Assurance Configuration
AssuranceService	This contract enables service structures to be registered and SLA based on those services to be submitted for assurance support.	Trinity College	Assurance Configuration
ReportGenerator	This contract enables users of the assurance system to request SLA conformance reports.	Trinity College	Report Generator
ServerMonitor	This contract enables the distributed components within the assurance system to be configured to collect certain statistics. This contract also allows access to these statistics.	Trinity College	Server Monitor
Customer Reporting Service	This contract offers a Web-based service, which enables a customer to login as service user and use the web service to request selected data to be displayed on his browser or saved in a file.	Tele Danmark Communications	Customer Reporting System
Resource Allocation Manager	The ResourceAllocationManager contract provides management services related to the negotiation, or renegotiation, of a bandwidth brokered SLA. The contract is intended to be used by a service user, with particular Quality of Service needs in terms of bandwidth, delay and jitter	Broadcom	GQIPS

10.2.2 Billing Contracts

Contract Name	Description	Partner	Name of BB implementing contract
AquEXCtr	This contract enables a party to query for any well-defined data model. The query must be defined as an AQuEX_XML query. Once computed against a SQL DataSource the query result is returned as an AQuEX_XML answer.	Waterford Institute of Technology	AquEX
BillingInteractionManagement	The BillingInteractionManagement contract is a billing management contract that presents callback operations for receiving streams of XML data, or receiving final locations of analysed data for bills/reports.	Waterford Institute of Technology	AquEXClient
IPDRRecorderCtr	The contract supports (a) subscription of the RBS to the IPDRRecorder, (b) retrieval of non-rated E-IPDRs from the IPDRRecorder, and (c) passing of rated E-IPDRs back to the IPDRRecorder.	Waterford Institute of Technology	IPDRRecorder
RBSCtr	This contract provides an interface between the RBS and the IPDRRecorder BBs. The contract allows the IPDRRecorder to notify the RBS that one or more E-IPDRs require rating.	Waterford Institute of Technology	RBS
Interdomain Accounting Management	This contract supports accounting management in a federated environment where multiple SPs provide their services to the customer. It is designed to perform accounting management tasks on application-level services (e.g., delivery of video, sound and text content to user applications), as well as network-level service (e.g., a VPN). Although, the term accounting management collectively means a number of operations, including mediation and charging of service usage, and settlement of charges, this contract does not provide services that directly perform these operations. The primary function is to exchange of accounting management information, which, in turn, enables Billing operation processes to perform mediation, charging, and the rest. This contract is provided by the Federated Mediation Adaptor (FMA) building block. The service provided by this contract are defined within TOM's Billing business process (functional domain).	FOKUS	Federated Accounting Management (FMA) BB

10.2.3 Order Handling / SLA negotiation Contracts

Contract Name	Description	Partner	Name of BB implementing contract
SLARepositoryContract	This contract provides an interface for a SLA negotiation engine to the SLA Repository building block. The services provided by this contract relate to storing, retrieval and modification of SLA templates and SLAs in the repository.	UHC	SLARepository
SlaHanServ	This contract enables SLA negotiation to take place as part of the ordering process and accesses the SLA negotiation engine. The contract is responsible for enabling all communication between the SLA Negotiation Engine and the PLATIN Platform to take place.	FOKUS	SLAHandlingService
SlaNegReq	This contract enables a party to enter and complete a SLA negotiation process with a SLA Negotiation Engine. The party entering the negotiation process is a prospective service customer. The SLA negotiation engine is able to control the negotiation process on behalf of a service provider.	UCL	SLANegotiationEngine

10.2.4 VPN Service Provisioning Contracts

Contract Name	Description	Partner	Name of BB implementing contract
ipsec-pContract	The IPSec-Provisioning contract provides management services related to the configuration of IPSec tunnels using policies. The contract is intended to be used by a service user, which has the need to control, and manipulate IPSec tunnels. This could e.g. be a VPN provider needing IPSec tunnels as part of a more generic tunnel abstraction. The policy objects needed to perform the management are based on IETF's drafts 'IPSec Configuration Model' and 'IPSec Policy Information Base'. The IPSec Provisioning BB will receive Provisioning Policy Objects from the VPN Provisioning (VPN-P) layer	DELTA	IPSec-P
ipsec-pCOPSPRContract	The IPSec-Provisioning (IPSec-P) COPS-PR contract provides an interface for COPS-PR (Common Open Policy Service for Policy Provisioning) enabled CPEs to access the IPSec-P building Block to obtain Provisioning Policies. The COPS-PR protocol is based on IETF's drafts 'COPS Usage for Policy Provisioning (COPS-PR)' and 'The COPS (Common Open Policy Service) Protocol'. [Note: This protocol is not implemented fully as part of the DELTA trial system.]	DELTA	IPSec-P
VPN-Provisioning	This contract offers a VPN Provisioning service, which falls into parts: 1- Creation and modification of a network virtual topology (endpoints, link). The virtual topology includes Service Class information (level of security, QoS) that can be delivered by the service. 2- Creation and Physical activation (following different parameters such date, security, QoS) of virtual links between two endpoints of the virtual topology.	Atos-Origin	VPN-Provisioning
VPNServiceConfiguration	The VPN service configuration (VPN-SC) is the interface to the VPN Service Provider sub-system. The contract provides functionality to create, modify, activate and delete secure QoS IP-VPN connections based on the concepts of Service Access Group (SAG) and Service Access Points (SAP).	L.M. Ericsson	VPN Service Configuration

11 Conclusion

This document demonstrates the application of the FORM methodology to the Inter Enterprise Domain. It contains the system models that are the result of applying the FORM methodology "Business Driven System Development Guideline" from [FORM D12] to the business processes Fulfilment, Assurance and Billing. These system models were presented in Sections 5, 6, and 7. The system models are assembled using the catalogues of (a) reference points, and (b) contracts, which were specified in the Annexes, and were presented in Section 9 and 10 of this document. The Business Model driven approach suggested in the guideline helped to model the necessary management business processes, which span several organisational domains and involves several actors and roles in the Inter Enterprise Domain.

The Annexes cover the system models, which are the result of applying the FORM methodology "Building Block Development Guideline" also from [FORM D12]. The main outcomes of the Annexes are Reference Points, Building Block Contracts [FORM Contracts] and Building Blocks. These are assembled into catalogues that are described in Section 9 and 10 of this document.

The system models have been implemented and tested in prototypes, this is described in [FORM D10], which also covers the evaluations of the FORM Business Process Driven Development Guideline.

It should be noted however that only key areas of the problem domains were addressed and further work would be necessary to completely address the issues involved in providing Inter Enterprise Services. The system model in this document can be considered the result of the first iterations of systems modelling. Further work in terms of systems modelling would be to iterate, and to have a look at the complete system model per enterprise, looking for aspects that could be reused. These aspects could be functionality chunks, of it could be more structural aspects of how to organise Building Blocks, how to decide upon the size, complexity and contents of a Building Block. By doing further iterations, the system models would become more robust and integrated.

12 Acronyms

The acronyms cover D11 and the Annexes.

Acronym	Definition
ACS	Accounting Data Store
AS	Application Service
ASP	Application Service Provider
AS-CP	Application Service – Customer to Provider
AS-PP	Application Service – Provider to Provider
B2B	Business to Business
BB	Building Block
BIM	Boundary Information Model
CE	Charge Entry
CIM	Common Information Model
CoS	Class of Service
CPE	Customer Premise Equipment
DMTF	Distributed Management Task Force
DS-CP	DiffServ – Customer to Provider
DS-PP	DiffServ – Provider to Provider
E-IPDR	Extended Internet Protocol Detail Record
EIM	External Information Model
FMA	Federated Mediation Adapter
GQIP	Guaranteed QoS IP
GQIPS	Guaranteed QoS IP Service
GQIPSPS	Guaranteed QoS IP Service Provider System
GQIPS-PM	Guaranteed QoS IP Service – Provider Management
GQIPS-PP	Guaranteed QoS IP Service – Provider to Provider
GUI	Graphical User Interface
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
IE	Internet Explorer
IETF	Internet Engineering Task Force
IES	Inter-Enterprise Service
IESC	Inter-Enterprise Service Customer
IESP	Inter-Enterprise Service Provider

IESPS	Inter-Enterprise Service Provider System
IES-CM	Inter-Enterprise Service - Customer Management
IP	Internet Protocol
IPDR	Internet Protocol Detail Record
IPSec	IP Security
IPSec-P	IP Security – Provisioning
IR	Information Retrieval
IRS	Information Retrieval Service
IRSP	Information Retrieval Service Provider
ISP	Internet Service Provider
ISV	Independent Software Vendors
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
JPEG	Joint Photographic Experts Group
L2TP	Layer Two (2) Tunnelling Protocol
MA	Mediation Adapter
MAG	Methodology Advisory Group
MIB	Management Information Base
MPLS	MultiProtocol Label Switching
NE	Network Element
NGOSS	New Generation Operating System Support
OCS	Online Collaboration Service
ODF	Open Development Framework
OMG	Object Management Group
OSSs	Operational Support Systems
QoS	Quality of Service
RAR	Resource Allocation Request
RBS	Rating Bureau Service
RUP	Rational Unified Process
SAG	Service Access Group
SAP	Service Access Point
SC	Service Customer
SE	Service Element
SHS	SLA Handling Service
SLA	Service Level Agreement
SLAR	Service Level Agreement Repository

SLO	Service Level Object
SLS	Service Level Specification
SNE	SLA Negotiation Engine
SP	Service Provider
SQL	Structured Query Language
SS	Service Session
TM Forum	Tele Management Forum
TOM	Telecoms Operation Map
UE	Usage Entry
UML	Unified Modelling Language
URI	Uniform Resource Identifier
VoIP	Voice over IP
VPN	Virtual Private Network
VPNS	Virtual Private Network Service
VPNSP	Virtual Private Network Service Provider
VPNSPS	Virtual Private Network Service Provider System
VPNS-CM	Virtual Private Network Service - Customer Management
VPNS-PM	Virtual Private Network Service - Provider Management
VPN-P	Virtual Private Network – Provisioning
VPN-SC	Virtual Private Network – Service Configuration
W3C	World Wide Web Consortium
XHTML	eXtensible HyperText Markup Language
XMI	XML Metadata Interchange
XML	eXtensible Markup Language
XSL	eXtensible Stylesheet Language
XSLT	eXtensible Stylesheet Language Transformations

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