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

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ABSTRACT

This Annex to FORM Deliverable 11presents the final inter-enterprise management system model for Billing.

KEYWORDS

Billing, Business Model, System Model, Analysis Model, Building Block, Contract specification

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Deliverable D11

Final Inter-Enterprise Management System Model

Annex D, Billing System Model

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1 Introduction

This document presents the final system model done in FORM within the Billing Business Process Area. It demonstrates how the FORM methodology is applied to the problem of providing a billing service. It should, however be noted that only key functionality is handled. The system models can be regarded as the result of the first system development iteration.

The FORM methodology "Building Block Development Guideline" [FORM D12] is applied to the Billing Domain in the following way:

FORM D12 Building Block Development Guideline – Workflows:	FORM D11 – FORM methodology applied in Sections:
1.Perform Business Modelling Workflow	Section 2 Business Model 2.1 Business Use Case Model 2.2 Business Object Model
2. Define Reference Architecture Workflow	2.3 Reference Architecture
3. Define Requirements Analysis Workflow	Section 3 System Model 3.1 Use case Model
4. Develop Analysis Models Workflow	3.2 Analysis Model
5. Re-organise Analysis Models Workflow	3.3 Re-organise Analysis Model and Group to Building Blocks 3.4 Building Block Specification

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

The Billing Business Model in Section 2 sets the context for the system model by presenting the business use cases and business object model. The reference architecture is also presented.

The System Models are presented in Section 3,4 and 5 respectively. Section 3 presents the Billing IES Customer System Model. Section 4 presents the Billing IES Provider System Model. Section 5 presents the IRS Provider System Model. Systems modelling involves the identification of the functionality necessary to support the system and the design of the software components necessary to provide that functionality.

First use cases and actors are identified and explained in Section 3.1. Then analysis objects that implement the use cases are identified and the interactions documented in Section 3.2. Having identified the analysis object the next step is to group these object into Building Blocks and specify their contracts, this is shown in Section 3.3 and 3.4. The complete set of contract specifications can be found in the on-line contract catalogue at the FORM website [FORM Contracts]. This structure is also used in Section 4 and Section 5.

2 Billing Business Model

This section sets the context for the Billing management system by presenting business uses and business object model. The Billing subsystem reference architecture is also presented.

2.1 Business Use case Model

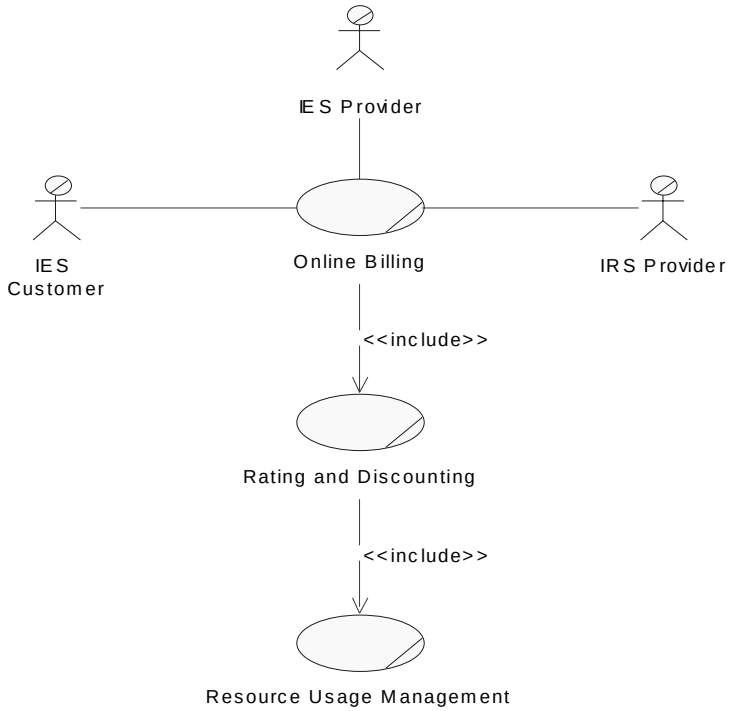

Figure 2-1 Business Use case diagram for Billing

The business case is centred around the idea that the customer are provided packages of useful services for which they pay a single consolidated bill. The bill is for all services that make up the service package. Irrespective of the location where the service is used and the service provider who provides the service, the customers may want to see a single bill for all the services they use.

Business customers, who travel frequently and use different types of services for personal and business use, will definitely prefer to receive and pay a consolidated bill of all services that they use. Customer expect that service providers providing various sorts of services and operating in different zones will settle within themselves all the charges for services provided. The customer will be presented with a final consolidate bill.

Business driver for this billing process is that a greater aggregation of services and service packages that can be billed as single service simplifies the billing process and in particular makes business much easier for the customer. Aggregation also helps the service providers by allowing for differentiation based on service packages. The winners will be those service providers who can identify useful services that can be packaged and offered on a subscription to customers.

Three main business actors can be identified in the billing management business use case:

- *IES Provider:* A role that maintains relationships with a number of third-party SPs for providing services to the IES Customer. IES Customer subscribes to IES Provider and pays for the services.
- *Third Party Service Provider:* A role with which the IES Provider must collaborate in order to provide the services required by the IES Customer.
- *IES Customer:* A role that uses and pays for the service provided by third-party Service Provider.

2.2 Business Object Model

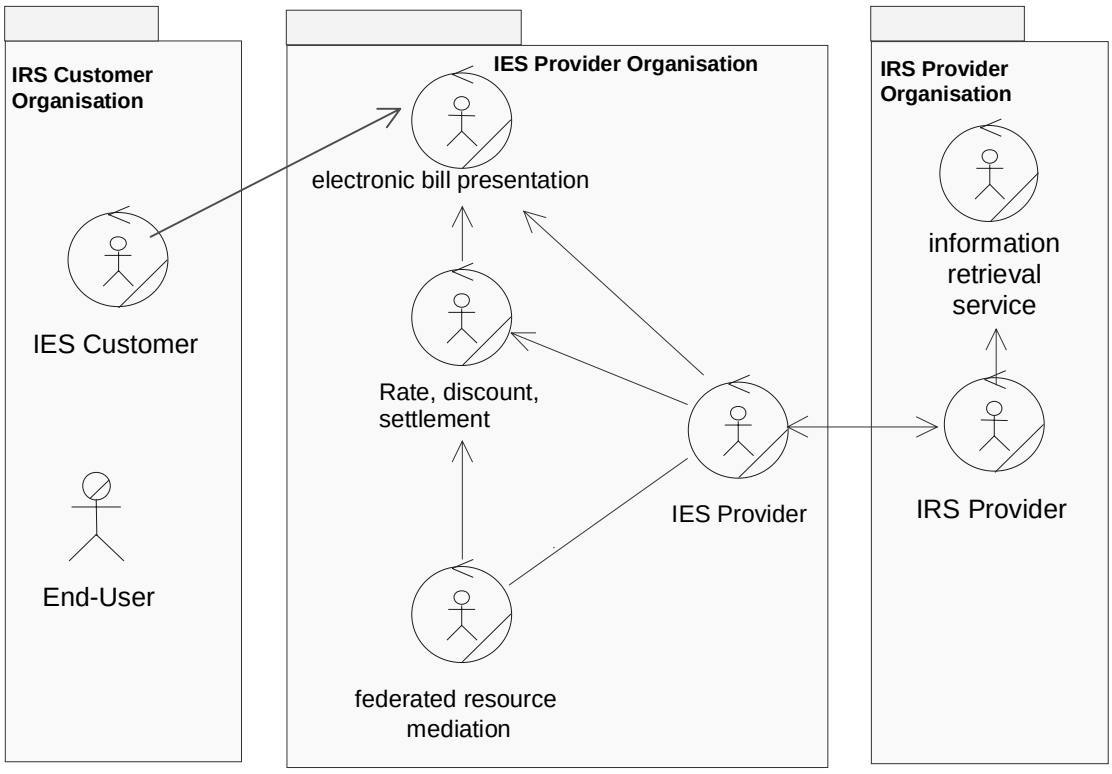

Figure 2-2 Business Object Model for Billing management business process

Business Worker	Description
End-User	A person who uses Inter-Enterprise service. End-user may be a private user or he/she may work for the IES Customer.
IES Customer	A business (organisation) or a private customer. The subscriber of Inter-Enterprise Services. IES Customer negotiates and signs a SLA with the IES Provider. It receives and pays bills for serviced used. It also validates, checks against the records, and controls the usage of service.

IES Provider	It provides communication, application, and information services, through third-party SPs (e.g, IRS Provider). IES Provider performs the task of charging and billing of service usage and charge settlement among IES Customer and third-party SPs. IES Provider acts as a service retailer and maintains contracts with third-party SPs. IES Provider also negotiate, finalise deals between IES Customers and third-party SP, and do final settlement (final bills, etc).
IRS Provider	A third-party SP that provides information or multimedia services (video or VoIP teleconference).
Electronic Bill Presentation	The Electronic Bill Presentation worker object is responsible for presenting the bill to the customer.
Rate, Discount, Settlement	The Rate, Discount and Settlement worker object is responsible for the task of handling the charging and billing of service usage.
Federated Resource Mediation	The Federated Resource Mediation worker object is responsible for mediation of usage that occur in multiple domains.

Table 2-1 Billing Business workers

2.3 Reference Architecture

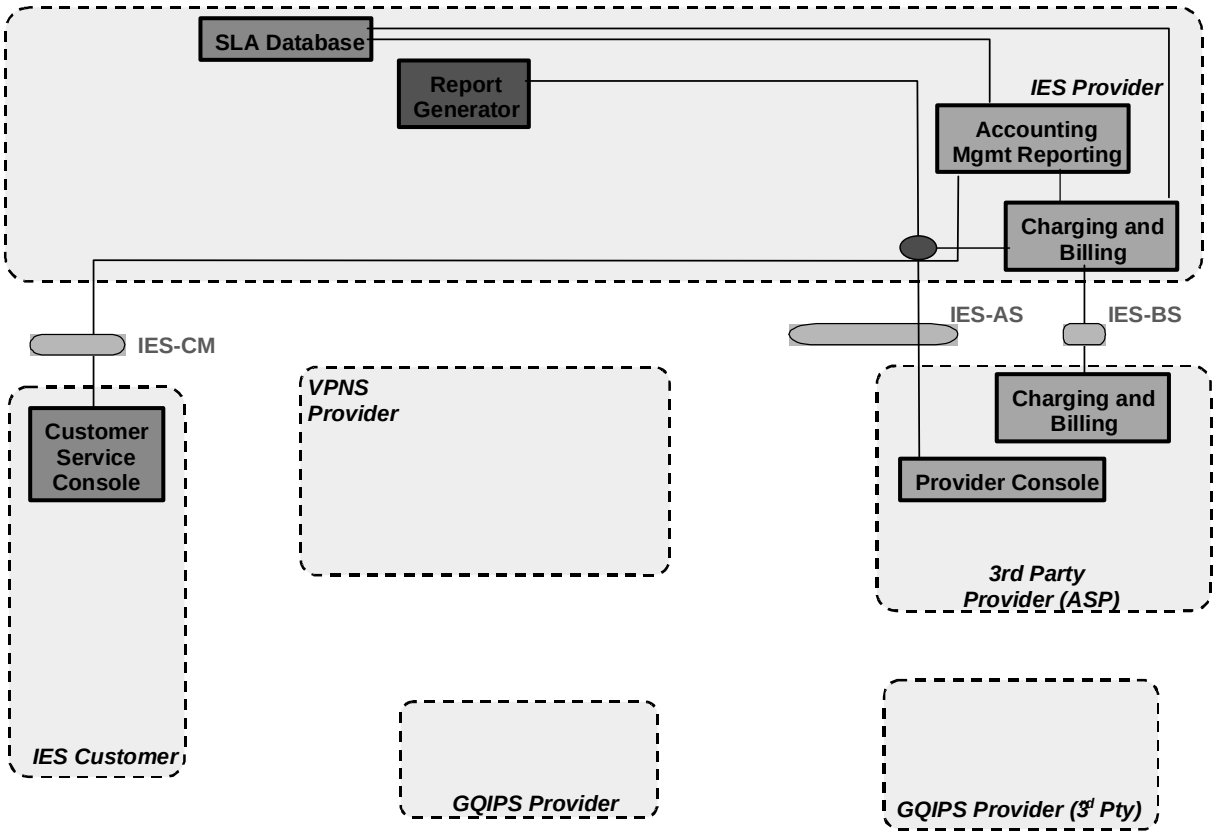

Figure 2-3 Billing subsystem with FORM Reference Architecture

This contains the initial accounting system reference architecture, the system boundary definitions and a decomposition of the system into logical subsystems containing building blocks.

The relationships between these processes and the other business roles (via reference points) is outlined in Figure 3. Note that this figure only show Billing management business processes. It is a snapshot of the accounting aspects of the IES system.

The Billing Reference architecture contains two main reference points: the IES-BS and IES-CM. These serve two purposes:

1. They represent the boundaries of Billing management subsystem: They serve as logical demarcation lines (boundaries) between management/administrative domains within which management business processes of IES Provider, IES Customer and third Party SP can be placed.
2. The reference points are sets of coarse-grained integration points for business entities and model the business-level relationship that IES Provider maintains with IES Customer and third Party SP.

2.3.1 IES-BS

This reference point represents a business-to-business (B2B) relationship between the IES Provider and one or more third-party SPs (e.g., IRS Provider). This relationship implies that the third-party SP provides the IES Provider with accounting information (i.e., details of usage and charge) on the service and contents that it provides to IES Customer. In return, the third-party SP receives payments for the services and contents provided.

If many third-party SPs provide their services then the task of IES Provider is to:

- receive usage or charge details from all of them;
- calculate charges for individual service provided; and
- merge charges into a consolidated bill, forward the consolidated bill to IES Customer and receivespayments from it.

The third-party SPs receive payments as a part of charge settlement for the services and contents that they provide to IES Customer. Charge settlement is done by IES Provider.

Third-party SP and IES Provider negotiate and sign a SLS (service level specification), which becomes a biding agreement between two co-operating parties. SLS includes terms and conditions by which charge settlement is to be done. It tells the way the IES Customer payment is proportioned among several parties, that is to say, which proportion is to be kept by the IES Provider and which must be forwarded onto the third-party SP.

Equally importantly, SLS also includes terms and conditions for service discounts the third-party SP are to provide and QoS requirements to support.

A third-party SP and IES Provider may employ their own management processes and the functionality of these process may range from service mediation (usage data collection, record production) to full-fledged bill processing. Therefore depending upon the management process they use, third-party SP and IESPs can co-operate in a number of business-to-business scenarios.

The main activity that take place at this reference point is the exchange of accounting information whereby the third-party SP provides the IESP with accounting information (service usage data, charge details, etc) for charging and on-line billing purposes.

The IES Provider uses this information to calculate charges for the service and contents that are used by IES Customer and prepares invoices.

2.3.2 IES-CM

This reference point represents a business-to-customer relationship between the IES Provider and the IES Customer.

This relationship implies that the IES Provider sends invoices to the IES Customer for all the service and contents used and receives payments.

It is assumed that the IES Customer has negotiated with the IES Provider and signed a SLA with details of the services ordered. Those details of SLA that are relevant for Billing management process are retrieved and used by IES Provider during invoicing and charge settlement.

SLA should lay down tariffs for the services ordered. It should also contain the penalty clauses for failure to maintain the SLA commitments as well as provision for cancellation fees.

The IES Provider also manages customer relationship and on-line billing on behalf of third-part SP. This means that IES Customer can send queries on service usage and charges to IES Provider and expect replies.

3 Billing IES Customer System Model

3.1 Use case Model for Billing IES Customer System Model

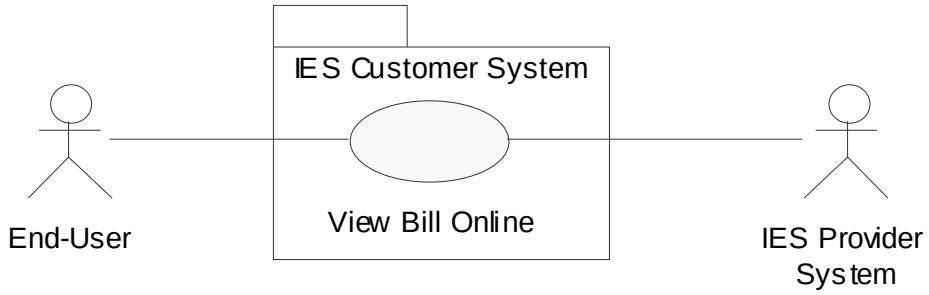

Figure 3-1 Use case diagram for the Billing IES Customer System

Actor Name	Role Taken
End-User	Please see the description given above in the business object model.
IES Provider System	It is responsible for mediation of composite service and charge aggregation.

Table 3-1 Billing Actors

Use case Name	View Bill online.
Summary	Assuming the user has used a service or a composed service, the user might want to access the bill online. This use case supports bill presentment and querying in a federated environment where a Broker Entity brokers multiple service providers to provide services to the user.
Actors	End-User, IES Provider System
Pre-Conditions	IES Customer has a set of accounts, hence, the online billing client user can be authenticated and authorised for profiled information access. End-Users have successfully used the service. An SLA defines the customer service requirements Service Usage has been rated and discounted.
Begins When	Customer logs onto IES Provider on-line billing client.
Steps	Customer logs on and its retrieved profile dictates the level of information access. Customer formulates a query by selecting the different criteria it might be interested in (total charge, discount, usage time, usage date, etc…) The query is passed to a query engine (AQuEX) that processes and return the query result. The resulting information is displayed in the customer browser. The user may process multiple queries.
Ends when	The customer logs-off or when the HTTP session terminates.

Post-Conditions	The user is logged off, the HTTP session is terminated.
Exceptions	Query Failure: the user is then presented a friendly error message.
Traceability	Business use case: Online Billing. Business worker object: Electronic bill presentation Requirements: EC-II.14, EC-II.15, EC-II.35, CB-II.19

Table 3-2 Use case description of "View Bill online"

3.2 Analysis Model for Billing IES Customer System

The boundary, entity and control object from the figure above are described below.

3.2.1 Boundary Objects

Boundary Objects	Responsibility
BillingInteractionManager	This is the customer entry point to the accounting/IPDR information stored by the IES Provider.
AQuExCtr	This accepts customer query, parses it into a format that can be understood by RBS BB and sends the parsed query to E-IPDR Recorder BB.

Table 3-3 Boundary Objects

3.2.2 Entity Objects

Entity Objects	Responsibility
queryDoc	Support querying metadata (an XML document)

Table 3-4 Entity Objects

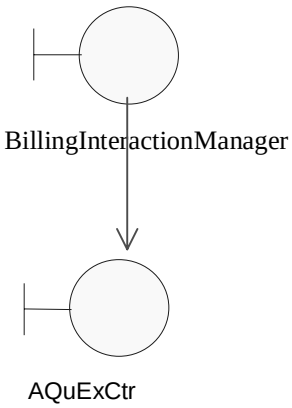

Figure 3-2 Object diagram showing the analysis objects that implements the use case

3.3 Re-organise Analysis Model and Group to Building Blocks for Billing IES Customer System

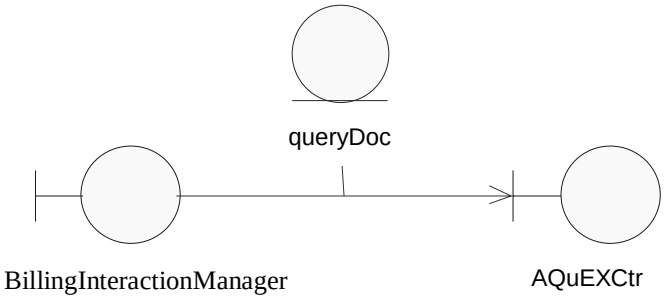

Figure 3-3 Collaboration diagram showing Building Blocks and Building Block Contracts

The above shown analysis objects are identified based on functionality required, captured and analysed. A complete list of Billing requirements can be found in FORM deliverable D4 titled "Market Potentials, Requirements, Business Model and Scenarios Definition" [FORM D4]. Identification and grouping of objects was also done on the basis of TMForum document "Generic Requirements for Telecommunications Management Building Blocks", GB909, Member Evaluation Version 2.0, TeleManagement Forum, September 1999 [gb909].

The following interaction diagram shows more details about the relations between the building blocks and the actors.

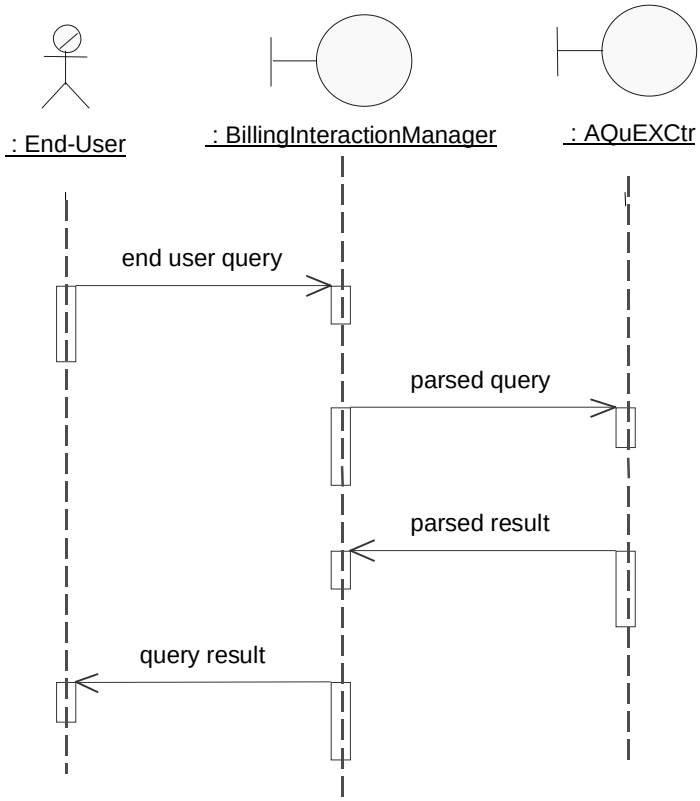

Figure 3-4 Interaction diagram for the use case view bill on-line showing the use of BB

4 Billing IES Provider System Model

4.1 Use case Model

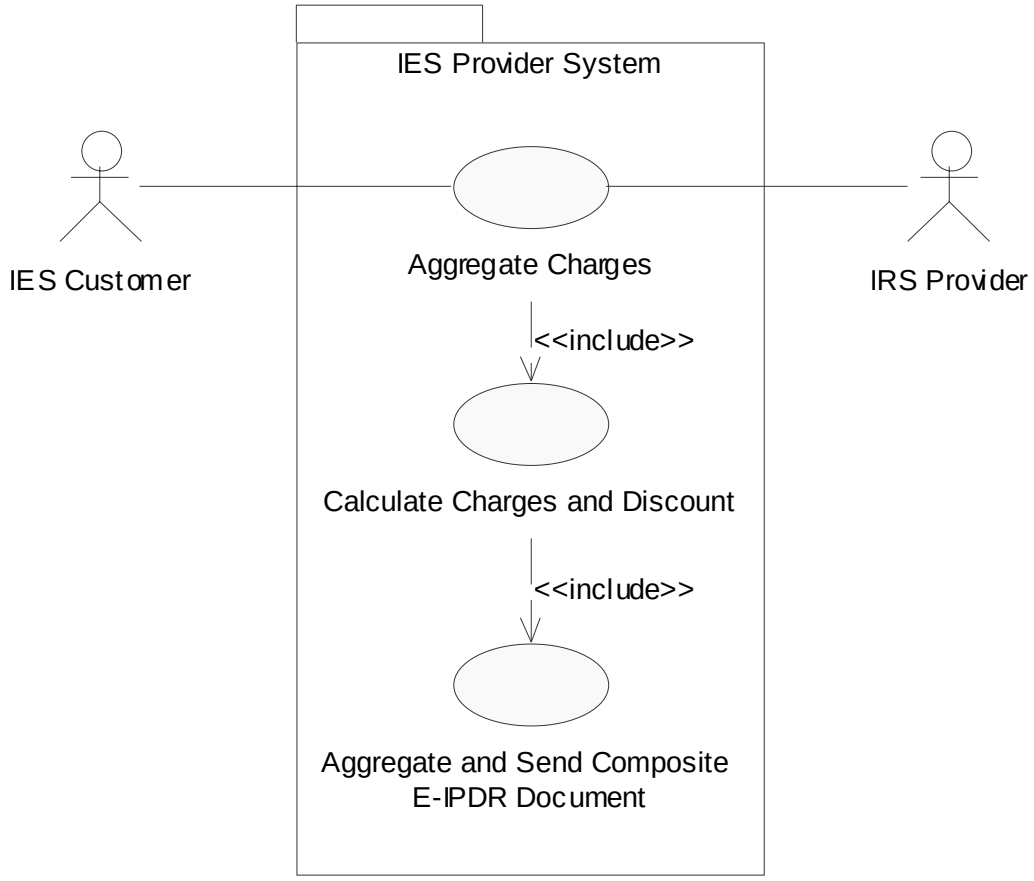

Figure 4-1 Use case diagram for the Billing IES Provider System

Actor Name	Role Taken
IES Customer	Please see the description given above in the business object model.
IRS Provider	Please see the description given above in the business object model.

Table 4-1 Billing IES Provider System Actors

Use case Name	Aggregate and send composite E-IPDR document.
Summary	This use case describes how FMA collects and aggregates the E-IPDR documents from VoIP and MediaShop Mediation Adaptors under a global usage session called parentSession. It also describes how a composite E-IPDR document is sent to E-IPDR Recorder.
Actors	End-User, IES Customer, IRS Provider
Pre-Conditions	The end-user has ended OCS usage session. An SLS exists for each participating service provider. A SLA exists for the customer.
Begins When	• FMA records ParentSessionID. • MediaShop and VoIP Mediation Adaptors are ready to send E-IPDR documents to Federated Mediation Adaptor.
Steps	• Record ParentSessionID. • Collect E-IPDR documents. • Aggregate them under a single ParentSessionID, which binds all documents under a single usage session. Generate an composite E-IPDR document for the service package. • Send the aggregate E-IPDR documents to E-IPDR Recorder.
Ends when	FMA has received from E-IPDR Recorder an acknowledgement of the receipt of the documents.
Post-Conditions	Recording of identifiers of the services that constitute service package (ie, MediaShop and VoIP service Ids). Start and end of parentSession is registered in composite E-IPDR document.
Exceptions	Failure in delivery of composite doc.
Traceability	Business use case: Resource usage management. Business worker object: Federated Resource Mediation Requirement: CB-I.01, CB-I.02, CB-I.04, CB-I.07, CB-I.08, CB-II.09, CB-II.11, CB-II.15, CB-II.21, CB-II.23, CB-III.29, CB-IV.30, CB-IV.31, CB-V.35, CB-V.39.

Table 4-2 Use case description of "Aggregate and send composite E-IPDR document"

Use case Name	Calculate charges and discount.
Summary	The usage information is extracted from IPDR documents, compared to various SLA parameters, charged, rated and discounted accordingly and finally customer and settlement charges are fed back into the CE (charge Element extension to the IDPR initial schema) and sent back to a data store, to await billing retrieval.
Actors	IES Customer, IRS Provider
Pre-Conditions	One or more related E-IPDR documents have been delivered to the IESP IPDR recorder. An SLA exists for the customer. An SLS exists for the service provider. A charging scheme exists for the service.
Begins When	When the IPDRRecorder notifies the RBS that one or more E-IPDR documents are ready for rating.
Steps	Extract the customer and Service Provider IDs from the E-IPDR. Retrieve the relevant charging scheme from the Service Provider's SLS. Retrieve the relevant charging/discounting parameters from the Customer's SLA. Extract the usage data that the charging scheme requires from the E-IPDR. Apply the charging algorithms to the data. Insert the final customer/settlement charges, discounts and the charge time into the Charge Element of the E-IPDR Send the E-IPDR back to the IPDRRecorder for storage.
Ends when	The rated E-IPDR document is returned to IPDRRecorder for storage.
Post-Conditions	E-IPDR is rated and discounted for customer and settlement charges.
Exceptions	If RBS fails/crashes then the relevant E-IPDR document(s) is re-requested.
Traceability	Business Use Case: rating and discounting. Business Worker Object: Rate, Discount, Settlement Requirements: CB-I.01, CB-I.4, CB-I.5, CB-I.6, CB-I.8, CB-I.9, CB-II.10, 1 CB-II.4, CB-II.15, CB-II.17, CB-II.18

Table 4-3 Use case description of "Calculate charges and discount"

Use case Name	Aggregate charges
Summary	This use case describes how the IPDRRecorder notifies the RBS, upon the arrival of an OCS document, to pull relevant E-IPDR documents that are participating within the OCS session.
Actors	IES Customer, IRS Provider
Pre-Conditions	An OCS service usage has occurred and the corresponding E-IPDR document has been mediated to the IPDRRecorder. Participating E-IPDR documents have been delivered to the IESP IPDRRecorder. An SLA exists for the customer. An SLS exists for each participating service provider. A charging scheme exists for each participating service and for the OCS service. The RBS has subscribed to the IPDRRecorder for OCS group type of document.
Begins When	When the OCS IPDRDocument is received.
Steps	A notification is sent (based on subscription) to the RBS that an OCS set of related E-IPDR documents is ready for charging. The RBS pulls one by one each of these documents and rates them. Each participating E-IPDR is returned to the IPDRRecorder for storage. The Charge Element of the OCS E-IPDR is populated with the overall charge and discount for the service. Note: there is no settlement entry as this is contained in the individual E-IPDRs for the constituent services.
Ends when	The rated/aggregated OCS E-IPDR document is returned to IPDRRecorder for storage.
Post-Conditions	OCS Session E-IPDR is rated and discounted for customer.
Exceptions	If RBS fails/crashes then all the relevant E-IPDR documents for the OCS seesion are re-requested.
Traceability	Business Use Case: Online Billing. Business Worker Object: Electronic Bill Presentation Requirements: CB-I.01, CB-I.4, CB-I.5, CB-I.6, CB-I.8, CB-I.9, CB-II.10, 1 CB-II.4, CB-II.15, CB-II.17, CB-II.18, CB-II.21, CB-II.26

Table 4-4 Use case description of "Aggregate charges"

4.2 Analysis Model

This subsection provides the definition of the accounting subsystems, candidate components, identification of the interfaces between the components and their mapping to the three tiered architecture.

4.2.1 Boundary Objects

Boundary Objects	Responsibility
interdomainAcctMgmt	This is a service management contract and supports accounting management in a federated environment where multiple SPs provide their services to the customer. This contract is provided by the

	Federated Mediation Adaptor (FMA) building block. Mediation Adaptors (MAs) can use this contract to send E-IPDR documents to FMA.

Table 4-5 Boundary Objects

4.2.2 Entity Objects

Entity Objects	Responsibility
Composite E-IPDR Doc	This is the enhanced IPDR document, based on Master IPDR Schema. Its main role is to carry usage information for a service package, i.e., details of usage event of Online Collaboration Service. The information model is presented below in the Boundary Information Model of IES Provider System.

Table 4-6 Entity Objects

4.2.3 Control Objects

Control Objects	Responsibility
Federated Mediation Adaptor	This BB supports collection and aggregation of E-IPDR documents and generation of a composite E-IPDR document. The documents are aggregated under a single usage session that records usage of a service package.
AQuEX	The AQuEX contract ensure the availability to a fine-grain of all recorded IPDR information.
E-IPDR Recorder	The IPDR Recorder takes upon the role of a data recorder/transmitter. It implements methods specified in the IPDR "Protocol Primitives and Parameters" specification (Push, Pull, Subscribe, etc).
RBS	RBS supports aggregation of the charges for each usage of the constituent services of a composed service (within the composed service accounting session) into a single composed service (OCS) charge. It generates and stores a rated/discounted E-IPDR document for the OCS.

Table 4-7 Control Objects

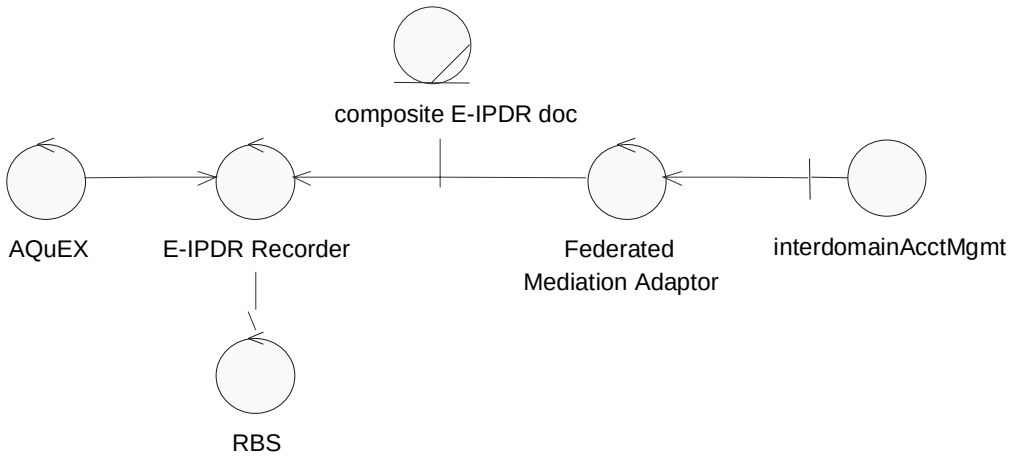

Figure 4-2 Object diagram showing the analysis objects that implements the use case

4.3 Re-organise Analysis Model and Group to Building Blocks

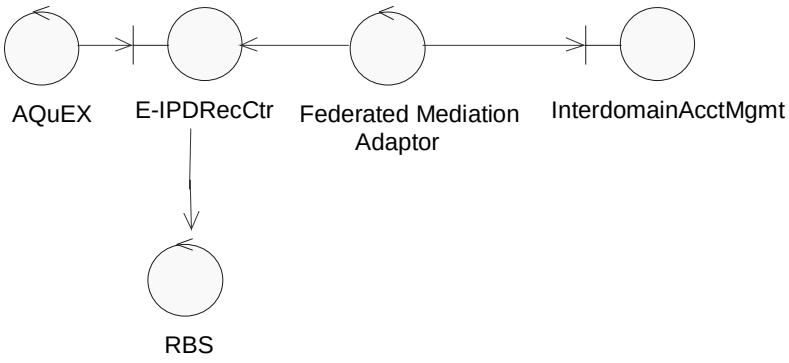

Figure 4-3 Collaboration diagram showing Building Blocks and Building Block Contracts

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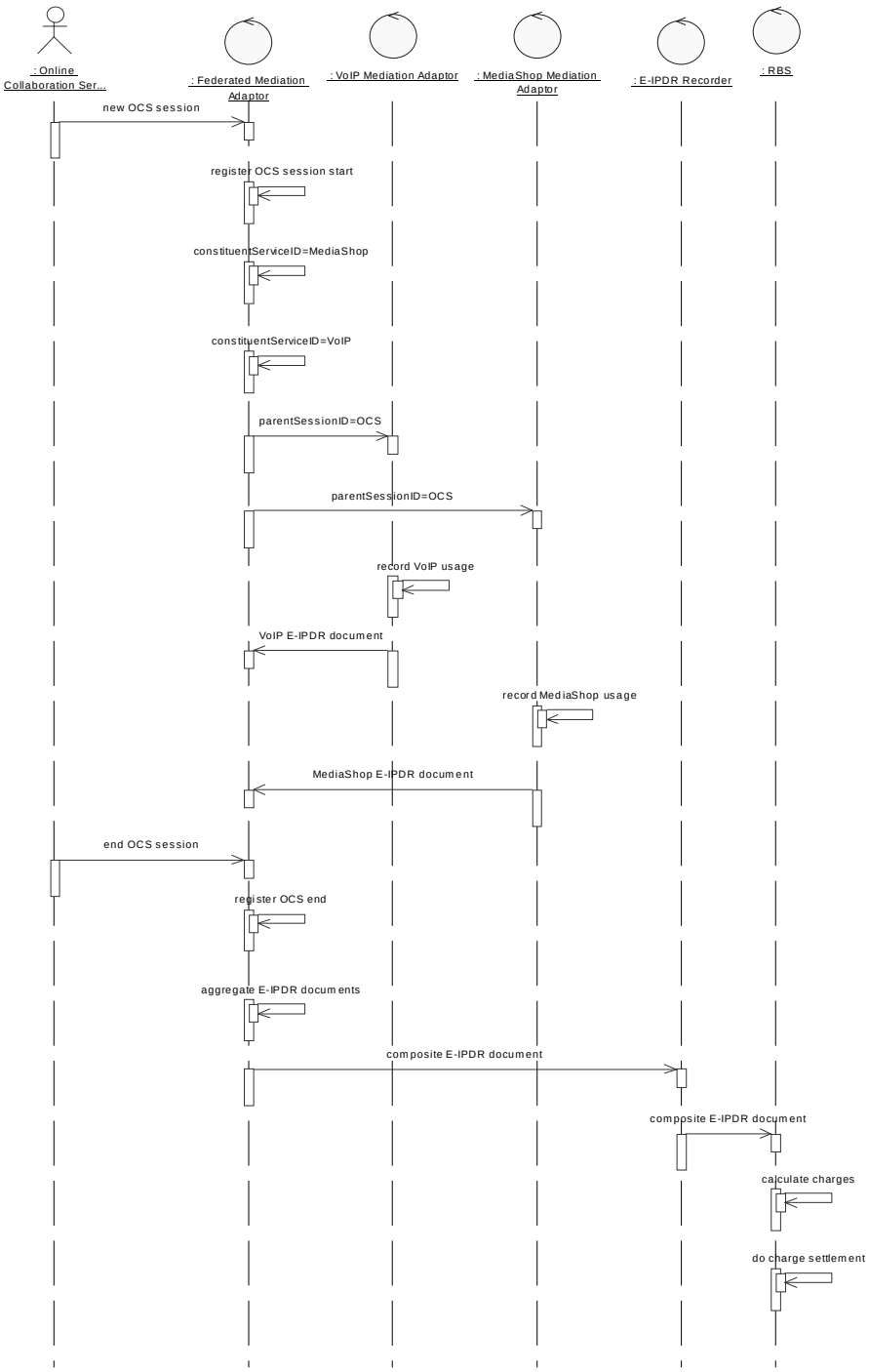

Figure 4-4 Interaction diagram for the use case showing the use of BB

4.4 BB Contract specification

This is an example specification of interdomainAcctMgmt contract.

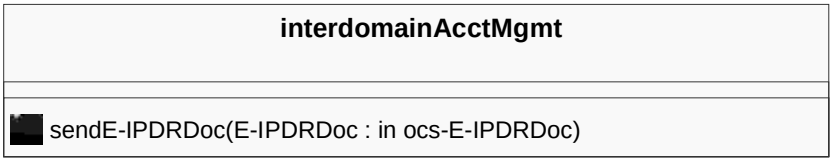

Figure 4-5 Example interdomainAcctMgmt Contract

4.5 Boundary Information Model (IES Provider System)

This is an UML diagram of information object communicated at the E-IPDRCtr contract, which is between E-IPDR Recorder and FMA.

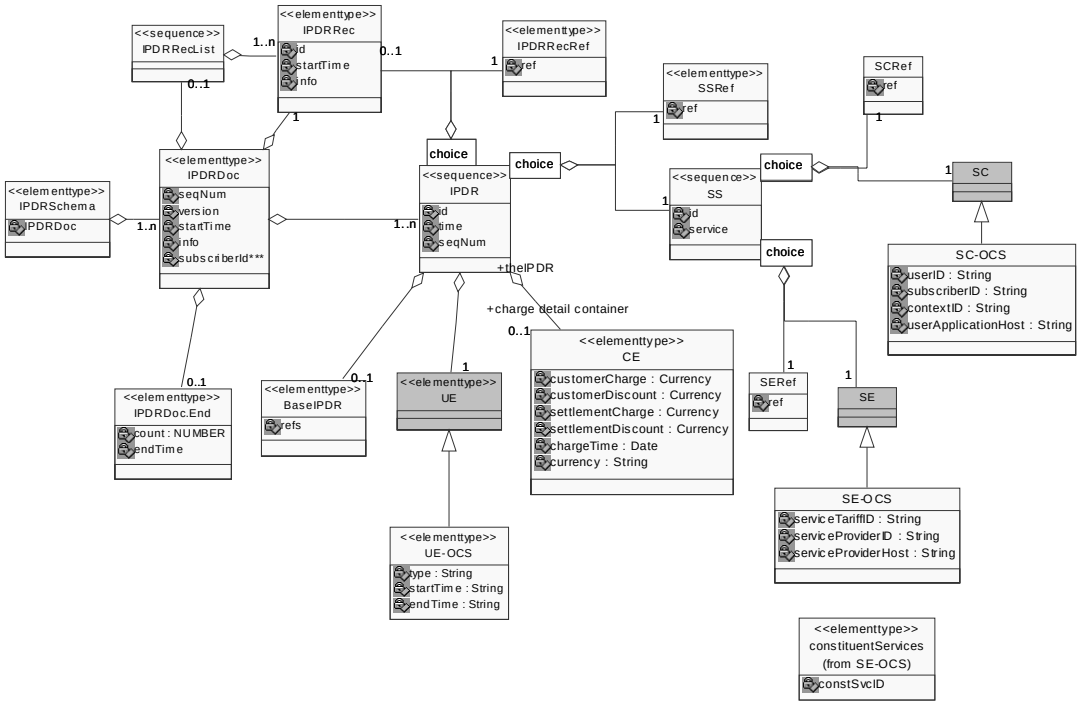

Figure 4-6 Information Model for Composite E-IPDR document

5 Billing IRS Provider System Model

5.1 Use case Model for the Billing IRS Provider System

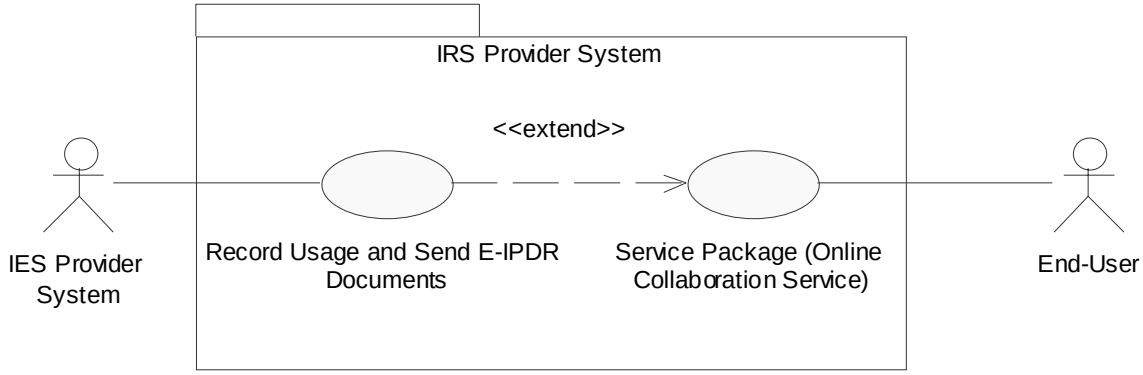

Figure 5-1 Use case diagram for the Billing IRS Provider System

Actor Name	Role Taken
IES Provider	Please see the description given above in the business object model.
End-user	Please see the description given above in the business object model.

Table 5-1 Billing IRS Provider System Actors

Use case Name	Service package (Online Collaboration Service)
Summary	The Online Collaboration Service (OCS) enables the end-user to use MediaShop and VoIP services (or constituent services) simultaneously and within a single online session. When the OCS session is in progress, it may branch off MediaShop and VoIP usage sessions at user's request.
Actors	End-users, IES Provider
Pre-Conditions	A SLA exists for the customer. All the service listed in the service package can be supported by service providers. Service package has been configured to provide services to the end-user.
Begins When	When end-users log on.
Steps	End-user-1 wishes to speak to End-user-2 using VoIP service. He/She logs onto the OCS, selects VoIP service, picks up the phone and makes a phone call. This service is provided by a VoIP service provider. During the conversation, End-user-1 decides to upload a media file (eg., a JPEG image). He/she selects MediaShop service to upload the image. This service is provided by a MediaShop service provider. Both end-users end the phone conversation and logs off.
Ends when	When the end-user log off.
Post-Conditions	None.
Exceptions	One or both constituent services are available.
Traceability	Business use case: Not applicable. Requirements: Not applicable.

Table 5-2 Use case description of "Service package (Online Collaboration Service)"

Use case Name	Record usage data and send E-IPDR documents.
Summary	This use case describes how VoIP and MediaShop Mediation Adaptors do usage-by-usage and real-time mediation of constituent services, ie, VoIP and MediaShop. It also describes the transfer of E-IPDR documents to FMA.
Actors	IES Provider, IES Provider.
Pre-Conditions	Mediation Adaptors have been configured to detect usage events.
Begins When	A usage event is detected.
Steps	• Record a usage event in real-time. Collection usage data from service package (ie, Online Collaboration Service) usage-by-usage. • Produce an E-IPDR document containing details of usage event and data (IPDR organisations "five Ws", which are, who, when, what, why, where). • Send E-IPDR documents to the FMA.
Ends when	MediaShop and VoIP Mediation Adaptors have sent E-IPDR documents to Federated Mediation Adaptor.
Post-Conditions	VoIP and MediaShop Mediation Adaptor has received from FMA an acknowledgement of the receipt of the documents.
Exceptions	Mediation Adaptors are not able to detect a usage session or receive usage data.
Traceability	Business use case: Resource usage management. Requirements: CB-I.01, CB-I.02, CB-I.04, CB-I.07, CB-I.08, CB-II.09, CB-II.11, CB-II.15, CB-II.21, CB-III.29, CB-IV.30, CB-IV.31, CB-V.35, CB-V.39.

Table 5-3 Use case description of "Record usage data and send E-IPDR documents"

5.2 Analysis Model for Billing IRS Provider System

5.2.1 Entity Objects

Entity Objects	Responsibility
E-IPDR Doc	This is the enhanced IPDR document, based on Master IPDR Schema. Its main role is to carry usage information for a service, i.e., details of usage event of MediaShop or VoIP service. The information model is presented below in the Boundary Information Model of IRS Provider System.

Table 5-4 Entity Objects for Billing IRS Provider System

5.2.2 Control Objects

Control Objects	Responsibility
MediaShop Mediation Adaptor	The main role of MediaShop Mediation Adaptor is to collect usage data, record the usage events, generate an E-IPDR document, and send it to FMA.
VoIP Mediation Adaptor	The main role of VoIP Mediation Adaptor is to collect usage data, record the usage events, generate an E-IPDR document, and send it to FMA.

Table 5-5 Control Objects for Billing IRS Provider System

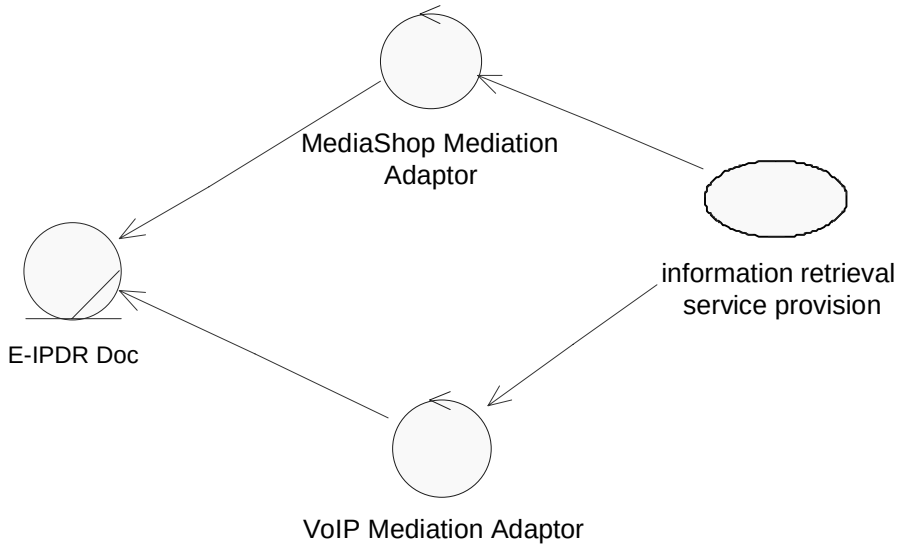

Figure 5-2 Object diagram showing the analysis objects that implements the use case

5.3 Re-organise Analysis Model and Group to Building Blocks for Billing IRS Provider System

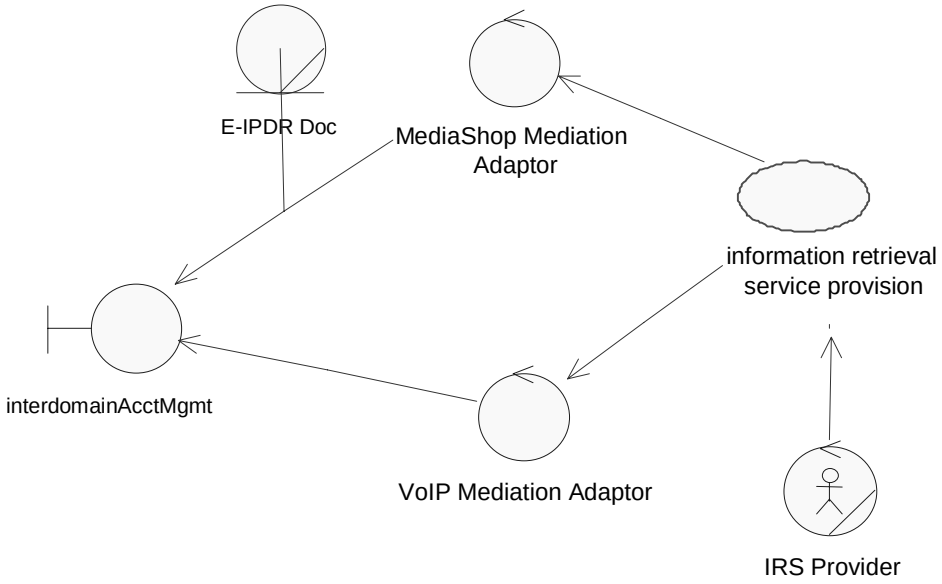

Figure 5-3 Collaboration diagram showing Building Blocks and Building Block Contracts

The following interaction diagram shows more details about the relations between the building blocks and the actors.

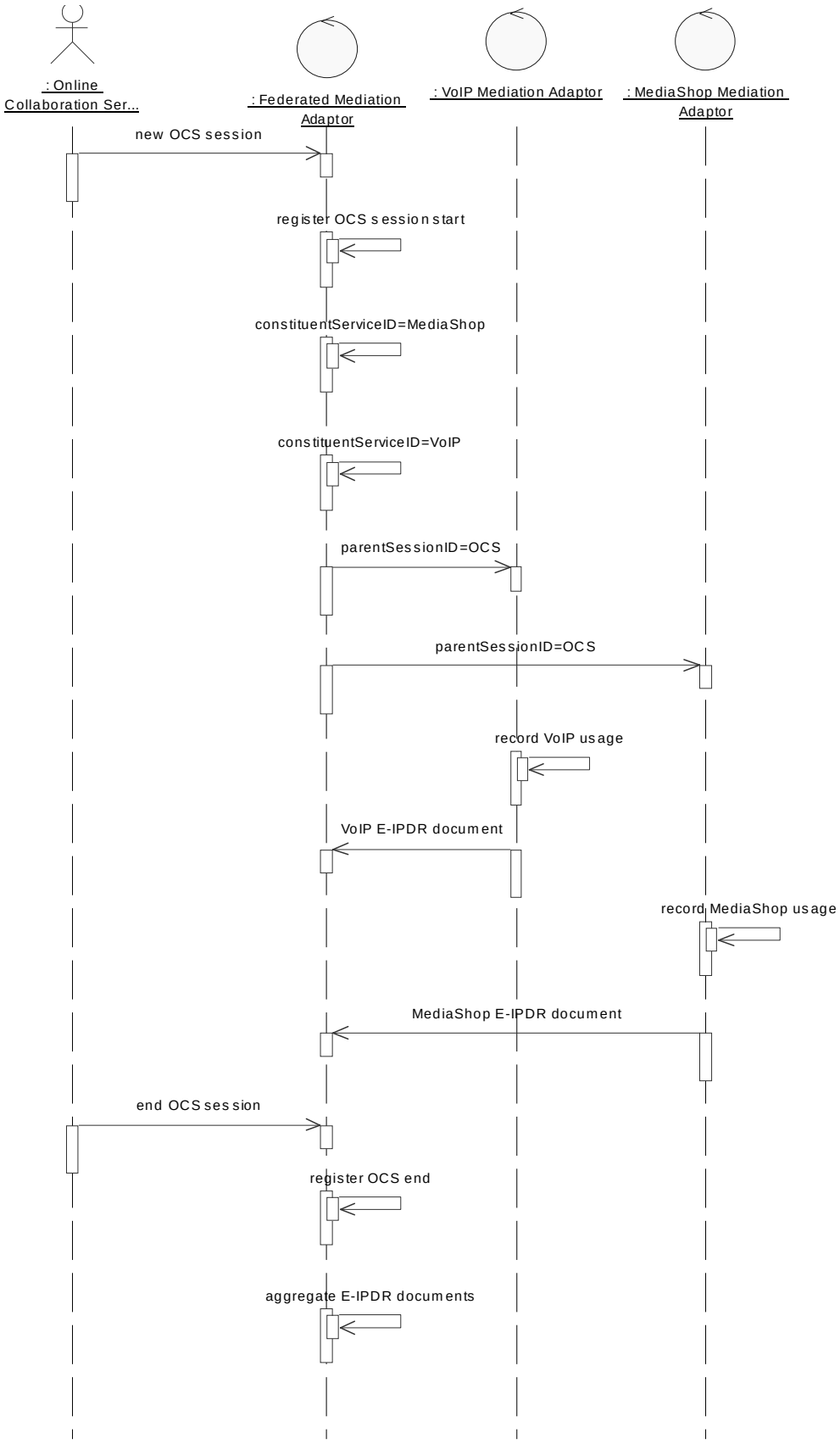

Figure 5-4 Interaction diagram for the use case showing the use of BB

5.4 Boundary Information Model (IRS Provider System)

This is an UML diagram of information object communicated at the interdomianAcctMgmt contract, which is between MAs and FMA.

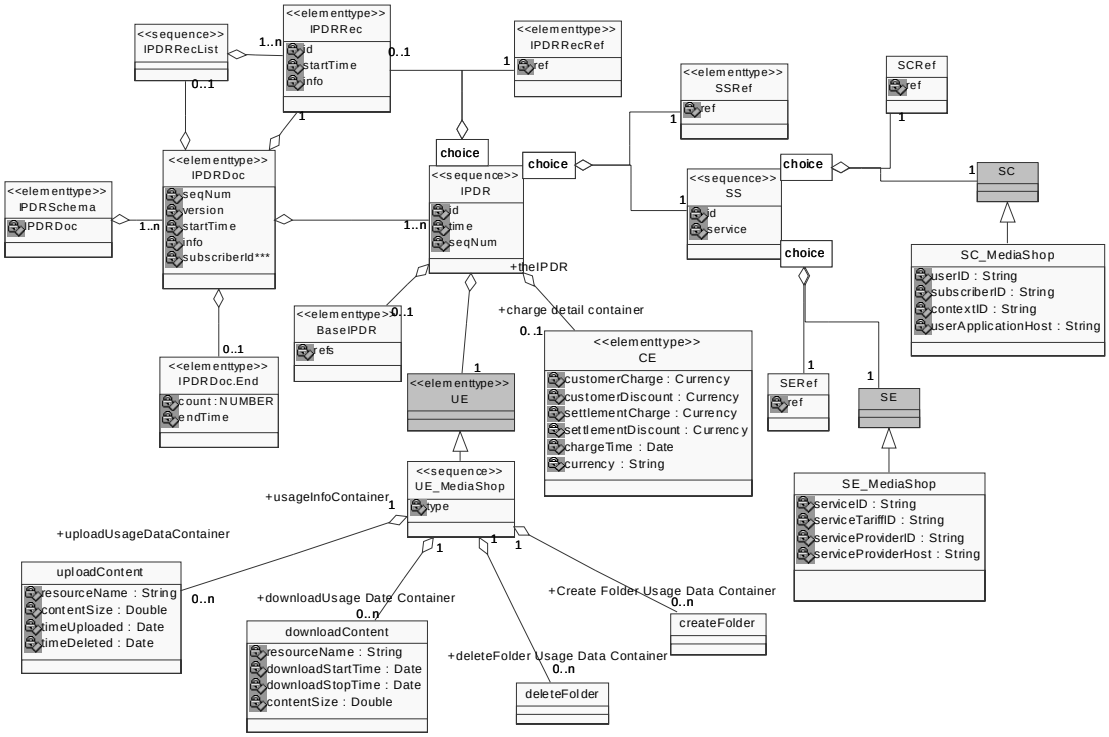

Figure 5-5 Information Model for E-IPDR document

6 Conclusion

This Annex applies ODF framework guidelines to the development of a Billing business process. ODF consists of technology architecture, logical architecture, building block development guidelines and business process guidelines. Technology architecture and logical architecture of ODF have only been used to a limited extent compared to the development guidelines. The main aim of this process is to demonstrate that ODF is applicable. This document also presents to the reader an example of the use of ODF for the development of a component-based Billing management solution.

7 References

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