Project P610

Management of Multimedia Services

Deliverable 3

Application of the management architecture to service: examples

Volume 2 of 3: Annex I - Application of the Management Architecture to High Performance Islands Service - Version 1.0

Suggested Readers:

- Experts for system engineering
- Designers of both multimedia services and management services from service providers

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Preface

(Prepared by the EURESCOM Permanent Staff)

The Project P610 addresses the problem of management of multimedia services and TMN system development guidelines. It defines a management framework for multimedia services and a set of concepts and principles for specification, analysis, design, reuse and operation of service-oriented management components for multimedia services, as well as the identification of some reusable management components. In addition it will establish methodological guidelines for the design of distributed management systems.

The Project P610 started its activities in July 1996. It will be finished by end of March 1998. The Project was initially led by Luis Alberto de la Fuente (Telefónica) and is now led by Javier Gallego (also Telefónica); 8 Shareholders participate in the Project (DT, IT, OG, PT, RB, ST, TE, TI) and the budget is approximately 178 MM.

This is the third Deliverable of P610. The purpose of the Deliverable is to apply the Management Architecture to service examples. The final Deliverable (D4) is due by end of March 1998 and, based on the work of Deliverable D3, it will provide the main findings of the Project and a refined version the Management Framework for multimedia services and Methodology which was initially defined in Deliverable D2.

The Deliverable should be of interest to experts in the field of system engineering and designers of both multimedia services and management services for service providers.

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List of Acronyms

ADSL	Asymmetric Digital Subscriber Line
ATM	Asynchronous Transfer Mode
CME	Centralised Management Element
DNS	Domain Name System
FTP	File Transfer Protocol
HFC	Hybrid Fibber Coax
HPI	High-Performance Island
IP	Internet Protocol
LME	Local Management Element
LSS	Local Service Sub-network
MMDS	Multi-channel Multi-point Distribution Service
MTTR	Mean Time To Restore
MTBF	Mean Time Between Failures
ORDIT	Organisational Requirements Definition for Information Technology
PSTN	Public Switched Telephone Network
QoS	Quality of Service
SAP	Service Access Point
SLA	Service Level Agreement
SMS	Subscriber Management System
SPC	Service Provider Center
UML	Unified Modelling Language
VoD	Video on Demand
WWW	World Wide Web

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1 Introduction

This report addresses the application of the framework, architecture and methodology defined in [D2] to the High Performance Islands (HPI) case study.

Section 2 describes the service analysed in this case study. The description includes the definition of the business model, the actors and the roles those actors play in the service. The service description also addresses the management requirements.

Section 3 starts the application of the methodology: from the service description, we get a first rough domain model.

Section 4 presents the scenarios and use cases for each sub-domain.

Section 5 describes the behaviour model of the application. This model is mainly taken from the previous section, where we have described the scenarios and use cases, and consists of sequence diagrams and state diagrams.

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2 Service Description

Currently, users that access some on-line services, mainly Internet services or Internet-like services, are not given any performance guarantees for their services and do not have access to the ever increasing possibilities of multimedia. The access rate to the service is fixed, and often low for services carrying multimedia contents. Besides, the involved transport network is often brought down by users competing for the same resources.

These on-line service facilities are often only available across local domains, called Intranets, that usually belong to a company. Users have access to most of the valuable information within the Intranet domain and access outside only for a small amount of information. Within the Intranet domain, users are guaranteed higher performance and thus the possibility of multimedia features.

The HPI service would provide residential users with Intranet-like features and would override the problems of low performance existing in some environments. The main characteristics of the HPI service are the following:

- Users would access the service through high-performance access networks.
- Users could be grouped in local sub-networks with high-performance (hence the HPI concept) supporting multimedia capabilities. This can only be achieved if the local sub-network is properly dimensioned and, of course, restricted to a given limited geographical context.
- Users will be able to access other HPIs and services offered over the Internet. These services could be also delivered under high-performance conditions, although maybe not as high as those guaranteed inside the HPI.
- The HPI would provide some contents (through SPC - Service Provider Centres) of interest mainly for the local users. There could be also some SPCs of interest for all the users of the HPI service.
- The HPI service could be based on IP addressing and would provide the customers with IP based services: e-mail, FTP, WWW and software downloading. In the future other services based on IP addressing could be available, like news, chat, etc. .
- The HPI service is designed in a way that installation/configuration of user terminals and enabling software packages overhead is kept to a minimum.

Given the high performance of the underlying infrastructure, the services can easily incorporate or process multimedia features (e-mail can be multimedia e-mail, WWW pages can include pictures, audio and video, etc.).

From the customer's viewpoint, this service is fairly appealing because of the high bandwidth guaranteed inside the HPI to access multimedia contents. This property can be reflected in attractive SLAs agreed with the customers which eventually could influence the billing process.

For example, for the e-mail service, it can be guaranteed that (A) e-mail messages would be delivered in 1 minute or (B) e-mail messages could be delivered in 3 minutes. If (A) is not met a 10% discount is applied to the bill. If (B) is not met a 20% discount is applied to the bill.

Another example, for the WWW service, it can be guaranteed that (A) the HTTP throughput could be above 128 Kbit/s or (B) the HTTP throughput could be above 64 Kbit/s. If (A) is not met a 10% discount is applied to the bill. If (B) is not met a 20% discount is applied to the bill.

Figure 2.1 presents a general view of the service architecture. There may be a certain number of HPIs interconnected through a backbone transport network (based on ATM technology). Some of the HPIs would have connection to the Internet (maybe to different nodes of the Internet). Users may be connected to one HPI and can use services (e-mail, FTP, WWW, etc.) on the same HPI, on other HPIs or across Internet.

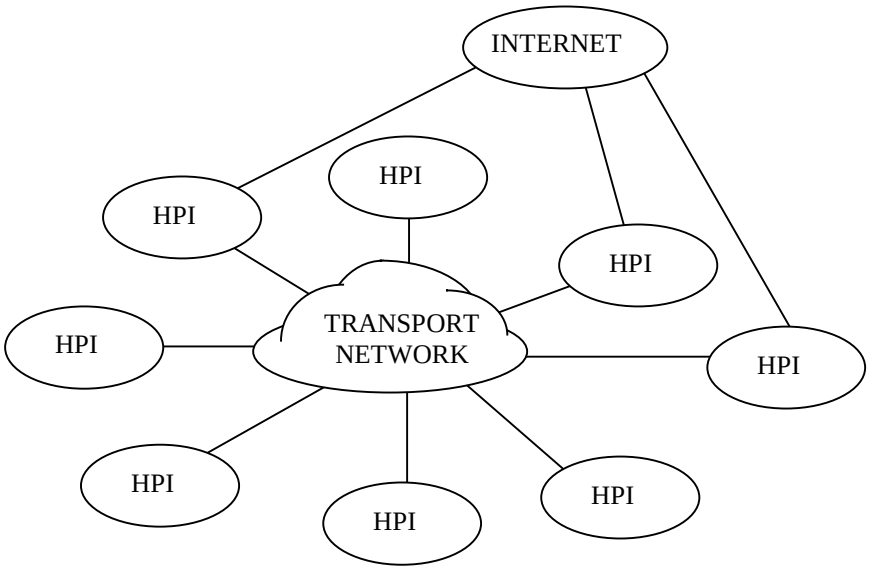

Figure 2.1: General view of the HPI Service architecture

Figure 2.2 presents the structure of a management solution for the HPI Service. An LME (Local Management Element) could be included inside each HPI to perform local management operations related to that HPI (for example alarm management, performance management, local configuration, etc.). All the LMEs could be connected to a CME (Central Management Element) that would perform overall tasks (for example subscription management, billing, global performance, global configuration).

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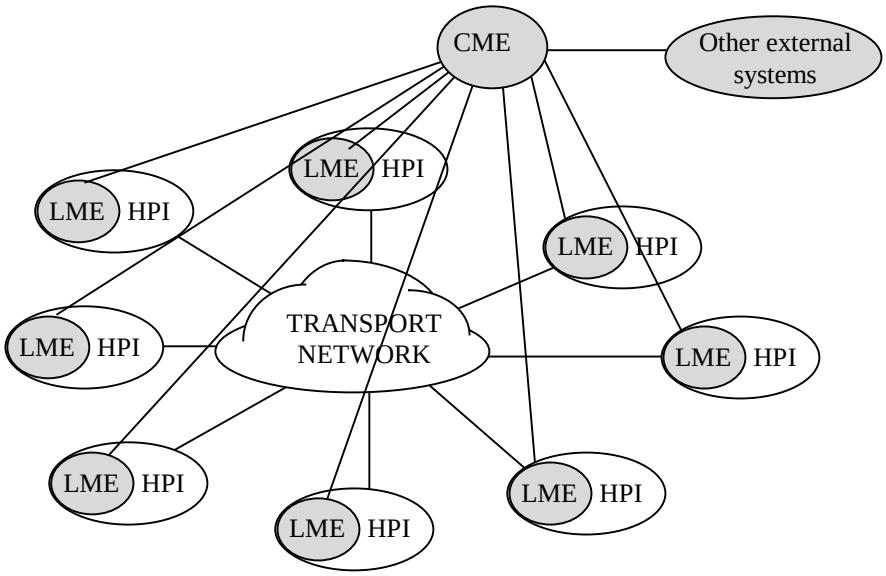

Figure 2.2: Management Solution for the HPI Service

Alternatively, the tasks performed by the CME can be brought to a minimum by transferring some of them to a more specialised external system, for example an SMS (Subscriber Management System) or a Billing System. In this case the interface between the CME and the external systems is of paramount importance and reliable data transfer has to be supported.

Figure 2-3 presents a more detailed view of the service and its elements. The elements below the dashed line are components and infrastructure that commonly are already running and could be used for supporting the service. The elements above the dashed line are the ones which have to be specifically developed and deployed for the service.

An HPI environment is composed of the following elements:

- The Local Service Sub-network (LSS), which contains the elements and logic required to provide the different HPI services. It also includes all the security elements required by the HPI services.
- The access networks, including peripheral devices (PABX, concentrators,...) interfacing to these networks.
- The end-user terminals, typically PCs.
- SPCs (Service Provider Centres) that provide added-value to the HPI users. These SPCs feature e-mail servers, FTP servers, WWW servers, mixes of them, etc.

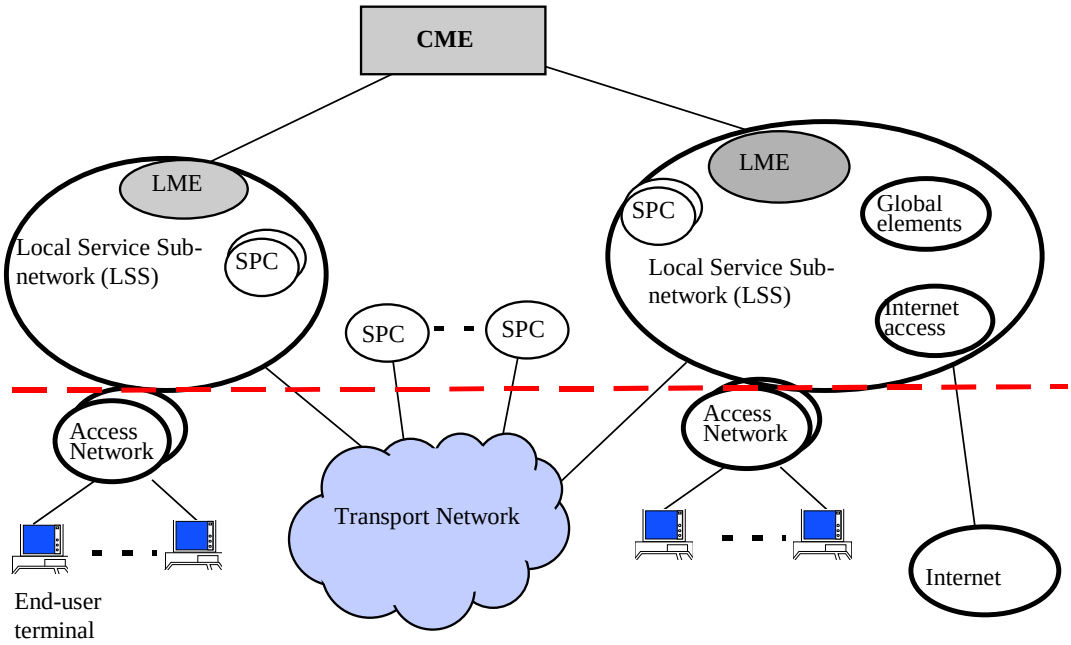

Figure 2.3: Elements of the HPI Service

The end-users, making use of their terminals and different access networks (HFC, PSTN with ADSL modems), access the HPI services. The user profile could determine his/her home HPI island, the mobility over different HPI islands, the possibility of accessing HPI services from any visited HPI islands, the exit to Internet, etc. .

Access to the HPI services must be well controlled. Of course, the user could be only allowed to access those facilities to which he has subscribed. Fraud must be carefully addressed.

Each HPI contains one or more SPCs. The SPCs can be physically connected to the rest of elements in the HPI by different means. There may be some SPCs that are global to the service, i.e. they go beyond the scope of a given HPI island.

Each HPI would have several components, internally located, which perform service functions (user authentication, access control, routing, cacheing, etc.). However, there are some other components that are global to the whole HPI service (for example, the primary DNS or the main directory of SPCs) and will be located within a master HPI. The maintenance of consistency of the information held by global and local elements will be one of the assignments of the management system (CME plus LMEs).

2.1 Business Model

The proposed business model for the HPI Service is shown in Figure 2-4.

The Consumer actor is specialised in bringing the Service Customer and the Service Users together. Each Customer can have one or more users (for example, a family) associated. The Customer will have a contractual relationship with the Service Provider, but need also a contractual relationship with the Access Network Provider,

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who permits access to all services. The Customer register users for specific services and pays those services in advance.

The Service Provider has also contractual relationships with the Content Provider, the Security Provider, the Internet Access Service Provider, the Access Network Provider and the Transport Network Provider. The Service Provider register users in the HPI and collects usage data of the users to bill the Customers.

The Security Provider is responsible for security. For example, the Security System Provider supplies for unequivocal evidence by the non-repudiation of delivery services applied. This actor has contractual agreements with the Service Provider, as well as, to the Access Provider.

The Content Provider as others actor keep a contractual relationship with the Access Network Provider to use the Transport Network.

The Internet Access Service provider can be considered as a specific Access Network Provider and has a contractual relation with the Service Provider (the Service Provider could provide Internet access to different customers). If a direct access to Internet is not available, the Internet Access Service Provider keeps contractual relationships with the Access Network Provider.

The Transport Network Provider maintains the network through which all the actors are communicated.

The Access Network Provider keeps contractual relationships with the Transport Network Provider and pays in advance the use of the network.

The business model represent a commercial for environment and so actors can be identified as organisations. As this model is so generic an actor can play many roles. The presented business model is not unique and other configurations may be possible, for example, the Internet Access Service Provider can be a part of the Access Network Provider or Security Provider can be seen as a role of the Service Provider.

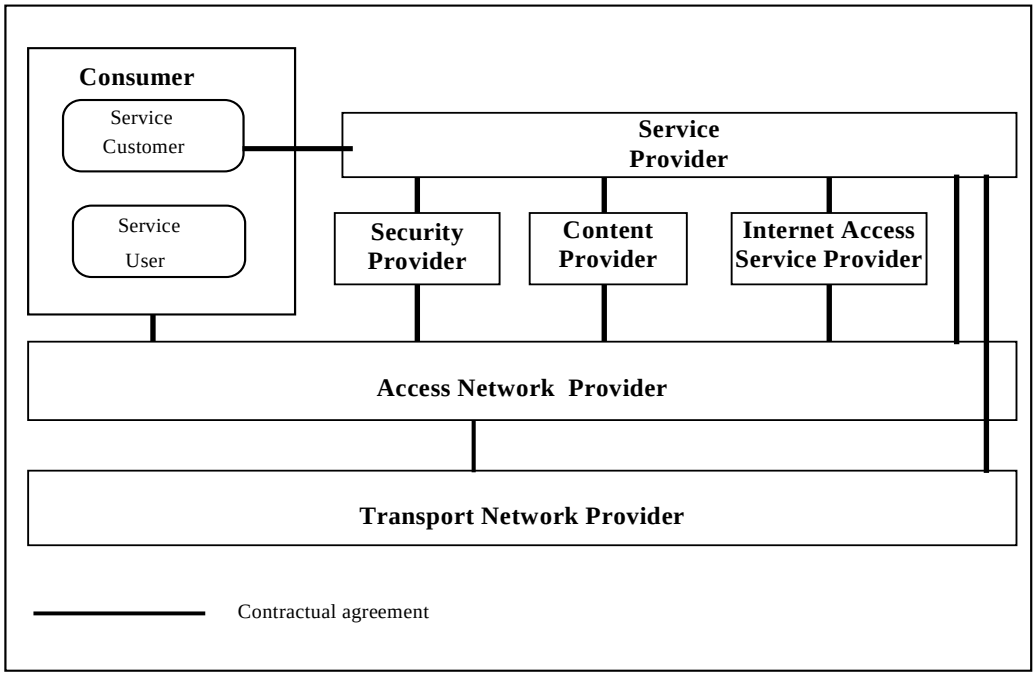

Figure 2.4: Business Model

2.1.1 Identification of actors

The following actors are relevant to the HPI Service:

- ***The Customer*. represents the entity (person, organisation, etc.) that subscribes to and manages the usage of the service.**

The Customer is responsible to the Service Provider for:

  - **provision of the identity of the service users**
  - **payment for the use of the service**

- **The *HPI Service Provider* is the entity which owns the HPI infrastructure and runs it for the sake of delivering HPI services.**

The Service Provider is responsible to the Customer for:

  - **provision of contents**
  - **provision of and updates to the user interface**
  - **administration of contents (upkeeping of Yellow and White Pages)**
  - **maintenance of the HPI service**
  - **monitoring and preventing unauthorised use of the HPI service**
  - **SLA fulfilment (monitor low performance levels and reflect it in billing)**

The Service Provider is responsible to the Contents Provider for:

  - **maintenance of the HPI service**
  - **the provision of performance (usage) reports**

- ***Internet Access Service Provider* is an entity which provides customers with true-Internet access. The HPI Service is used as a gateway to reach the Internet. Occasionally the HPI Service Provider would provide itself with this access.**

- ***Content Provider* is an entity which provides customers with information or value-added services for free, on a subscription basis or according to one-ticket charge (examples of Information Providers are a weather information provider or a news provider; examples of value-added Service Provider are a travel agency or a ticket agent service for theatre, concerts, sport events, etc.).**

The Content Provider may have to pay the Service Provider for hosting and distributing its contents, or simply for promoting its products (marketing campaigns). If the Service Provider wants to use/integrate contents (for example films) which belong to a Content Provider, it will have, obviously, to pay for them.

- ***Security Provider* entity which provides security. Its main responsibilities are:**

  - **Deployment of Security Services in consistency with the SLA negotiated and decided upon with the HPI SP, as well as, with the Access Provider and Transport Network Provider.**

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- **Maintaining of Security Services to the actors involved for the provision of the HPI MM Services.**
- **Secure initialisation of the key management service for HPI Service Customer/Provider.**

- ***Access Network Provider* is an entity which provides and manages access communication networks.**
- ***Transport Network Provider* is an entity which provides and manages long-hand communication networks; it provides connectivity services to most of the actors referred to above.**

2.1.2 Identification of roles

The roles that are relevant for the HPI Service are the following:

Consumer

- The service customers. These are parties who subscribe to the service and pay for it.
- The service end-users. These are parties who actually make use of the service. Each end-user is associated with a customer.

HPI Service Provider

- Financial Manager Role. Entity responsible for subscriptions, service billing and accounting.
- HPI Service Manager Role. Entity responsible for the operation and management of the service, including maintenance of the servers, configuration, alarm monitoring, security monitoring, performance, tracking, etc.
- HPI Service Integrator Role. Entity responsible for integrating the information provided by the content provider, as well as creating and maintaining white and yellow pages.

HPI Security Provider

- Financial Manager Role. Entity responsible for marketing and sales of the security components and the key management process (for example to check the claimed identity of users before certifying a public key and thereby binding a key to an asymmetric key pair).
- Certification Administrator Role. Entity responsible for key generation and certification process.
- Key Management Service Administration Role. Entity responsible for providing means of distributing public key certificates and related information to the End-Users.

Content Provider

- Financial Manager Role. Entity responsible for the contractual and economic relationships with other actors.
- Content Manager Role. Entity responsible for the generating and upkeeping of the contents.

Access/Transport Network Provider

- Financial Manager Role. Entity responsible for selling the access or transport network facilities, as well as metering and billing for their usage.
- Network Manager Role. Entity responsible for running and managing access or transport networks, and controlling the fulfilment of SLAs.

2.2 Management aspects of the HPI Service

The management of the HPI Service covers all aspects of service management (see the service life cycle model in [D2]). The HPI service provider must offer services, as well as, provide the mechanisms for subscription. Once a customer has subscribed and paid for use of the HPI Service, the service provider must support customers while are using the services. Information about the customer is required for maintaining and charging for sites.

Each user would be authorised to use a HPI Service and would need access to the various components of the service. This implies that a security service provider would exist. For this case study the security provider acts as a certification authority, as well as a mediator between two actors should they fall into dispute.

The service provider would guarantee a minimum quality of services, so must provide performance and fault management. The overall quality of service depends on the management of both the service and all the networks over which it runs from end to end, including the customer's own network and terminal equipment. This requires a management system in place that can ensure that the various domains involved in providing and delivering the service can support the quality of service required by the user. There would be a means of monitoring the performance to ensure that the quality of service is maintained and alternative strategies should be available if the requested quality cannot be maintained, for instance, re-routing, re-negotiation, the use of priorities and alternatives in user profiles, etc..

Accounting for the use of services would be send to the HPI Service Provider, which has to ensure that the costs of usage are covered by the charges made to the customer for the HPI service subscription.

Provisioning of the HPI Service involves provisioning of the supporting services for the users subscribed to this services. Fault and performance management also requires interaction between the management systems of the various services involved in providing the service. This implies complex management relationships between HPIs. Management support must be available between HPIs and different HPIs must co-ordinate their management systems to enable resources to be shared.

The subsequent sub-sections present the data need for management and the management requirements (see management requirements [D2]) for HPI case study.

2.2.1 Management Information

- Customer data

  These data identify the customer, its financial information, its location, billing history, end-users associated, etc.

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- End-user data

  This data identifies the end-user, its location, the equipment assigned to him, problems history, etc. .It also includes the user profile (services and facilities subscribed to, preferences W.S.F the user interface, etc.).

- Service data

  Different information related to the service (features, options, prices, legal constraints, etc.) provided by the Service Provider. It must include tariffs for all the services, including information on promotions or discounts related to marketing campaigns.

  SLA general information can be included as well, for example, system/service availability, time to identify the case of a customer-reported malfunction, time to repair a customer-reported malfunction, provision time, quality of service targets, etc. Together with the definition of the parameters to measure these behaviours, it must be indicated the way they affect the billing process.

It must also include a directory of all the services, information provided by the Content Providers, and Yellow/White Pages.

- Service usage

  This information details the subscribers usage. This is the basis for service planning in the medium term and for service configuration in the short term.

  Important data items include:

  - capacity percentage of each HPI service module (server) that is being used
  - number of customers that use each service module (server) and mean time of use instances

- Quality of Service information.

  The QoS can be split into two parts: service independent measurements and service specific measurements.

  Service independent measurements refer mainly to service availability at the Service Access Point (SAP) and include:

  - The number of SAP outages per month
  - Time to Restore for a specific SAP
  - % occasions exceeding the agreed Time to Restore
  - Mean Time To Restore (MTTR) for a specific SAP or SAP group
  - Mean Time Between Failures (MTBF) for a specific SAP or SAP group
  - Service specific measurements includes:
  - IP packets sent, received, rejected, retransmitted, etc.
  - The QoS, from the application perspective, may include some additional information:
  - Total time that Web/FTP/E-mail servers are down, accumulated over a month

  - Time that Web/FTP/E-mail servers are congested and are not delivering information at the expected transfer rate, accumulated over a month

- Traffic data information

  There are some traffic data to be recorded. Some of this data is used for billing purposes, whilst more may guide performance tracking activities:

  - Mean throughput of data transfer for each service module (e-mail, FTP, WWW)
  - Time percentage one HPI server is serving one user at least or total minutes such a server is serving one user at least
  - Total amount of data transferred (measured in Kbytes or Mbytes) by each HPI server per hour/day

- Trouble ticket information
  - Trouble tickets will include a lot of information, among this:
  - Date and time of trouble ticket creation
  - Data of the customer affected
  - Service(s) affected
  - Trouble description
  - Expected date and time of trouble resolution
  - Date and time of trouble ticket closure

- Service Configuration

  The following data is relevant for each customer:

  - number of users and service access configuration for them
  - (Access and switching) HPI composition and topology
  - HPI backup elements and procedures

- Service charging information

  This information reflects data on HPI sessions, collected for the purpose of customer billing. Some relevant data items are:

  - Date and time of session start
  - Date and time of session stop
  - Number of bytes sent
  - Number of bytes received
  - Number of IP packets sent
  - Number of IP packets received
  - Status before session stop
  - Session type (FTP, WWW,…)

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- Security information
  - Logging of valid accesses to the system. Logging of attempts to access the service in a non-valid way
  - Customer and user passwords

2.2.2 Management requirements

The following list gathers together some management requirements for the HPI service but is not intended to be exhaustive.

- Establish attractive SLAs and determine the ways to monitor them as well as reactive mechanisms that must be put in place when they go below the agreed levels.
- Automation of Trouble Ticketing handling, featuring high levels of responsiveness given the economical impact of out-of-order situations.
- Analysis of acceptability of new customers. A new customer may be rejected if its use of the service would cause a drop in the performance of the HPI below acceptable levels.
- Analysis of bottlenecks and optimisation of the use of resources in real-time. Some HPI services may be prioritised over others in order to increase performance on the HPI.
- Automation of order handling, both for new subscriptions and subscription modifications.
- On-line support for ordering HPI services.
- Complex billing system, based on service charges, performance reports, and SLA (service failure) fulfilment.
- Distinguish between end-users and customers.
- Support mobility of users between terminals and between HPI islands.
- Handle security issues.

2.2.3 Additional management requirements from Deliverable D2

What follows is a description of requirements taken from Deliverable D2 which are most relevant for HPI management.

- **Customisation and customer profile management**

  HPI services are provided in a personalised way. This means that the selected options can be quite different among users.

  Besides, a certain degree of service management is available for the users so that they can query and modify certain service parameters, mainly related to configuration aspects.

- **Security and authentication**

  The user is initially given a unique user name and a password to access the service. The password can be modified by the user later on. The service will allow to make associations of users to customers in a flexible way.

- **Network performance information and usage statistics**

  Parameters impacting on the service and subsequently on the SLAs must be specially observed. Therefore, allocated bandwidth, number of users being served at the same time, distribution of traffic generated, average duration of user sessions, etc. are parameters which need to be tracked in order to command reconfigurations.

  The collection of usage statistics will be a prerequisite for the billing job.

- **Charging and billing**

  Several charging schemes are to be supported, even simultaneously for the same customer:

  - Free services.
  - Services with flat tariff.
  - Services charged according to different concepts: traffic generated, session daytime, geographical aspects, etc.

  Facilities have to be provided to support different payment methods such as electronic funds transfer, VISA, checks, etc. Mechanism for dispute resolution triggered by trouble tickets (unexpected charges for concepts which have not been used or violations of SLAs) are also important. Scenarios and Use Cases

This section presents scenarios and use cases grouped by actors.

In this presentation we do not presented all the possible scenarios that contain a use case. In fact, we only present those scenarios for exceptions of use cases when they identify an object that is to be modelled.

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2.3 HPI Service

2.3.1 Provisioning

Use Case:	HPI Service Configuration.	Uc- 1
Summary:	The operator configures the HPI Service.	
Actors:	HPI Service Provider (HPI Service Manager Role).	
Pre-conditions:	The physical installation of all the HPI elements is available.	
Description:	The operator must: • Define all the HPI • Define the characteristics of each HPI • Define the links between HPI • Define the logical routing between HPI • Define the logical global elements of the HPI Service (i.e., DNS, proxies to Internet, Internet mail server), make the copies needed in each HPI and establish the consistency mechanisms. • Define the logical elements needed in each HPI (mail Server, proxies, security mechanisms, routing mechanisms, etc.	
Exceptions:		
Post-conditions:	The HPI Service must be ready to use.	

Use Case:	Add Customer.	Uc- 2
Summary:	Adds a new Customer to the HPI Service when the Customer is subscribed.	
Actors:	HPI Service Provider (HPI Financial Manager Role) and Customer.	
Pre-conditions:	The feasibility of adding a customer and its users to an HPI (impact on traffic, impact on security…) must be analysed. The Customer must to be able to access to the HPI Service Provider.	
Description:	The Customer takes information of all the contract features. The Customer gives all its personal information and also information about the way of billing. The Customer provides all the information regarding the end-user that will access to the service: • number of end-user, • terminal type, • service access configuration, • access and switching high performance networks composition and topology, • backup elements and procedures,...	

	The operator must fill the template with all the data provided by the Customer, mainly personal (or identification data) and financial data. A Customer may have associated more than one End-User. The billing process is initialised for the Customer.
Exceptions:	Adding a Customer is not feasible in that HPI island in order to avoid a QoS reduction. The Customer or end-users profile does not correspond to the service constraints
Post-conditions:	Each customer should have associated one or more users. The billing process is ready for that customer. The Customer is subscribed for a certain number of end-users who have to be notified and then they can access to the HPI service.

Use Case:	Add End-User.	Uc- 3
Summary:	Adds a new End-User to the HPI Service.	
Actors:	HPI Service Provider (HPI Service Manager Role), Customer and End-User	
Pre-conditions:	Each End-User must be associated with a Customer. Each End-User should have the required equipment to access the service. The Customer should be allowed to deal with the service.	
Description:	The operator must fill the template with all the data concerning the End-User (equipment, identification to the system), service components and features subscribed. It can also store preferences and End-User interfaces. The relation with the Customer could then be realised. Finally the End-User must be activated in the system (set up of permissions, mail-box, usage records, etc.) creating its profile.	
Exceptions:	Duplication of user names.	
Post-conditions:	The user should be allowed to use the service	

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Use Case:	Add new Content Provider.	Uc- 4
Summary:	Adds a new Content Provider and makes its products available to the End-Users.	
Actors:	HPI Service Provider (HPI Service Integrator Role) and Content Provider.	
Pre-conditions:	The physical elements required to support the Content Provider are available.	
Description:	The Content Provider supplies the HPI Service Provider with information about the contents he is offering. The HPI SP configures the HPI Service to include the Content Provider (routing, configuration, etc.). Then it adds the information to the White Pages and Yellow Pages so the Content Provider can be found.	
Exceptions:		
Post-conditions:	The Content Provider should be accessible by the End-Users	

Note: Only use cases for 'adding' have been considered, but there should be also use cases for 'modifying, deleting or querying' the information.

Use Case:	Initiate Session.	Uc- 5
Summary:	Allow User to log on for a service session.	
Actors:	HPI Service Provider, End-Users and HPI Security Service Provider.	
Pre-conditions:	Service in operation and End-Users are registered in the HPI service.	
Description:	A log on request is received from the End-User. The user name and password are checked. If this check is successful the End-User Profile is read to obtain End-User preferences, etc.. The End-Users Session Log is updated to reflect their activities while logged on.	
Exceptions:	Log on authorisation failure. End-User's credit is bad. System faults.	
Post-conditions:	End-User takes part in a service session.	

Name:	End-Users fails to connect with the HPI Service Provider.	Sc- 1
1.	A connection request is received by the Service Provider which includes an identification and password.	
2.	A check is carried out by the Service Provider's Security Service Provider to ensure that the End-User is a legitimate one and that the correct password has been used.	
3.	If the Security Service Provider fails to authenticate the Student's details or if their credit rating is bad then the session is not initiated.	

2.3.2 Accounting

Use Case:	Billing Process.	Uc- 6
Summary:	This use case compiles the billing process.	
Actors:	HPI Service Provider (HPI Financial Manager Role), Customer.	
Pre-conditions:	The Customer has to be able to access to the HPI Service Provider.	
Description:	The billing process is started. This can be a planned action carried out of nights or on request. All the customers or only part of them are selected. All the information about service usage of the users associated with depending on these customers is gathered. The tariffs are applied to the service consumption. Rates, discounts and promotions are applied producing the total amount to be paid. The bill is prepared and printed in the format selected by the Customer (level of detail, language, etc.). The Customer receives the bill that has to be paid.	
Exceptions:	SLA violations, rebates…	
Post-conditions:	The control of payment is carry out to check that bills are paid by the Customers.	

Use Case:	Maintain tariffs.	Uc- 7
Summary:	This use case shows the maintenance of the tariffs.	
Actors:	HPI Service Provider (HPI Financial Manager Role).	
Pre-conditions:	The operator must be able to consult the existing tariffs, to create new billing concepts and to change them.	
Description:	Tariffs should consider the following criteria: flat rates, rates depending on time consumption, rates depending on the size of the information. The tariffs should be made publicly available so the End-Users are aware of them (mailing list explorer, information in web pages).	
Exceptions:		
Post-conditions:		

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Use Case:	Create invoices.	Uc- 8
Summary:	The HPI Service Provider generates invoices for its Customers.	
Actors:	HPI Service Provider (Financial Manager Role), Customers.	
Pre-conditions:	A contract exists between the Service Provider and its customers. The timing for generating invoices is correct.	
Description:	The operator generates invoices for customers. For this purpose, the relevant accounting data should be retrieved from the usage registers, apply tariffs and possible discounts (e.g. because of downtime and performance related issues).	
Exceptions:		
Post-conditions:		

Use Case:	Handle Customer account inquiries	Uc- 9
Summary:	The operator informs the Customer.	
Actors:	HPI Service Provider (Financial Manager Role), Customer.	
Pre-conditions:	The Customer has been identified as such.	
Description:	The Customer asks for charging information related to the usage of the service, and is informed by the HPI Service Provider.	
Exceptions:	The Customer does not agree with the supplied information: if this is the case, it should be investigated if there was a problem in the charging system.	
Post-conditions:		

2.3.3 Maintenance

Use Case:	Monitor alarms.	Uc- 10
Summary:	These are the typical fault maintenance facilities.	
Actors:	HPI Service Provider (HPI Service Manager Role)	
Pre-conditions:		
Description:	A representation of all the elements of the HPI Service is shown to the operator in order to check if there is any alarm. Elements to be considered are the elements of the HPI Service itself, and also external elements, like the Access Network or the Transport Network. When a new alarm appears, relevant information must be seen immediately (equipment affected, severity, time, etc.). At a button click more detailed information must be available (probable cause, service components and elements affected, etc.). The operator must be able to carry out some actions to handle the alarm (reset elements, change configuration, perform tests, check further information). The alarm will be cleared at the end of the process. All cleared alarms are logged into the systems. They can be examined later to study faulty behaviours and to prevent other alarms.	
Exceptions:		
Post-conditions:	Some action has been initiated to cope with alarms (discard them, perform tests,…).	

Use Case:	Monitor servers.	Uc- 11
Summary:	The operator monitors server logs	
Actors:	HPI Service Provider (HPI Service Manager Role).	
Pre-conditions:		
Description:	The operator monitors the server logs (e-mail, web, proxies, etc.). Summarised reports of the use of each service can be provided to decide if there is a need for any reconfiguration. Check that after any reconfiguration the HPI service works as expected, without problems.	
Exceptions:		
Post-conditions:		

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Use Case:	Performance management.	Uc- 12
Summary:	These are the performance management facilities.	
Actors:	HPI Service Provider (HPI Service Manager Role).	
Pre-conditions:		
Description:	Performance reports are elaborated regularly. They can be planned in advance or they can be invoked manually. Performance reports can be summarised for each End-User, for each HPI or for the whole service. The performance reports should consider the different traffic types presented for the HPI Service (internal to an HPI, internal to the whole HPI service and external to the HPI service). Some of the performance surveillance must be done in real time. If performance goes below certain selected levels, warnings or alarms can be generated, so actions can be invoked immediately. Historic reports are also elaborated to do a deep study of the performance of the whole service. They can be used to decide on reconfigurations, upgrades, extensions, etc.	
Exceptions:		
Post-conditions:		

2.3.4 Trouble Ticketing

Use Case:	Fault detection/Trouble ticketing	Uc- 13
Summary:	Service Provider ensure that service quality levels remain above agreed levels notify the relevant parties if do not.	
Actors:	HPI SP, NP, Customer, End-User, Content Provider.	
Pre-conditions:	Contracts for services have been agreed between suppliers and users. The service is operative.	
Description:	During each session monitoring systems notify failures in services or of drops of QoS below quality service level agreements. These failures are logged and maintenance service request to restore service.	
Exceptions:		
Post-conditions:	End-Users are notified of the problem an estimated time to normal resumption of service. Service is restore to normal.	

Use Case:	Fault Notification	Uc- 14
Summary:	A fault is reported to the Service Provider by some actor in the HPI.	
Actors:	NP, HPI SP, CP, Customer, End-Users.	
Pre-conditions:		
Description:	SP receives an abnormal condition notification by an Actor of the HPI . The HPI provider's Fault finding service is used to investigate the problem. The fault is categorised and if it is the HPI provider service's fault estimate of how long the fault will take to fix are sent to actor who notified the problem and if possible to End-Users of the service affected. A note of severity and duration of the fault is kept. This information may be used later in bill handling.	
Exceptions:		
Post-conditions:	Fault is logged and repair is underway.	

2.4 Security Provider

2.4.1 Monitoring

Use Case:	Monitor attacks.	Uc- 15
Summary:	These are the security facilities.	
Actors:	HPI Security Provider (HPI Security Manager Role)	
Pre-conditions:	Typical security attacks are characterised and monitored.	
Description:	The HPI Security Provider analyses the security logs and produces summarised reports. It investigates each case in detail to see if security mechanisms are handling properly the attacks from unauthorised persons. If not, the operator must try to solve the problem. Security attacks not characterised yet must be investigated.	
Exceptions:		
Post-conditions:		

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Name:	Security terms & parameters monitoring Security Provider in accordance with his obligations coming from the agreement made with HPI Service Provider and Network Provider on security issues, monitors all the relevant security data, and reports accordingly to HPI Service Provider, (Content Provider and Customer), Network Provider.	Sc- 2
1.	Security Service Provider, on time intervals pre-decided (periodically), monitors its facilities as it refers to security terms and parameters, in order to keep out unauthorised users from accessing HPI services, and more precisely to ensure encryption parameters validation, and submits them to HPI Service Provider (Content Provider and Customer).	
2.	HPI Service Provider conducts an analysis and checks these reports against its own records. He finds these reports not covering the security (encryption, protection) parameters requirements, and asks Security Provider to modify certain parameters data.	
3.	Security Provider accepts these modifications under the condition of covering this matter with a relative change of the initial agreement specific term.	
4.	HPI Service Provider agrees on Security Provider's position and security surveillance new terms are signed up.	

Use Case:	Security/ Fraud occurrence.	Uc- 16
Summary:	A non authorised End-User requests to be served. Security Provider running a security check, detects him as an illegal one, and after HPI Service Provider's verification bars the End-User.	
Actors:	Security Provider, HPI Service Provider, End-User	
Pre-conditions:	A highly qualified Security Service System.	
Description:	A non authorised End-User requests to be served. Security Service Provider control picks him up as an illegal one and asks HPI Service Provider for verification. HPI Service Provider's validation system acknowledges that the specific End-User is a non authorised one. Then Security Provider has two alternatives, either to bar the End-User right away or to divert him to HPI Service Provider (service desk).	
Exceptions:	The hacker's (intruder) violation is not picked up by security system.	
Post-conditions:	After hacker's rejection, Security Provider's facilities clearance from specific non-authorised End-User .	

Use Case:	Repudiation of delivered Services quality (Non-repudiation of delivery). Uc- 17
Summary:	A Customer, following his End-Users complaints, repudiates the quality of the Services delivered by the HPI Service Provider. The Security System Provider supplies unequivocal evidence on the non-repudiation of delivery , the dispute is cleared out and the invoice is paid.
Actors:	End-Users, Customer, HPI SP, Network Provider, Security System Provider.
Pre-conditions:	The contract negotiated and signed by the Parties involved, must cover the non-repudiation of delivery security services. The Security System Provider provides efficiently unequivocal evidence by the non-repudiation of delivery services applied.
Description:	A Customer is repudiated by the HPI Service Provider to guarantee the quality of services, on the behalf of their End-Users. The HPI Service Provider disputes with the HPI Network Provider over the (latter) services quality provision, and requests the support of the Security System Provider. The Security Provider supplies non-repudiation services evidence. The dispute is cleared and the bill is paid by the End-Users.
Exceptions:	The Security contract does not cover the provision of non-repudiation of delivery services. The Security System Provider does not provide efficiently the non-repudiation of delivery services, agreed upon.
Post-conditions:	The End-Users /Customer pays the invoice to HP Service Provider. The HPI Service Provider asks the Security System Provider to investigate the cause of the problem reported by the Customer report accordingly.

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Name:	Repudiation of delivered services quality (Non-repudiation of delivery)	Sc- 3
1.	Some Customer's Clients (End-Users) complain to their Customer, that part of services delivered were not of a high level quality (some problems appeared), and as a consequence they will refuse to pay accordingly.	
2.	The Customer forwards these complaints to the HPI SP.	
3.	The HPI Service Provider informs HPI Network Provider on the Customer's complaints.	
4.	The HPI Network Provider runs a check in order to investigate the validity of the complaints (performance parameters monitoring and log-in data scanning according to the specific complaints data given), finds out that no problem on his part and notifies HPI Service Provider.	
5.	The HPI Service Provider insists supporting his Customer's complaints and calls upon the assistance of the Security System (Provider).	
6.	The Security System Provider provides the involved Parties HPI Service Provider, and HPI Network Provider with unequivocal evidence of HPI Network Provider's services on non-repudiation of delivery, that is, the services offered have been given properly and in consistency to the SLA agreed upon.	
7.	The HPI Service Provider and the Customer agree with the evidence provided and the Customer notifies his End-Users.	
8.	The invoice issued by Accounting System is paid.	

2.5 Customer

2.5.1 Subscription

Use Case:	Subscription contract modification	Uc- 18
Summary:	Customer uses/modifies subscription contract	
Actors:	Customer, HPI Service Provider.	
Pre-conditions:	The Customer has a contract with the HPI Service. The Customer is paying regularly.	
Description:	The Customer can access to the contract and carry out modifications to its profile or to the end-user's one (capabilities of access, etc.)	
Exceptions:	The operation is not possible if the Customer or End-Users profile do not correspond to the service constraints.	
Post-conditions:	The Customer is subscribed for a certain number of End-Users who have to be notified of the modification.	

Name:	Subscription contract modification: Customer profile do not correspond to the Customer constraints	Sc- 4
1.	The Customer contacts the HPI Service Provider who he has a contract with.	
2.	The Customer could access to all the information regarding the contract.	
3.	The Customer tries to modify some aspects of the contract.	
4.	The Service Provider asks to the Content Provider if the Customer could accessed to the service he provides.	
5.	The Content Provider give a negative response to the Service Provider, according to the Customer profile.	
6.	The Service Provider notified the Customer that the changes were refused.	

2.5.2 Maintenance

Use Case:	Access Service Usage	Uc- 19
Summary:	The Customer can access the HPI service usage information.	
Actors:	Customer	
Pre-conditions:	The Customer has to be able to access to the HPI SP.	
Description:	The customer should be able to access to the Service Usage information: • time percentage of each service module that is being carried out in the HPI; • number of customers that use each service module and mean time for each usage, etc.	
Exceptions:	The Customer wants to access to information not available.	
Post-conditions:	The Customer receives the information.	

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2.5.3 QoS

Use Case:	QoS information Uc- 20
Summary:	The Customer can access the HPI service QoS information.
Actors:	Customer
Pre-conditions:	The Customer has to be able to access to the HPI SP.
Description:	The Customer should be able to access to the following information generated by the HPI SP: • Service independent measurements refers mainly to service availability at the Service Access Point (SAP) and includes: ♦ The number of SAP outages per month ♦ Time to Restore for a specific SAP ♦ % occasions exceeding the agreed Time to Restore ♦ Mean Time to Restore (MTTR) for a specific SAP or SAP group. ♦ Mean Time Between Failures (MTBF) for a specific SAP or SAP group. • Service specific measurements includes: ♦ IP packets sent, received, rejected, re-transmitted, etc. • The Quality of Service, from the application perspective, may include additional management information: ♦ Time that Web/FTP/E-mail servers are down, accumulated over a month. ♦ Time that Web/FTP/E-mail servers are congested and not delivering information at the expected transfer rate, accumulated over a month.
Exceptions:	The Customer wants access to information not available.
Post-conditions:	The Customer receives the information.

2.5.4 Trouble Ticketing

Use Case:	Trouble ticketing Uc- 21
Summary:	The Customer can access to the HPI Service Trouble Ticket information
Actors:	Customer, HPI Service Provider
Pre-conditions:	The Customer has to be able to access to the HPI Service Provider.
Description:	Complaints are reported by customers when they have no access to the service in the SAP or they experience problems operating the service. The HPI Service Provider generates trouble tickets to notify that these complaints have been received and are being handled. Customers can access this kind of information.
Exceptions:	
Post-conditions:	The Customer receives the information.

2.6 Content

In this section, Content Provider Scenarios and Use Cases are considered. In the business model considered for HPI service, the Content Provider has a contractual relationship with the HPI Service Provider, but not with the HPI Customer. The Management areas related to Accounting and Maintenance are selected for the Scenarios and Use Cases because they imply inter-domain interactions, while pure Content Management activities in the HPI Service are essentially contained within the Content Provider Management domain.

2.6.1 Accounting

In general, provision of content is included in the HPI Service and appears to be free to the Customer, or is offered at a fixed fee. However, material subject to royalties and copy rights, such as VoD or MM publications, may require a specific accounting procedure, where usage records are kept as inputs for the accounting procedures between HPI Service Provider and Content Provider. In the event of dispute over a bill, the Management System may help by supporting usage records exchange and communication between parties.

Use Case:	Content Provider issues bill to the HPI Service Provider Uc- 22
Summary:	A bill is sent for later payment. In case of disagreement a consensus is reached.
Actors:	Content Provider and HPI Service Provider
Pre-conditions:	A contract exists between the actors involved, specifying billing aspects. An event, such as timing, triggers the billing process.
Description:	The Content Provider, using computer or manual support, gathers information on usage demand (mean and peak content) and performance data (actual supplied content, busy hour mean waiting time). Records are gathered concerning specific services such as copyrighted data retrieval (VoD, MM Encyclopaedia). Costs are computed according to the contractual agreement. Elements such as downtime or performance related discounts are considered. An official bill is composed and sent to HPI Service Provider. HPI Service Provider pays. HPI SP debts are reset. A receipt is issued.
Exceptions:	HPI Service Provider issues denies the bill, and further investigation is conducted until an alternative agreement can be reached.
Post-conditions:	In case of disagreement, possible updates to billing system or contract, according to results of investigation.

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Name:	Content Provider issues a bill, HPI Service Provider considers bill incorrect. An alternative agreement is reached.	Sc- 5
1.	The Content Provider, using computer or manual support, gathers information on usage demand (mean and peak content) and performance data (actual supplied content, busy hour mean waiting time). Records are gathered concerning specific services such as copyrighted data retrieval (VoD, MM Encyclopaedia).	
2.	Costs are computed according to the contractual agreement. Elements such as downtime or performance related discounts are considered.	
3.	An official bill is composed and sent to HPI Service Provider.	
4.	HPI Service Provider finds the bill incorrect and refuses payment. This may result from mismatching between the two actor's usage and performance data (e.g. VoD usage was assigned to a user that did not correspond to HPI SP records).	
5.	An alternative agreement is reached between the actors involved. (Usage records are later computed into service customer bills)	
6.	HPI Service Provider pays.	
7.	HPI SP debts are reset. A receipt is issued.	

Use Case:	The HPI Service Provider issues a bill to the Content Provider	Uc- 23
Summary:	A bill is sent for later payment. In case of disagreement a consensus is reached.	
Actors:	Content Provider and HPI Service Provider	
Pre-conditions:	A contract exists between the actors involved, specifying billing aspects. An event, such as timing, triggers the billing process.	
Description:	The Content Provider pays the HPI Service Provider for the infrastructure service. Costs are computed according to the contractual agreement with information on usage demand. Elements such as downtime or performance related discounts are considered. An official bill is composed and sent to Content Provider. Content Provider pays. CP debts are reset. A receipt is issued.	
Exceptions:	Content Provider denies the bill, and further investigation is conducted until an alternative agreement can be reached.	
Post-conditions:	In case of disagreement, possible updates to billing system or contract, according to results of investigation.	

2.6.2 Maintenance

Here a user complaint leads to maintenance actions on content data. a variation of this use case, concludes that the fault is in another management domain and notifies accordingly, suggesting possible causes.

Use Case:	Content Provider manages content response to a Trouble ticket. Uc- 24
Summary:	A trouble ticket coming from the HPI Service Provider is received by the Content Provider, who processes the occurrence.
Actors:	Content Provider and HPI Service Provider.
Pre-conditions:	An event such as an asynchronous signal may warn the Content Provider about an incoming ticket.
Description:	Content Provider receives a warning that a trouble ticket was received from the HPI Service Provider as a result of a user complaint. Content Provider uses his trouble ticketing system and examines the new item. (e.g. a user cannot access one menu item) He conducts a preliminary inspection and concludes that it needs further examining. HPI Service Provider is notified of new status. Content Provider's maintenance staff confirm fault (e.g. ill-configured pointers), estimate repair time and create a performance violation record, for accounting purposes. A notification to HPI SP is issued indicating new status. HPI SP forwards the notification to user. Repair is complete. Performance records are updated. A repair notification is issued to HPI Service Provider who forwards it to the originator.
Exceptions:	Content Provider's maintenance staff does not find a fault. Trouble ticket status is updated accordingly. A notification is issued to HPI Service Provider indicating new status, and suggesting possible causes for malfunction (e.g. ill-configured browsing software)
Post-conditions:	Statistical data concerning performance of repair processes are updated.

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Name:	Content Provider consults trouble tickets. No network fault is discovered in relation to trouble ticket.	Sc- 6
1.	Content Provider receives a warning that a trouble ticket was received from the HPI Service Provider as a result of a user complaint.	
2.	Content Provider uses his trouble ticketing system to consult the new item. (e.g. a user cannot access one menu item)	
3.	He conducts a preliminary inspection and concludes that it needs further examining, notifying HPI Service Provider of status.	
4.	Content Provider's maintenance staff does not find a fault. Trouble ticket status is updated accordingly. A notification is issued to HPI Service Provider indicating new status, and suggesting possible causes for malfunction (e.g. ill-configured browsing software)	

2.7 Access/Transport Network

2.7.1 QoS

Use Case:	Network performance parameters agreement setting	Uc- 25
Summary:	NP performance parameters are set to satisfy the QoS requirements	
Actors:	NP	
Pre-conditions:	NP must have a technology efficient network to meet the requirements.	
Description:	NP sets up all the network performance parameters agreed upon, such as: Availability (MTBF, MTTR, redundancy, alternate routes), Bit Error Rate, Error Blocks, loss/mis-insertion cells, etc.	
Exceptions:	NP equipment may not be able to satisfy a specific parameter; Malfunctioning of equipment	
Post-conditions:	Agreed network performance status between HPI SP and NP is established.	

Name:	Network Performance agreement. The Network Provider (NP) makes an agreement with the Service Provider (SP) on the Network Performance parameters requested and NP may not be able to satisfy a specific parameter.	Sc- 7
1.	NP responding to a HPI SP request informs him of the network performance parameters and their values, that he can provide to meet HPI SP requirements.	
2.	HPI SP requires from NP an improvement to some of the network performance parameters set, that the NP has previously provided.	
3.	NP indicates that he can not satisfy these extra HPI SP's requirements, and offers to the HPI SP the parameters that could be provided.	
4.	The HPI SP would try to obtain the best performance possible and ask for new requirements.	
5.	NP insures that could satisfy these extra HPI's requirements.	
6.	The HPI SP asks for a guarantee of the network performance provided.	
7.	NP replies he can offer the guarantee requested.	
8.	HPI SP requests specific penalties to be posed in the case when NP fails to meet the guarantee terms.	
9.	NP does not accept the whole set of penalties specified by HPI SP, and proposes their acceptance with a slight modification.	
10.	HPI SP agrees on and they establish an agreement.	

Use Case:	Network performance parameters modification.	Uc- 26
Summary:	NP performance parameters are modified according to a specific request (HPI SP).	
Actors:	NP, HPI SP.	
Pre-conditions:	NP must have a technology efficient network to imply the parameter(s) modifications as requested.	
Description:	Upon a request of HPI SP, NP modifies one or more of the parameters and/or their levels agreed upon initially, such as: Availability (MTBF, MTTR, redundancy, alternate routes), Bit Error Rate, Error Blocks, loss/miss-insertion cells, etc.	
Exceptions:	NP equipment may not be able to have the requested modifications implemented; Malfunctioning of equipment	
Post-conditions:	Modified network performance status establishment.	

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Name:	Network Performance modification when NP equipment may not be able to have the request modifications implemented.	Sc- 8
1.	Upon a request of HPI SP, NP is asked to modify specific network performance parameters levels.	
2.	NP replies that he could not satisfy this requirements.	
3.	HPI SP requests another performance parameters.	
4.	NP replies that could provide this requirements.	
5.	HPI SP agrees and proposes certain guarantee terms modification.	
6.	NP accepts HPI SP's proposal and requests the signing of new network performance agreement.	
7.	HPI SP agrees on and they establish a new agreement.	

Name:	Network Performance modification can not be satisfy because malfunctioning of equipment.	Sc- 9
1.	Upon a request of HPI SP, NP is asked to modify specific network performance parameters levels from those included in the initial agreement.	
2.	NP replies that he can not satisfy this requirement because a malfunctioning of equipment .	
3.	NP send a report of trouble.	

Use Case:	Bandwidth usage agreement	Uc- 27
Summary:	The bandwidth usage provision is agreed upon with the HPI SP.	
Actors:	NP, HPI SP	
Pre-conditions:	NP must have a technology efficient network to meet the bandwidth usage requirement.	
Description:	NP exchanges with HPI SP all information needed to be included in the agreement, which in turn specifies the bandwidth usage to be provided by NP.	
Exceptions:	NP's equipment inefficiency; ineffective negotiation procedures.	
Post-conditions:	Bandwidth usage availability is agreed upon. NP may proceed to the deployment of all equipment and procedures needed to the provision of the bandwidth usage, in accordance to the agreement made.	

Use Case:	Bandwidth usage modification	Uc- 28
Summary:	The bandwidth usage provision agreed upon is modified by the NP as required by HPI SP.	
Actors:	NP, HPI SP	
Pre-conditions:	NP must have a technology efficient network to imply the bandwidth usage modifications.	
Description:	NP modifies the bandwidth usage agreed upon initially.	
Exceptions:	NP's equipment inefficiency; ineffective procedures. Malfunctioning of equipment	
Post-conditions:	Modified bandwidth usage status is established and can be used accordingly.	

Name:	Not Bandwidth usage modification because of a NP's equipment inefficiency, ineffective procedures or Malfunctioning of equipment	Sc- 10
1.	Upon a request of HPI SP, NP is asked to modify the network bandwidth available in reference to the one included in the initial agreement.	
2.	NP can not satisfy this HPI SP's requirement.	
3.	NP send to all actors a trouble ticket.	

2.7.2 Accounting

Use Case:	Accounting agreement	Uc- 29
Summary:	NP puts into effect all the procedures necessary to meet the charging agreement requirements.	
Actors:	NP	
Pre-conditions:	The NP must have an efficient and reliable system for the implication of the charging conditions agreed upon.	
Description:	Charging parameters involved should be: Bandwidth, performance grade, time, etc. The NP activates all mechanisms needed to the provision of charging data in accordance with the specific agreement.	
Exceptions:	NP's system inefficiency; ineffective procedures. Malfunctioning of equipment/programs.	
Post-conditions:	NP's charging system is in effect to pass over to SP charging data as agreed upon.	

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Use Case:	Billing invoice	Uc- 30
Summary:	NP submits an invoice to HPI SP in order to get paid for the services offered by his network facilities (bandwidth usage, performance levels, etc.) over a time interval, in consistency with the agreement terms (usage based pricing in contrast to fixed based pricing).	
Actors:	NP, HPI SP	
Pre-conditions:	NP must have an integrated and highly reliable billing system, since information needed to be gathered from the network for pricing is very complex, and in particular when, it is referred to certain parts of the network, i.e., ATM connections, where much more usage parameters are offered (bandwidth, QoS, etc.).	
Description:	NP based on the agreement terms referring to billing submits an invoice to HPI SP in order to get paid for the services offered by his network facilities (bandwidth usage , performance levels, etc.) over a time interval (usage based pricing). The billing data included in the invoice sent to HPI SP has come out from charging records kept by NP, and based on the network facilities usage specified. HPI SP on his turn counter checks invoice billing data and payment follows after a common agreement is reached by the two actors.	
Exceptions:	Malfunctioning of NP's billing system and /or HPI SP's relevant equipment.	
Post-conditions:	After the invoice payment HPI SP's account is cleared and new charging records are tallied.	

Use Case:	Billing deduction	Uc- 31
Summary:	NP submits an invoice to HPI SP in order to get paid for the services offered by his network facilities (bandwidth usage, performance levels, etc.) over a time interval, in consistency with the agreement terms(usage based pricing in contrast to fixed based pricing).	
Actors:	NP, HPI SP	
Pre-conditions:	NP must have an integrated and highly reliable billing system, since information needed to be gathered from the network for pricing is very complex, and in particular when, it is referred to certain parts of the network, i.e., ATM connections, where much more usage parameters are offered (bandwidth, QoS, etc.).	
Description:	NP based on the agreement terms referring to billing submits an invoice to HPI SP in order to get paid for the services offered by his network facilities (bandwidth usage , performance levels, etc.) over a time interval (usage based pricing). The billing data included in the invoice sent to HPI SP has come out from charging records kept by NP, and based on the network facilities usage specified. HPI SP on his turn counter checks invoice billing data and since he founds that there is a discrepancy on the billing data, due to performance parameters degradation, requires a specific deduction according to the initial agreement. Payment is done after a relevant negotiation.	
Exceptions:	Malfunctioning of NP's billing system and /or HPI SP's relevant equipment.	
Post-conditions:	After the invoice payment HPI SP's account is clear and new charging records are tallied.	

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Use Case:	Fault detection/Trouble ticketing	Uc- 32
Summary:	NP's Fault Management Function(FMF) detects a fault occurrence and HPI SP is notified about its severity and duration expected.	
Actors:	NP, HPI SP	
Pre-conditions:	NP must have an efficient FMF to detect through its alarms, etc., a specific malfunctioning of network facilities	
Description:	Upon a specific fault's detection by NP's FMF, it proceeds in taking the necessary measures to the fault's eventual removal. HPI SP is notified by NP upon fault's detection, in order to inform accordingly. Customers affected by the fault are also given relevant data, such as, fault's severity and time estimated for its recovery. NP is asked by HPI SP to reduce the fault's recovery time period estimated. After fault's recovery, NP edits a trouble ticket and sends it over to HPI SP (trouble ticket content should be used in accounting processing-billing, as the service has been affected, i.e. down time, performance degradation, etc.).	
Exceptions:	Malfunctioning of FMF (NP).	
Post-conditions:	Fault recovery/clearance status.	

Use Case:	Fault Notification	Uc- 33
Summary:	NP receives an abnormal condition notification by HPI SP and checks if its facilities are operating properly. No problem is detected and HPI SP is been informed. HPI SP delegates NP to co-operate with actors involved, that is Content Provider (CP) and Customer. As a result of this co-operation, is found that the problem relied at the Customer side.	
Actors:	NP, HPI SP, CP, Customer	
Pre-conditions:	NP must have an efficient system to run such a co-operation session.	
Description:	NP receives an abnormal condition notification by HPI SP and checks if its facilities are operating properly. No problem is detected and HPI SP is informed. HPI SP delegates NP to co-operate with actors involved, that is Content Provider (CP) and Customer. As a result of this co-operation, it is found that the problem relied at the Customer side. An abnormal condition notification record is submitted to HPI SP.	
Exceptions:	NP, HPI SP systems inefficiency.	
Post-conditions:		

Name:	Performance monitoring NP's performance monitoring system detects a certain performance parameter degradation outside of SLA and HPI SP is informed. Certain procedures are initiated so that SLA requirements are met again. Performance, as long as it remains within the limits agreed upon, may be an optional information to the HPI SP (Customer).	Sc- 11
1.	NP's performance monitoring system detects a certain performance parameter degradation outside of SLA.	
2.	NP notifies HPI SP (Customer) and applies all procedures needed (alternate routing, etc.), in order to meet again the SLA requirements.	
3.	HPI SP requests from NP to be kept informed on NP's actions progress.	
4.	NP succeeds to meet again the SLA requirements and notifies HPI SP (Customer) accordingly.	

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2.8 Use Cases diagram

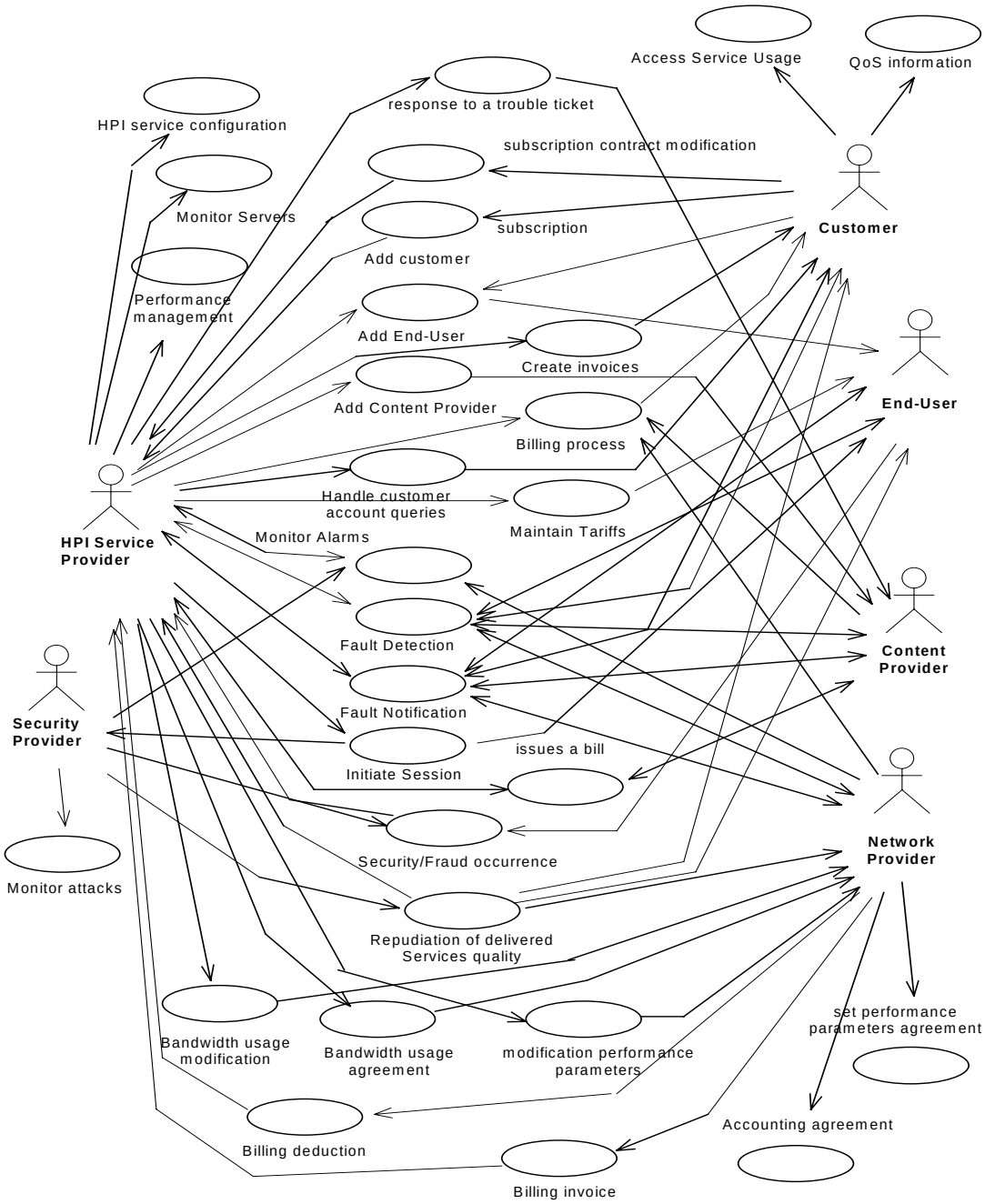

Figure 2.5 HPI service Use Cases Diagram.

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3 Domain model

According to the service description, we have sketched the domain model for the service adopting the division of this domain model into more manageable chunks:

- HPI Service
- Security
- Customer
- Content
- Access/transport Network

In Annex A of this document, we have presented a data dictionary for the domain model.

3.1 The P610 Services

The approach chosen for the definition of the domain models of the HPI Service was to start with the general P610 architecture as a support for the service. Afterwards, the specific elements of the HPI Service were introduced. In this way, Figure 3.1 shows the dependency of the HPI Service Specific package to the P610 package, which is composed of the elements of the P610 architecture.

The architecture was not fully used as defined in Deliverable D2, but some refinements were used to meet the needs of both case study services, which are common to every multimedia service management scenario.

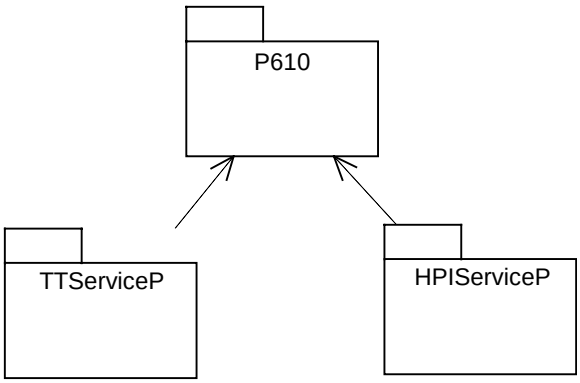

Figure 3.1: P610 Services

The packages used from the architecture are depicted in Figure 3.2. The other packages defined in Deliverable D2 as part of P610 architecture were not used because it was found that they are not addressed by the requirements of the service offer.

In the following sub-section the content of these packages is described as they have been refined. They are different from the initial P610 architecture.

The description of the package contents is short. For further information Deliverable D2 can be consulted.

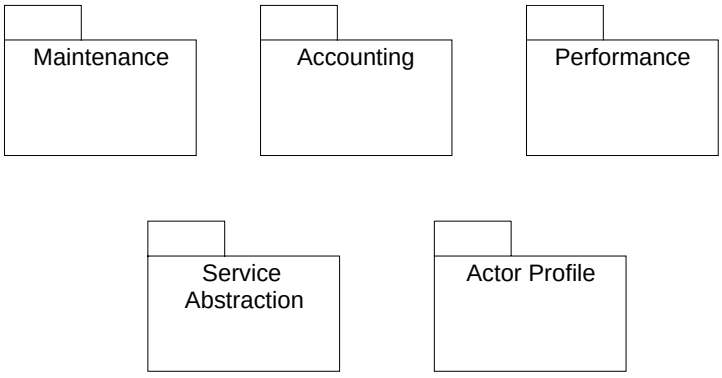

Figure 3.2: P610 packages used for HPI

3.1.1 Service Abstraction

The first package to be used is the Service Abstraction, which is the basis of every MM Service. This package has one class, the service and is related with the Actor Profile Package, through the Service Provider, the Customer and the End User classes.

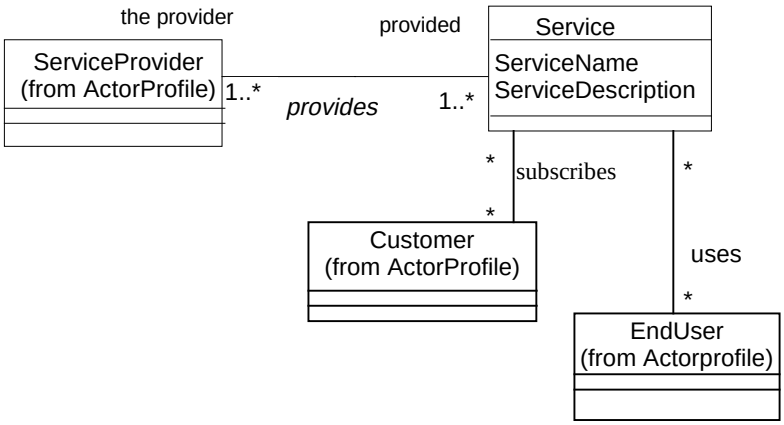

Figure 3.3: Service Abstraction

3.1.2 Actor Profile

In this package we have related elements to the customers, the End-Users and to the providers.

The Party class is a part of the analysis pattern with the same name, and represents either a Customer, a Provider or an End-User. All these actors have something in common and therefore, they can be obtained from the same class.

The Party class has the following attributes:

- PartyName: the Party's name;
- PartyAddress: the Party's address;
- PartyPhoneNumber: the Party's phone number;
- PartyEMail: the Party's e-mail.

Each actor has particularities so must exist a class for each different actors. In Figure 3.4 we show the classes that art part of the Actor Profile. See that there exits one class

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for the Customer and the End-User, but one class for each provider (Service Provider, Network Provider, Content Provider and Internet Access Provider).

The Profile contains the information related to the subscription process, indicating the services subscribed to, the billing options and additional data used in marketing activities. Each party may have one or more profiles, each which may be profile details.

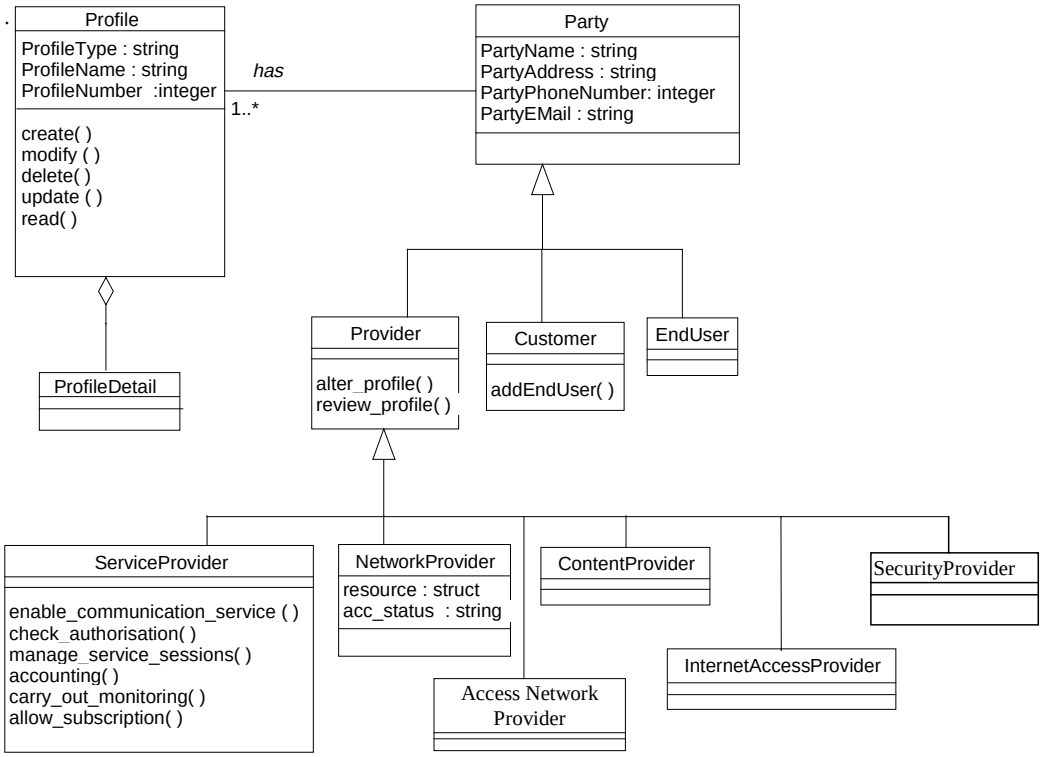

Figure 3.4: Actor Profile

3.1.3 Maintenance

Inside the Maintenance package the Fault Management and the Content Management are found. The Fault Management was detailed as shown in Figure 3.5.

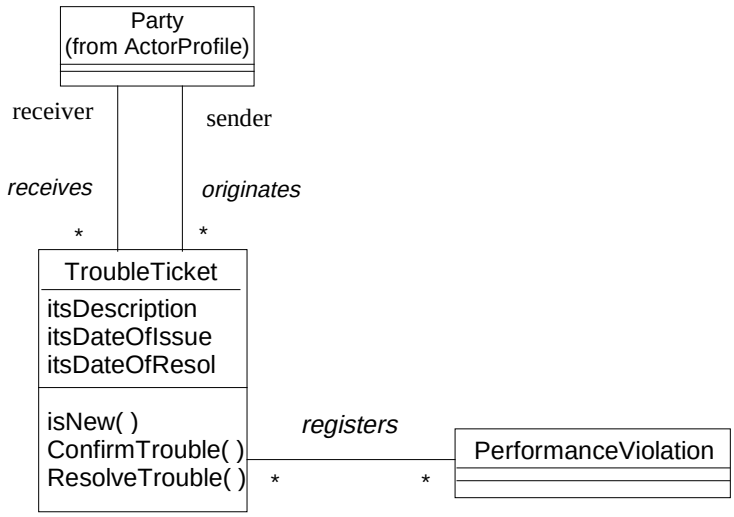

Figure 3.5: Fault Management Package

The Trouble Ticket class has the following attributes:

- TTDescription: the description of the trouble ticket;
- TTDataOfIssue: the date of issue of the trouble ticket;
- TTDateOfResolution: the date of resolution of the trouble.

This class has the following operations:

- ConfirmTrouble: confirms the trouble;
- IsNew: tell whether the trouble ticket is new (unread) or not;
- ResolveTrouble: considers the trouble resolved.

The Performance Violation occurs when the network or the service provider fail to deliver the QoS agreed in the contract.

3.1.4 Accounting

This package supports the functionality related to the subscription and billing of a MM Service.

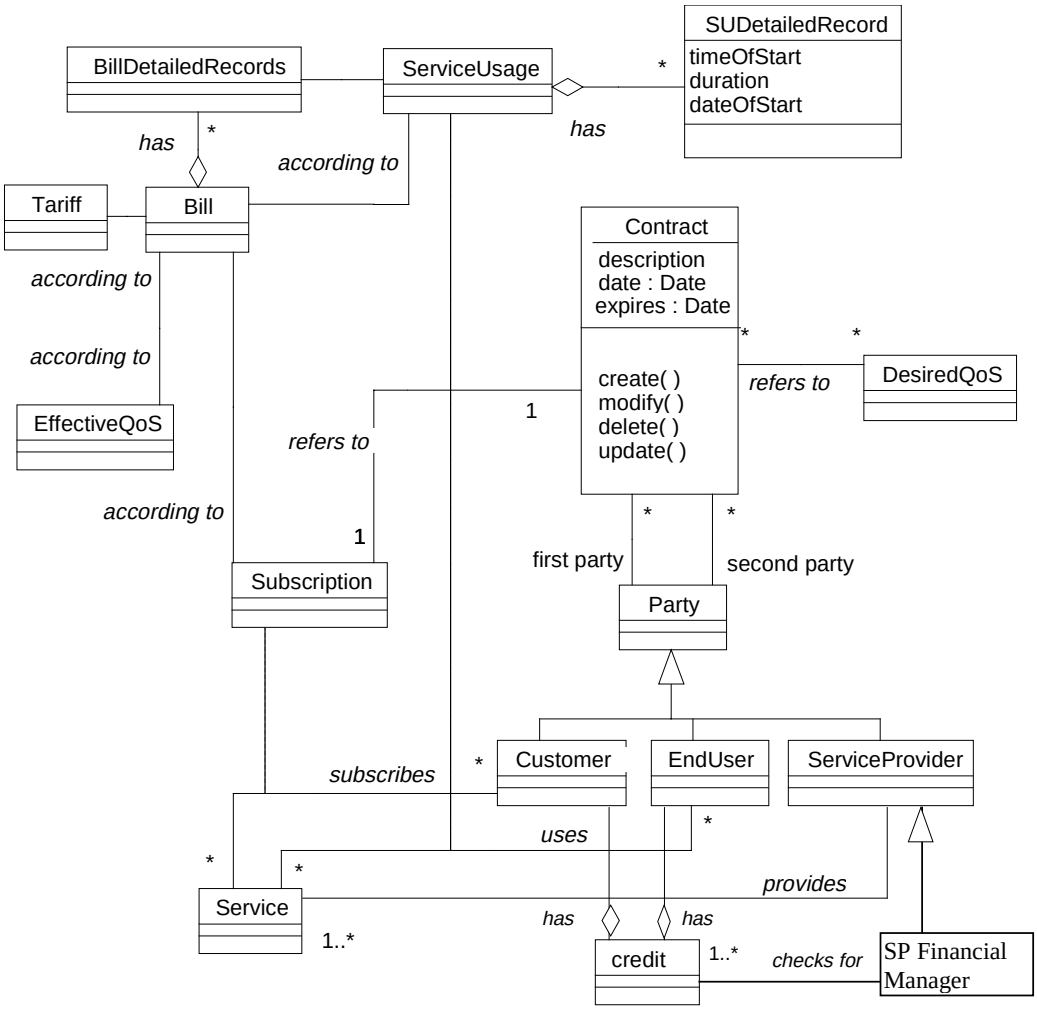

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Figure 3.6: Accounting

The subscription refers to a contract, which in turn must be signed by two parties. The contract defines the desired QoS, but the Customer only pays for the effective QoS. Under normal working conditions, both elements should hold the same value.

When the End-User makes use of the service, his service usage record is updated for the purpose of billing.

Performance

For the performance only the EffectiveQoS was found to be important in the definition of the HPI Service.

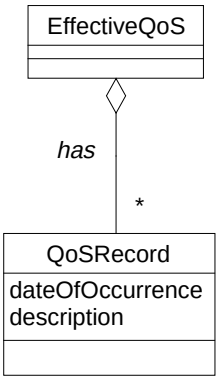

Figure 3.7: Performance

3.2 HPI Service

Starting from the top level packages, it is found that for the definition of the domain models of the HPI Service, a group of specific packages is needed as shown in Figure 3.8.

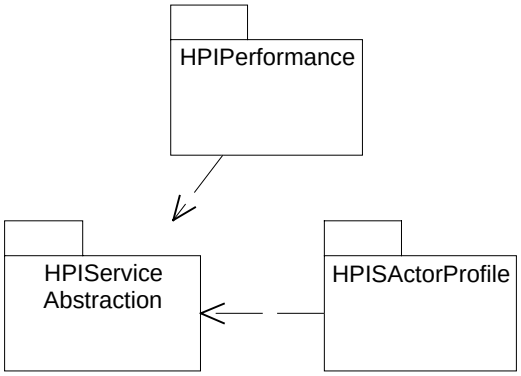

Figure 3.8: HPI Service Specific Packages

3.2.1 HPI Service Abstraction

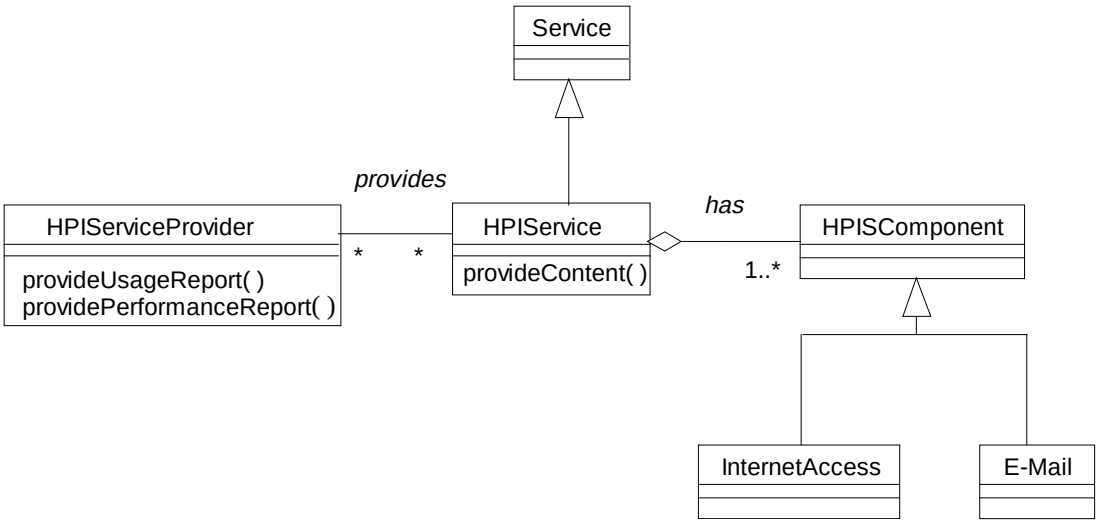

Figure 3.9: HPI Service Abstraction Specific Package

Figure 3.9 shows the sub-domain model of the High Performance Islands (HPI) service.

The HPI Service may be provided by many HPI Service Providers, which may provide more than one HPI Service. This service must provide some content. The Service Provider must provide a usage report and a performance report to each contracted Content Provider.

A service has at least one component, usually an IP based service that can be the Internet Access or E-mail. A service component has features which allow billing discounts for not fulfilling some contractual value.

3.2.2 HPI Actors

Figure 3.10 shows the HPI Actor Profile sub-domain model.

The HPI Service Provider is a specialisation of the general MM Service Provider. Some elements of the Service Provider have special roles, which are: a Financial Manager, a Service Manager and a Service Integrator. The Service Integrator manages the White and Yellow Pages.

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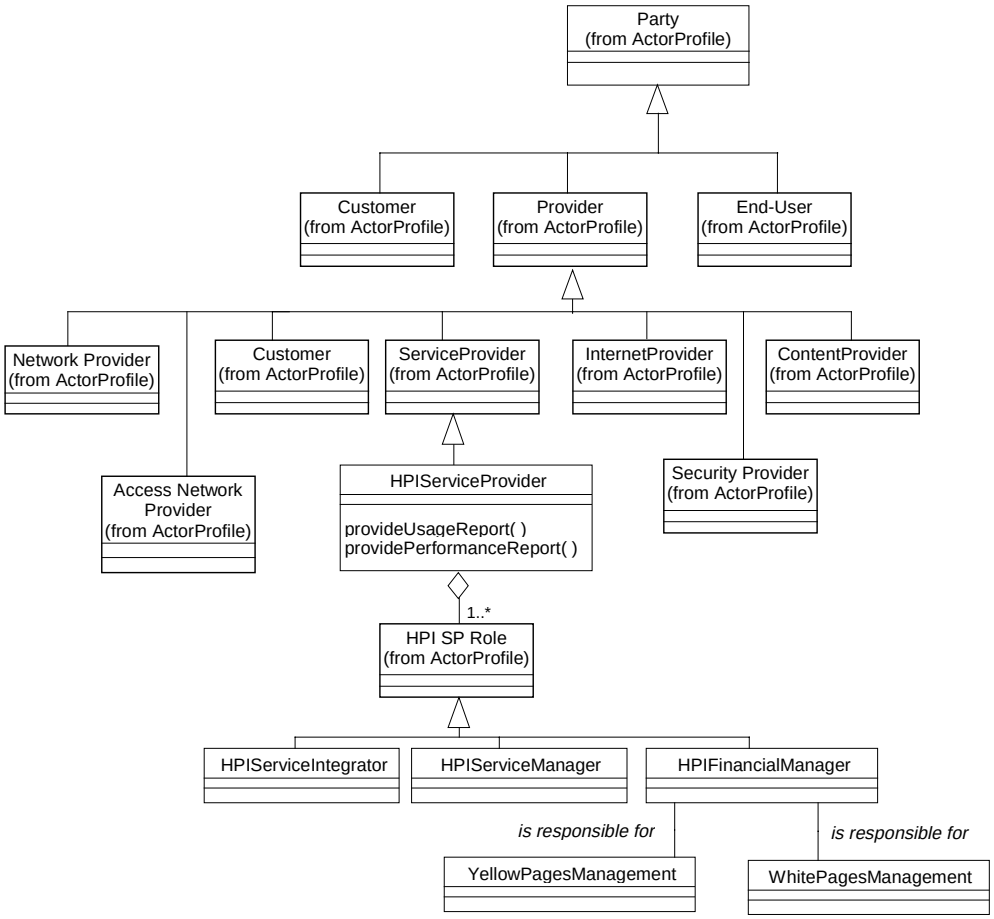

Figure 3.10: HPI Actor Profile

3.2.3 HPI Performance

For the HPI Service, it is possible to have a specialisation of the QoS Record, which keeps track of any Performance Violation. This information is later used when processing the bill.

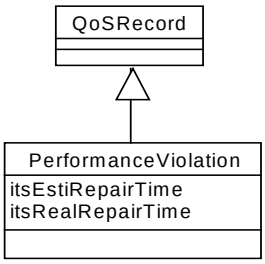

Figure 3.11: HPI Performance

3.3 Customer

Figure 3.12 shows the domain model of a Customer. A Customer subscribes to a service and pays for it. Sometimes, a Customer subscribes and pays for a service, but there are others that use it (the end-users). The Customer is responsible for registering End-users for usage of the service.

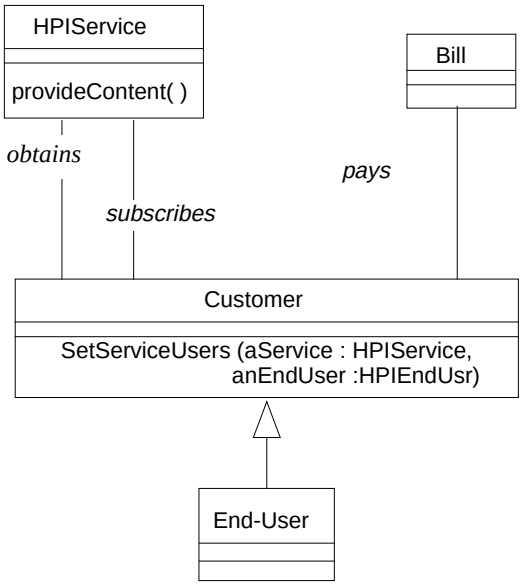

Figure 3.12: Domain model of the Customer

3.4 Content

Figure 3.13 shows the domain model of the content. The content is provided by a Content Provider, which has a Financial Manager and a Content Manager.

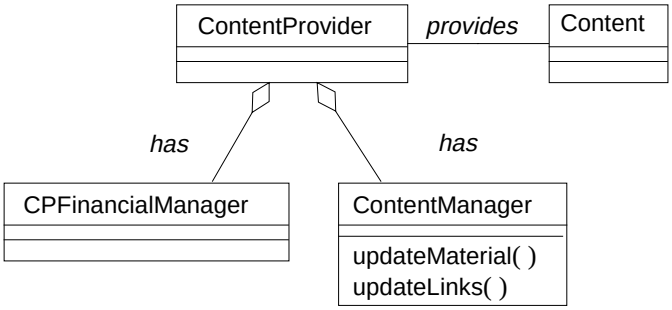

Figure 3.13: Domain model of the Content

3.5 Security Provider

The Figure 3.14 shows the domain model of the security.

The Security chuck must include the following concepts:

- Forgery, **unauthorised access to authenticated data, etc**.
- Repudiation, **uncertain distinction of responsibilities, etc**.
- Unauthorised access, **inadequate access control, etc**.
- Denial of service, **inefficient control of QoS and design inefficiencies, etc**.
- Masquerade, **non authentication mechanisms inefficiencies, etc**.

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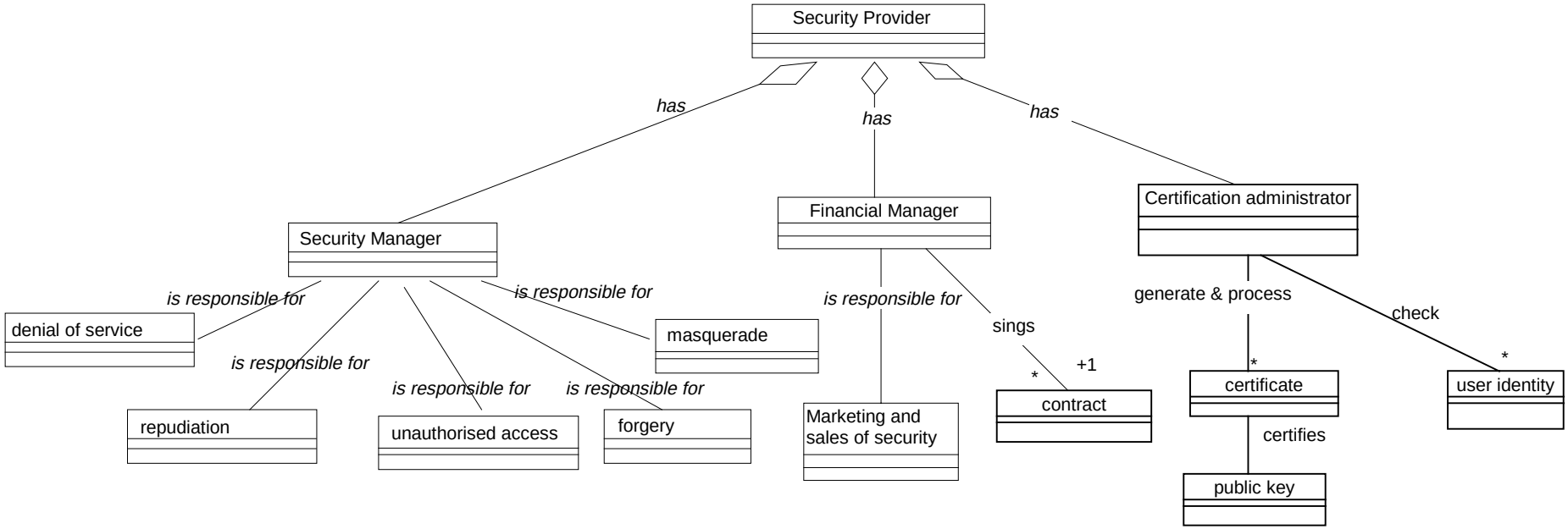

Figure 3.14 Domain Model of the Security Service

3.6 Access/Transport Network

Figure 3.15 shows the domain model of the Access/Transport Network.

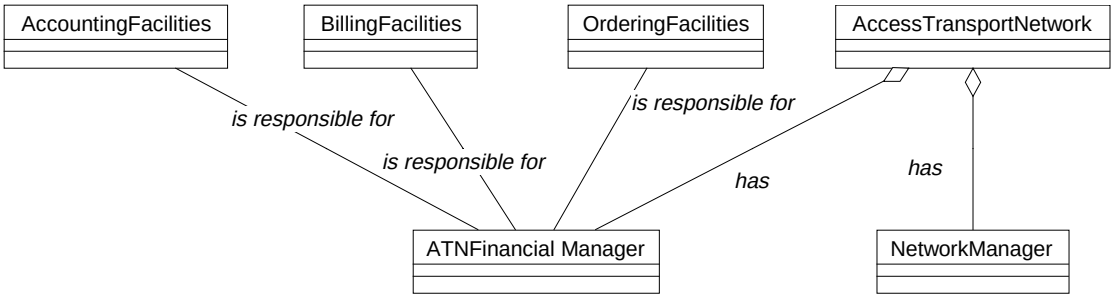

Figure 3.15: Domain model of the Access/Transport Network

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4 Behaviour Model

The Behaviour Model correspond to Sequence diagrams, Collaboration diagrams and

State diagrams as explain in our methodology.

Sequence diagrams are built from scenarios. Collaboration diagrams may eventually help viewing some inter-object relationships that sequence diagrams fail to make clear. State diagrams are drawn for those classes whose behaviour depends on the object internal state.

In this section the Sequence, Collaborations and States diagrams are grouped according to the actor that lead the interaction or to which the class of the state diagram is somehow related to. As before, these actors are:

- Service Provider
- Customer
- Service Provider
- Security Provider
- Content Provider
- Network Provider

In the following sections we present the most significant sequence, collaboration and state diagrams, grouped by actor. This selection was forced by the enormous quantity of scenarios and the lack of time to process them all. The selection criteria of the scenarios was left to the partner responsible for writing the scenario and sequence diagram.

4.1 HPI Service Provider

4.1.1 Sequence diagrams

This section contains sequence diagrams for the HPI Service Provider Use Cases.

Figure 4.1 shows the sequence diagram corresponding to the Use Case where the HPI SP adds a new customer or user.

The HPI SP must fill the profile with all the data provided by the customer, mainly personal (name, address, subscription date, identification code,…) and financial data (contractual agreements). The data needed to define the user profile are his name, address, equipment, login, password, and the services (WWW, FTP, E-mail) and facilities (access to remote islands, access to Internet) subscribed. It can also store preferences and user interfaces.

Finally the user must be activated in the system and permissions, mail-box and usage have to be set up.

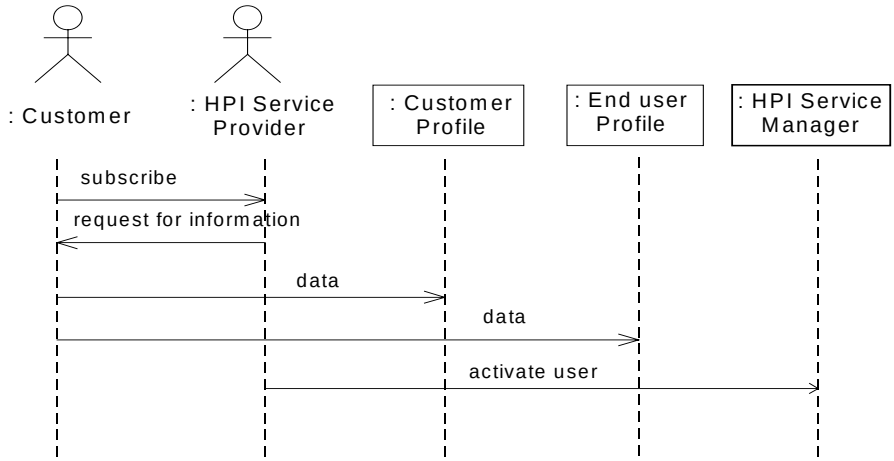

Figure 4.1: Add Customer and User sequence diagram

In Figure 4.2 represent a sequence diagram correspond to a User Service or enquiries request. In Figure 4.5 a collaboration diagram is presented to help the diagram understanding.

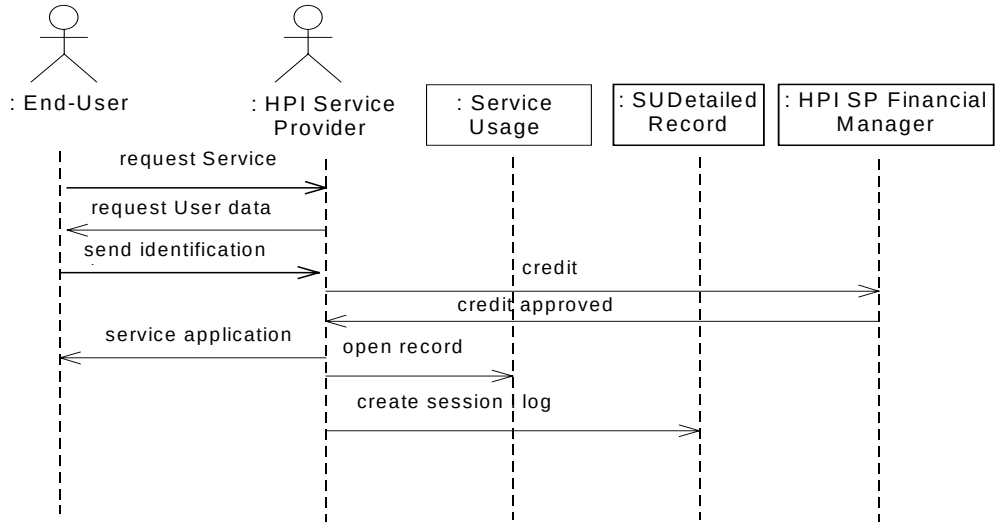

Figure 4.2 Service Provider provides a Service to an User

Figure 4.3 shows the sequence diagram corresponding to the HPI Service Provider billing process. The billing process is started and the information about service usage is collected. Tariffs and discounts are applied to the service consumption taken into consideration SLAs fulfilment.

Figure 4.4 shows the sequence diagram corresponding to the problem handling where the HPI SP gets a complaint from the Customer and investigates this trouble. In this case the Network Provider finds and solves the problem.

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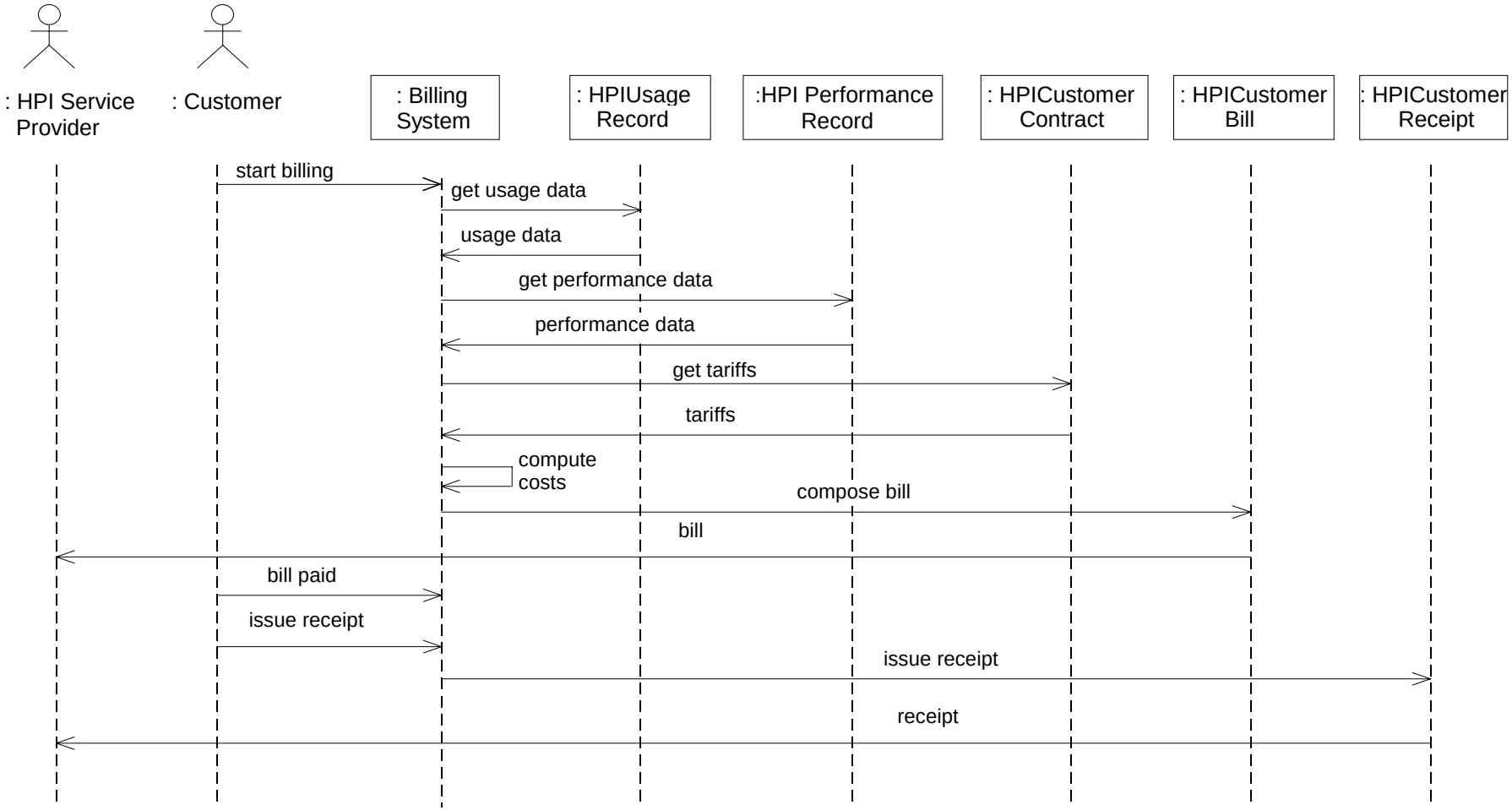

Figure 4.3: HPI SP billing process sequence diagram

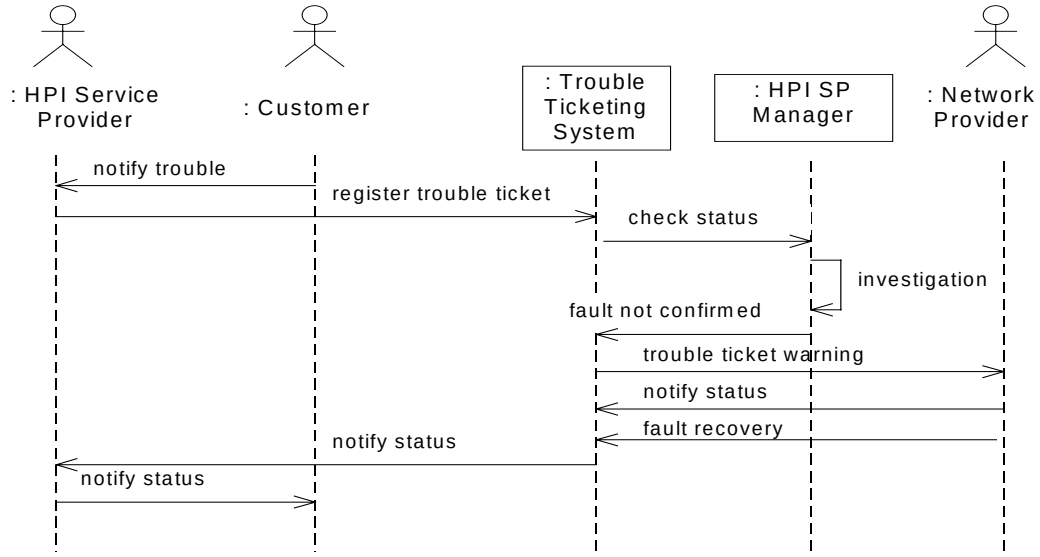

Figure 4.4: Problem handling sequence diagram

4.1.2 Collaboration Diagrams

To help the Service Provider sequence diagrams of Figure 4.2 here is a collaboration diagram. In this diagram can see how the Service Provider handles the enquiries and service to the HPI Service.

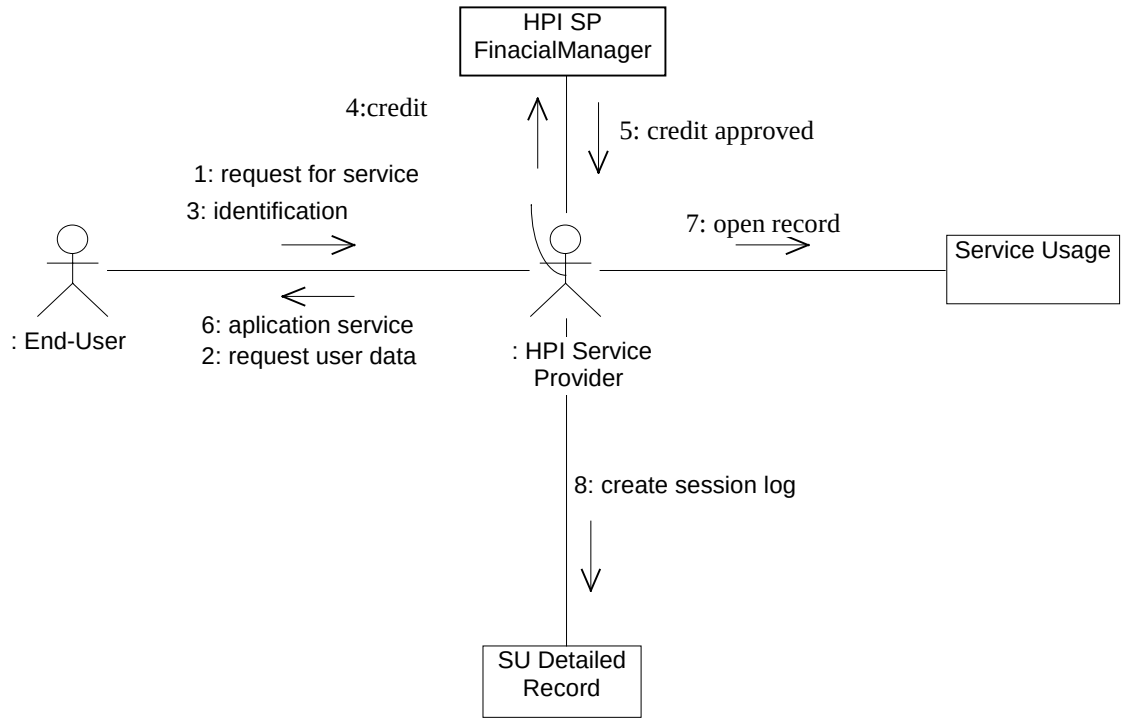

Figure 4.5 Collaboration Diagrams of session handles

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4.1.3 State Diagrams

4.1.3.1 Subscription

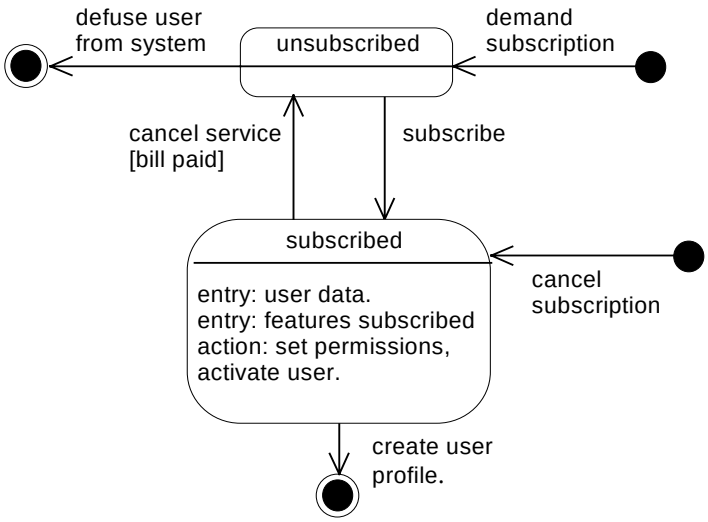

Figure 4.6: State diagram of the Subscription class

4.1.3.2 Service

According to the sequence diagrams shown in Figure 4.1 and Figure 4.3 a user could request a service. In this case the Service Provider must act in the following lines:

- authorise service usage (identify user, check accounting status, …)
- open an initial service session and let the user request to open other ones without identity control, until all these sessions are closed.

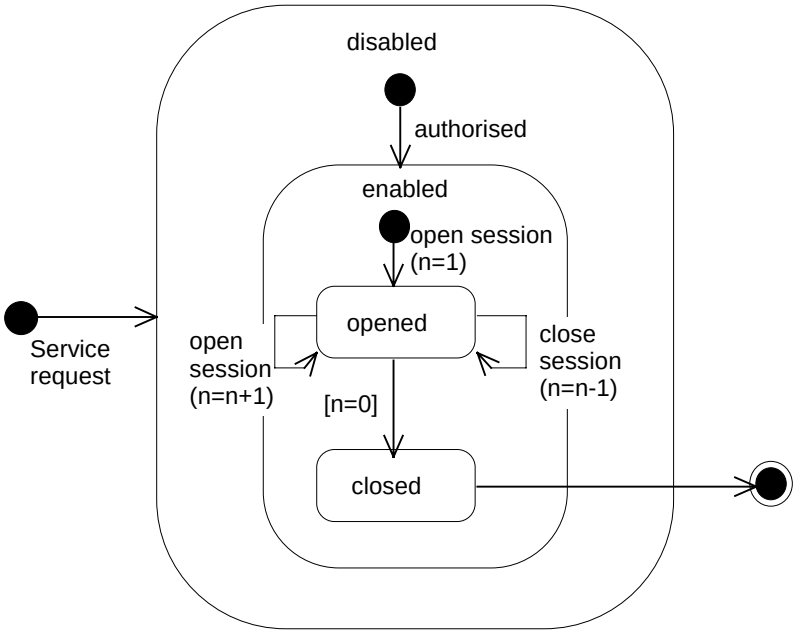

Figure 4.7: State diagram of the HPI Service class

4.2 Security Provider

4.2.1 Sequence Diagram

Here after sequence diagrams of the Security Provider are presented.

Figure 1. Presents the sequence diagram which is related to the scenario 01.

In this scenario the Security Provider system is called upon by the HPI SP to generate evidence of non-repudiation of delivery, in order that certain complaints petition is clarified.

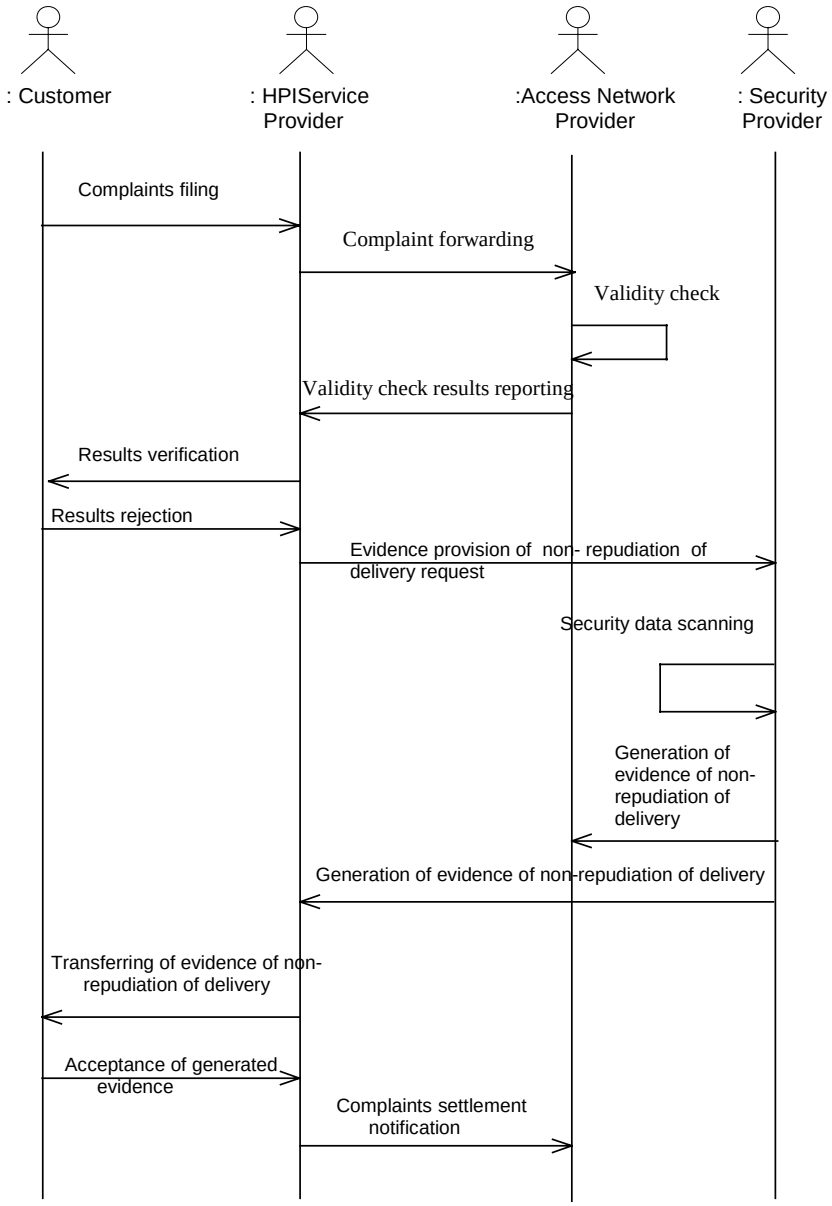

Figure 4.8 Sequence diagram related to Scenario Sc- 2

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4.2.2 State Diagram

In consistency with the sequence diagram in above Figure 4.9 the key steps and the sequence followed are the following: generate, confirm, resolve, clear.

The state diagram related to the above management aspects is given bellow:

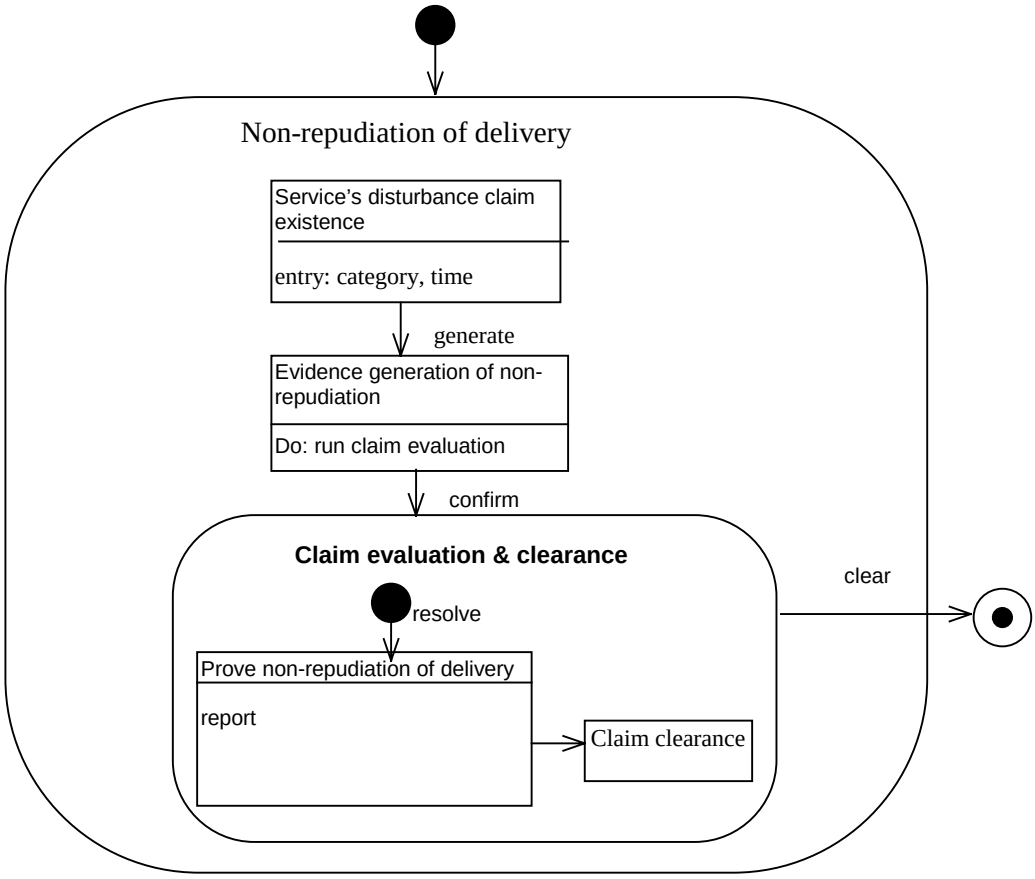

Figure 4.9 State diagram of non-repudiation of delivery

4.3 Customer

4.3.1 Sequence diagrams

The sequence diagrams for the Customer have been built taking into consideration the Customer Use Cases as a starting point.

The sequence diagrams that have been developed are the ones related to Subscription and Accounting. The others have not been developed because of the lack of resources.

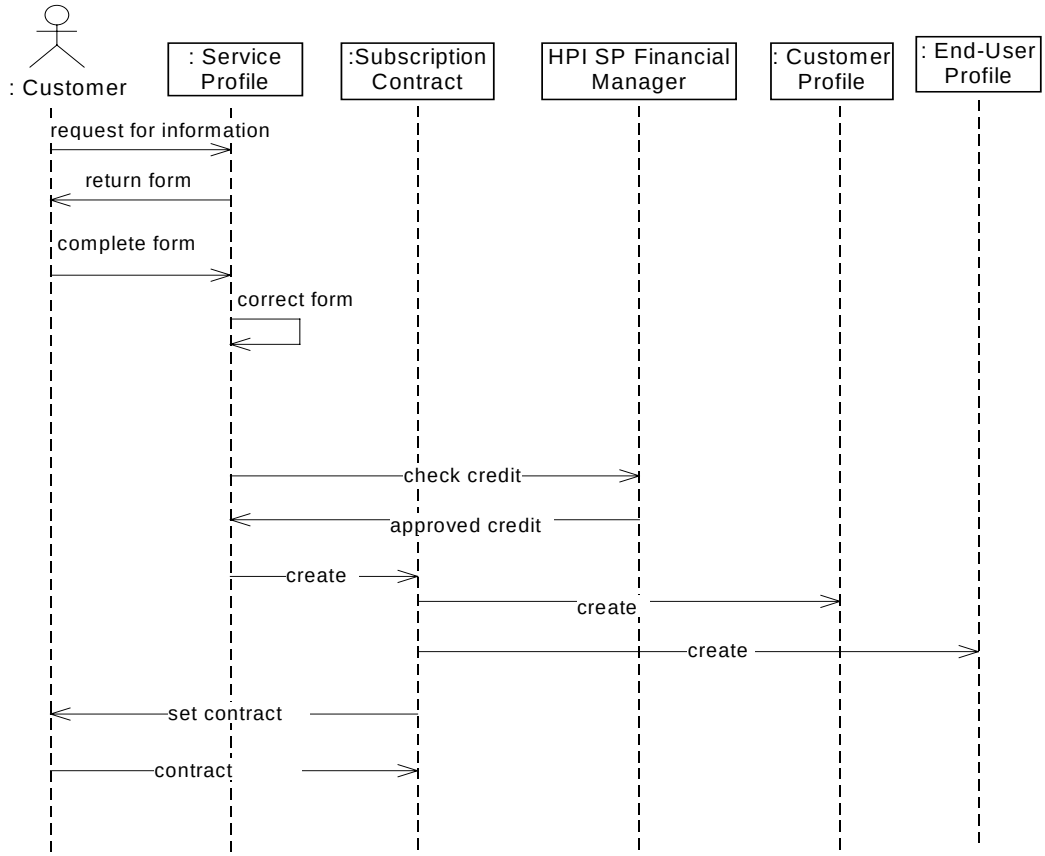

Figure 4.10: Subscription sequence diagram

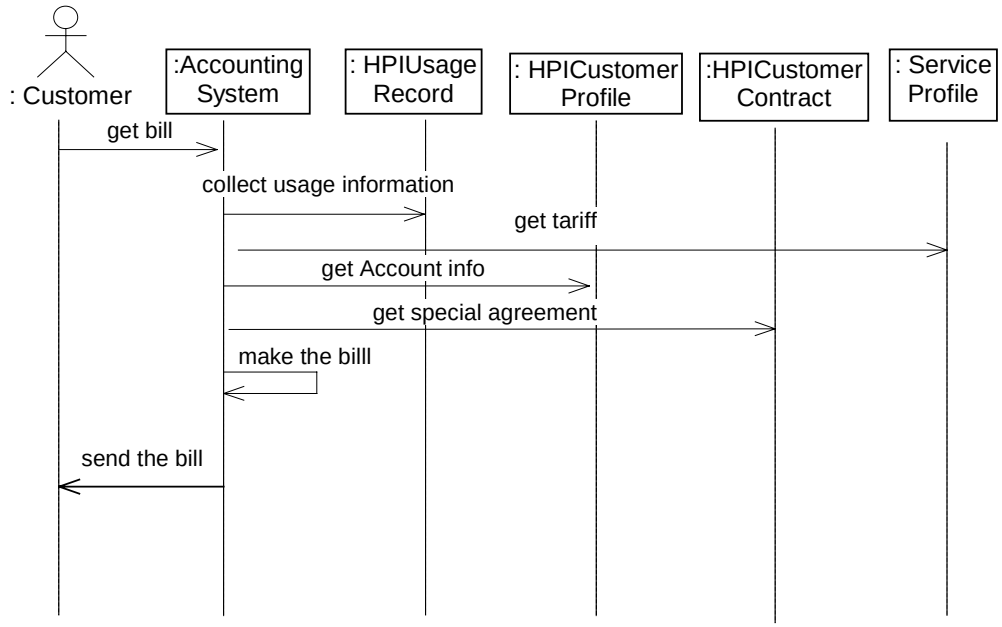

Figure 4.11: Accounting sequence diagram

The object interaction diagram and the state diagram have not been drawn as they do not seem so useful at this step. The steps should help in refining the class model, i.e. to identify new attributes and methods. In case the design model was requested, those

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models could be useful. In this case the sequence diagrams were sufficient enough to highlight the classes and methods needed to cover the use cases.

Analysing the sequence diagram it can be considered that some refinements on the use cases and requirements are needed. In fact, some information is missing, so an iteration step from analysis to requirements could be useful, in order to capture all the aspects of the problem.

4.3.2 State Diagrams

There are not defined.

4.4 Content Provider

4.4.1 Sequence Diagrams

This sub-section contains sequence diagrams of the Content Provider.

In these diagrams, we have added some detail to the corresponding scenario, such as the names of the domain model classes that are the source or the target of a message.

Figure 4.12 shows the sequence diagram corresponding to the use case Uc- 22, where a Content Provider issues a bill to a Service Provider, who accepts it, pays it, and gets the receipt.

This sequence diagram has some more detail than Use Case Uc- 22 does. For instance, there is an object called Form that manages the interaction with the Content Provider. This by no means implies any design time choice: it is just a way of showing that there is something between all the classes present in the scenario and the actor.

Some of these objects implied the change of the previous version of the design model. An example of this situation is the contract between the Content Provider and the Service Provider. This class had to be added because there was no other way of getting the contractual elements in the way the Domain model was built.

shows the sequence diagram corresponding to scenario Sc- 5,where a Service Provider does not accept the issued bill. The refuse of the Service Provider may be based on any incorrect value in the bill. After reaching an agreement, the Content Provider corrects any wrong values, re-computes the new bill's final value and re-issues the bill. From here on, the sequence diagram is similar to the previous one.

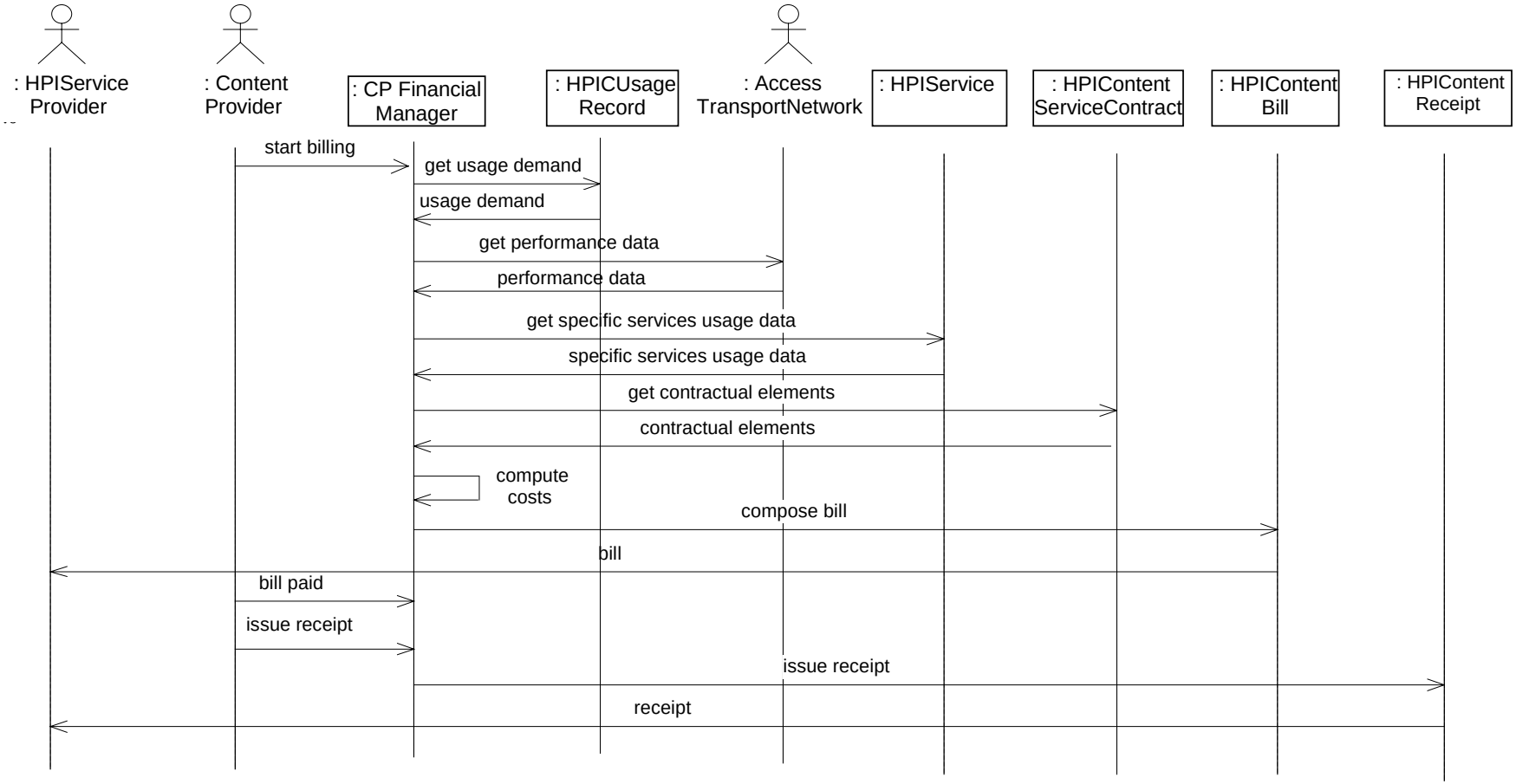

Figure 4.12: Sequence diagram related to Uc- 22

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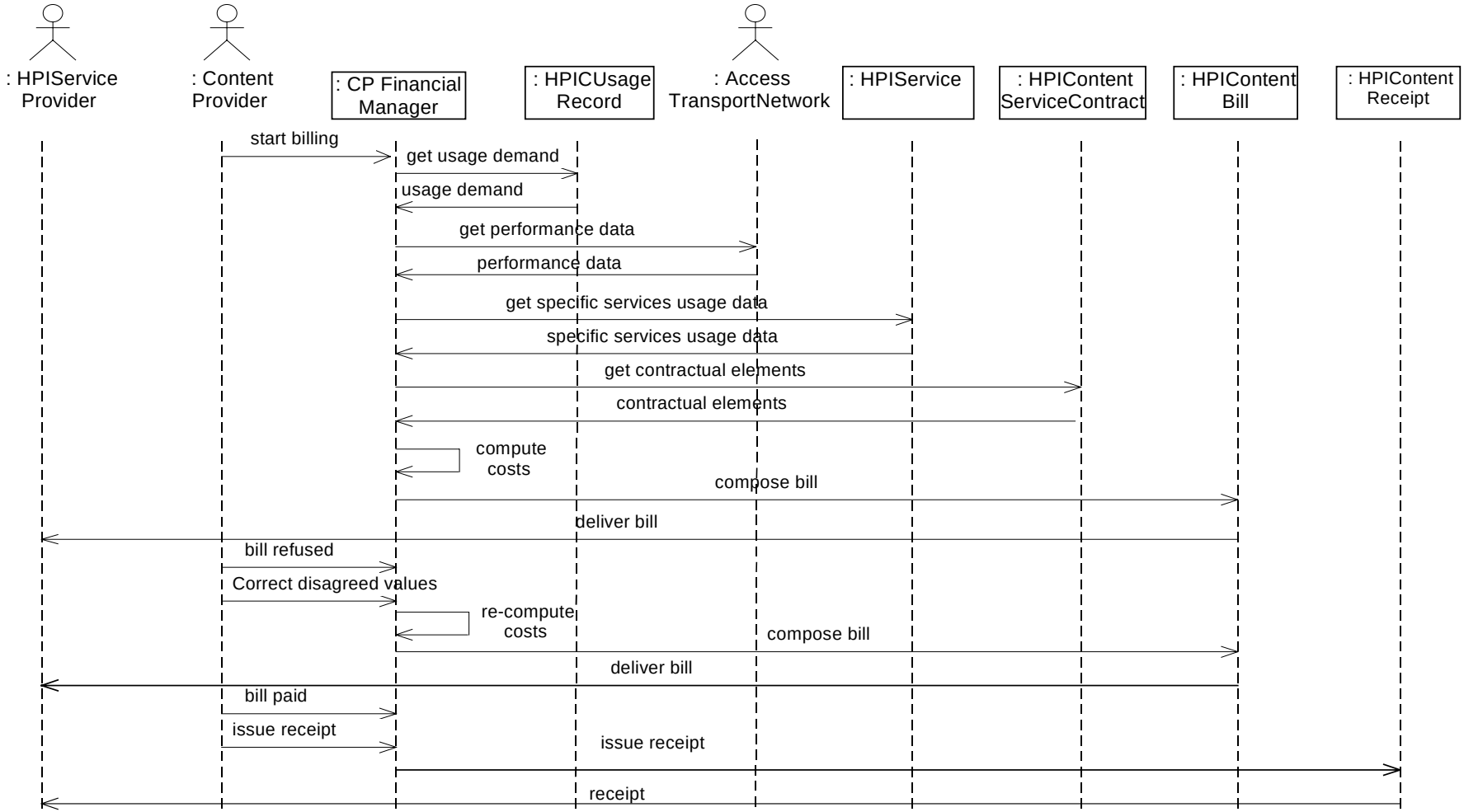

Figure 4.13 Sequence Diagram related to Scenario Sc- 5

Figure 4.14 shows the sequence diagram corresponding to Use Case Uc- 24, where a Content Provider consults trouble tickets.

We admit the existence of an external Trouble ticket management system that warns the Content Provider about the existence of a new trouble ticket. The following messages map directly to the scenario.

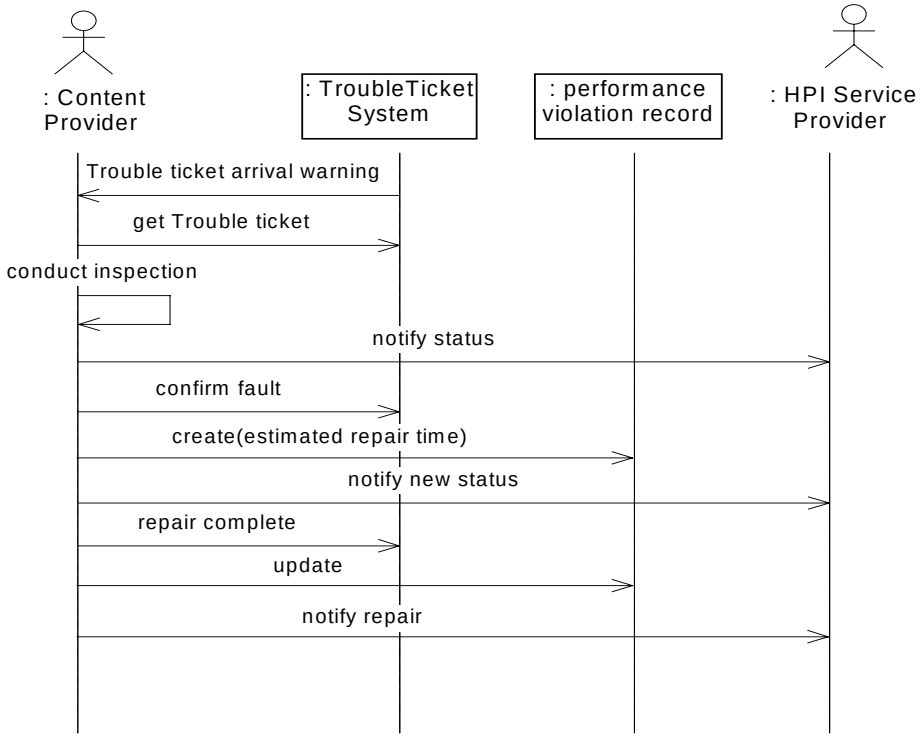

Figure 4.14: Sequence diagram related to Use case Uc- 24

Figure 4.15 shows the sequence diagram corresponding to Sc- 6, where a Content Provider gets a trouble ticket warning about a trouble for which he is not responsible.

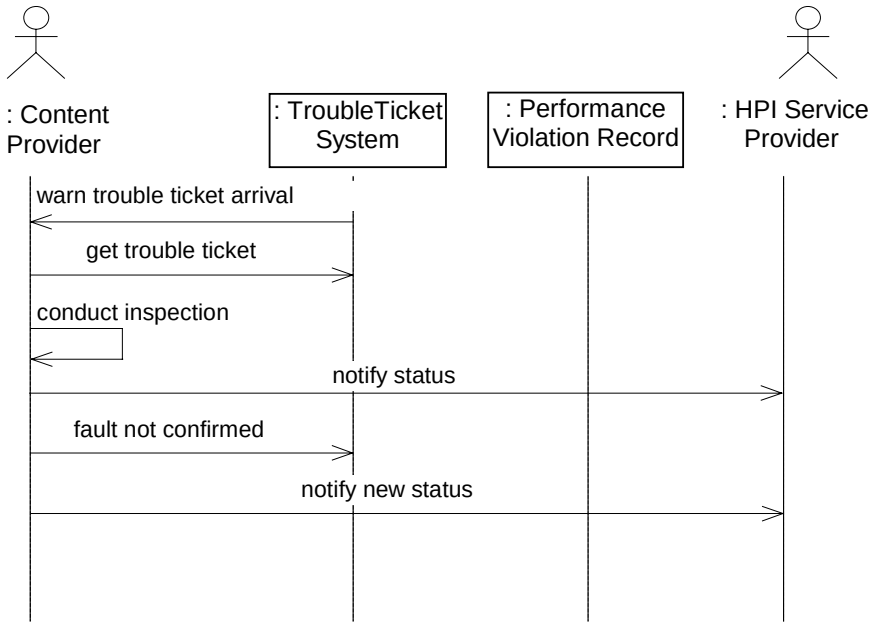

Figure 4.15: Sequence diagram related to Scenario Sc- 6

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4.4.2 State Diagrams

4.4.2.1 Content Bill

According to sequence diagrams of Figure 4.12 and Figure 4.13, the line of processing behind a bill is the following:

- **calculate;**
- **issue;**
- **pay, if not refused;**
- **issue receipt if paid;**

figure 4.16 shows this sequence. A bill is by default not issued and consequently not paid and not refused. When the Content Provider issues the bill, it remains unpaid. It may be refused or accepted. If accepted it will eventually be paid. It is only being paid that a receipt for that bill can be issued.

The destruction of the bill is, at the moment of writing, undefined. If we consider a role such as “Database Administrator” or “Application Manager”, there would be some scenarios that would deal with this situation.

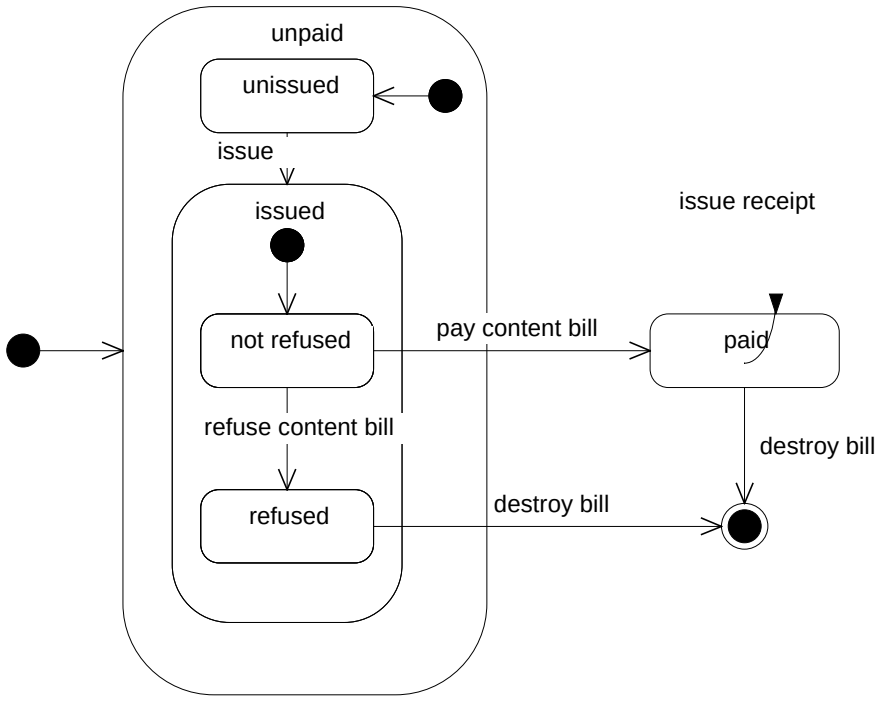

Figure 4.16: State diagram of the HPI Content Bill class (HPIContentBill)

4.4.2.2 Performance Violation

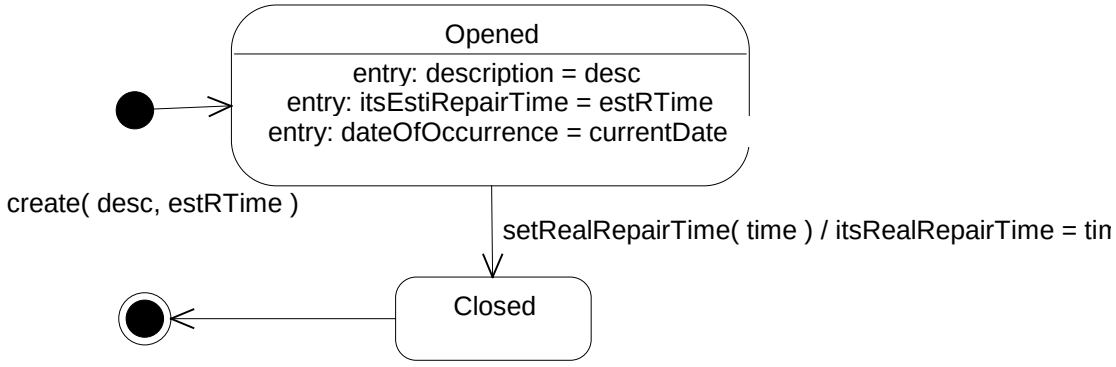

Figure 4.17: State diagram of Performance Violation class

4.4.2.3 Trouble Ticket

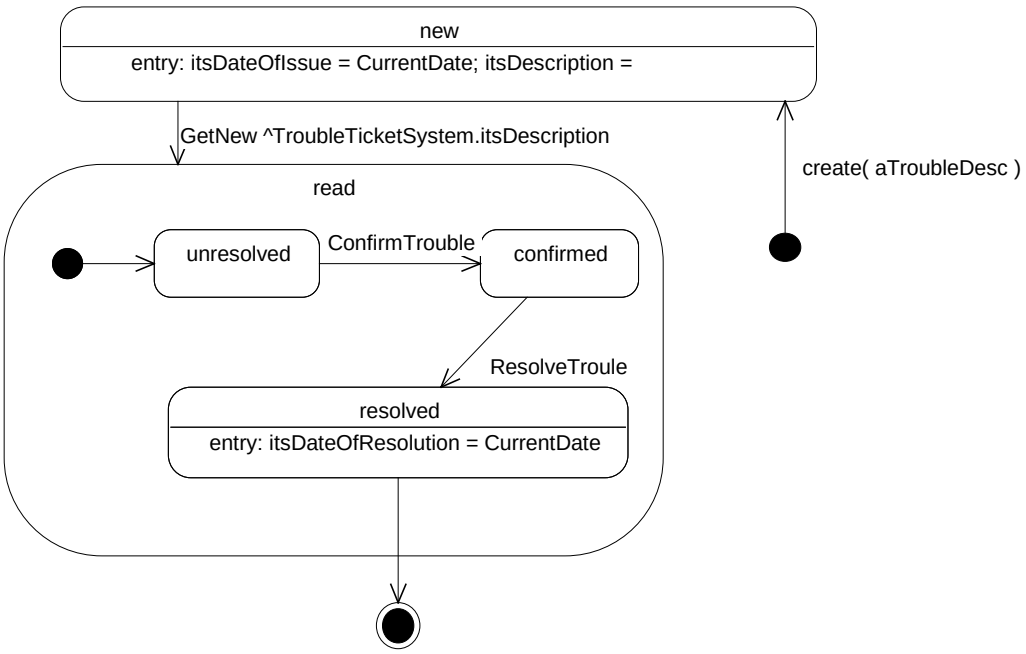

Figure 4.18: State diagram of the Trouble Ticket class

4.5 Transport Network Provider

4.5.1 Sequence Diagrams

Hereafter sequence diagrams of the Network Provider are presented.

In this scenario NP's Fault Management Function controls the alarms and status changes of links set. Fault conditions are correlated, and in case of a fault occurrence, a trouble ticketing report is issued and completed accordingly, after its recovery.

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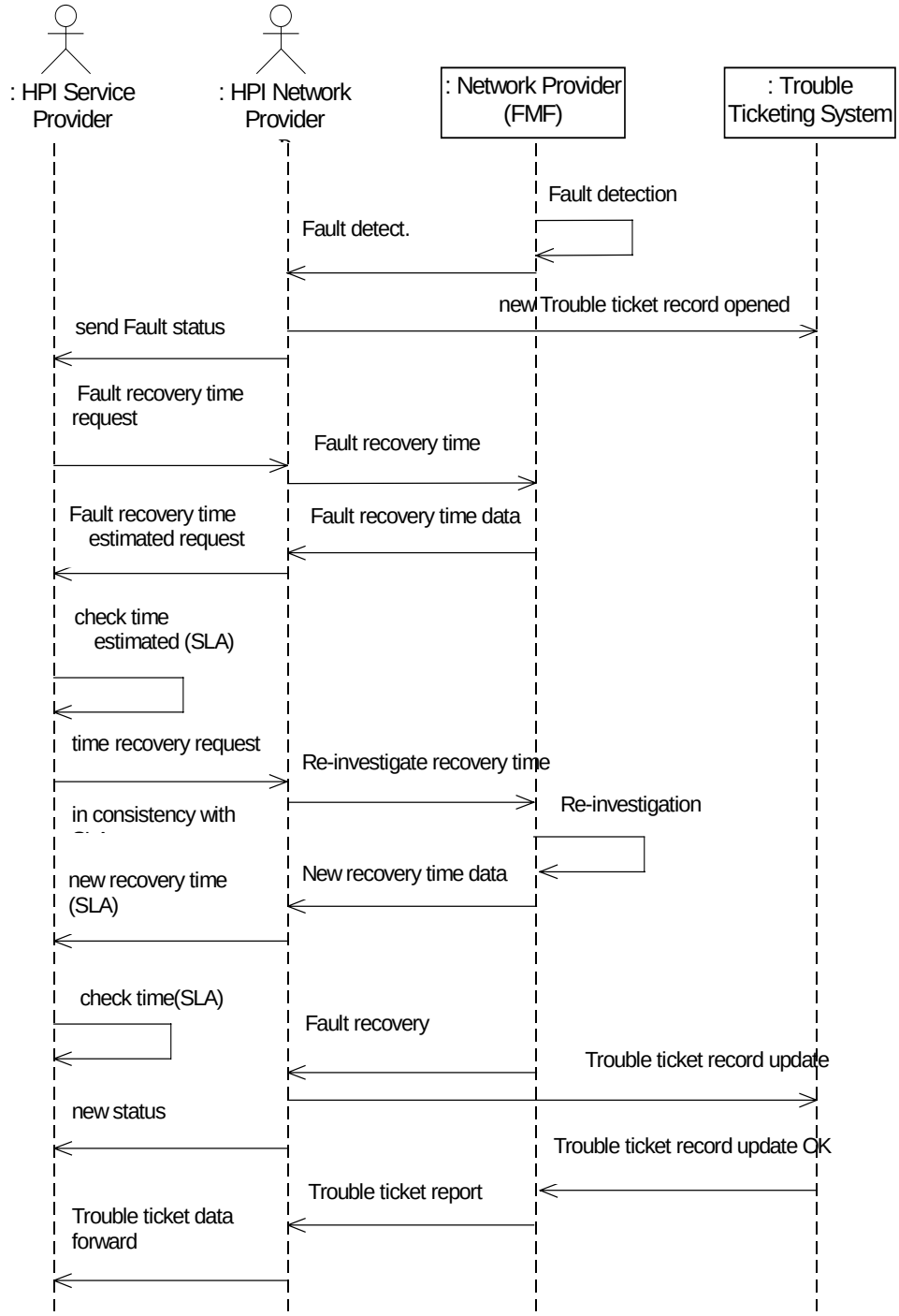

Figure 4.19: Sequence diagram related to Uc- 32

In this scenario upon an abnormal condition notification received by HPI SP (originated by a Customer), NP checks the network operating conditions, and since nothing is detected, notifies HPI SP, which requests from NP to communicate with Content Provider (CP) and Customer.

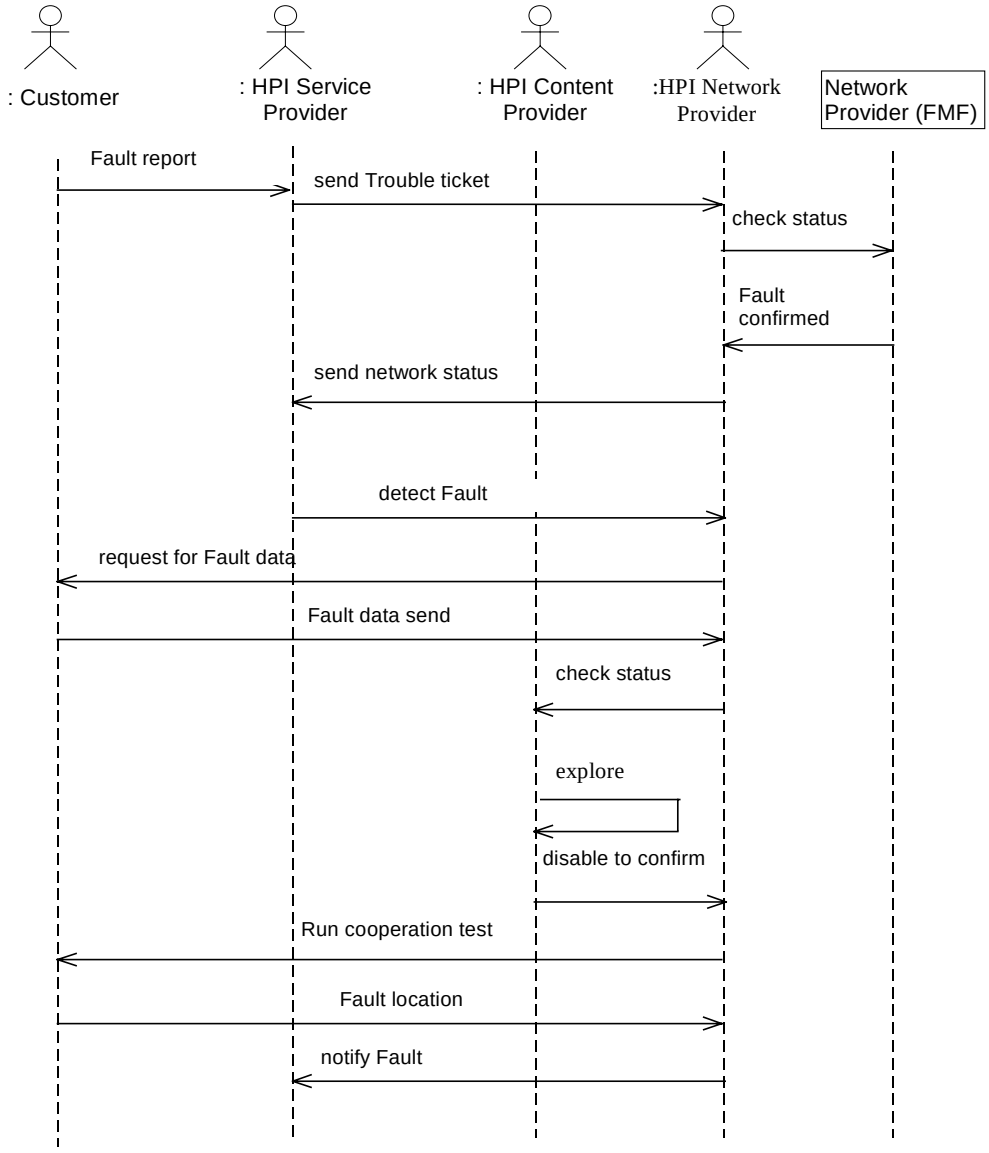

Figure 4.20: Sequence diagram related to Uc- 33

In this scenario NP's performance monitoring system detects a certain performance parameter degradation outside of SLA and HPI SP is informed. Certain procedures are initiated so that SLA requirements are met again. Performance, as long as it remains within the limits agreed upon, may be an optional information to the HPI SP and the Customer.

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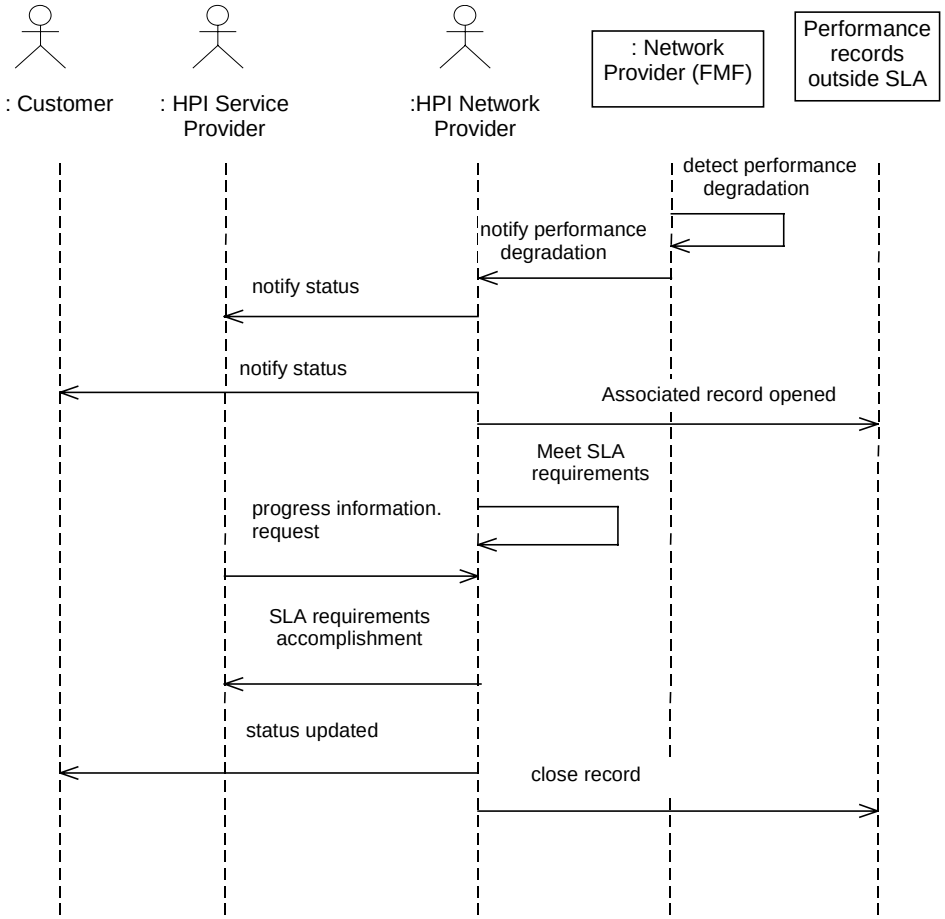

Figure 4.21: Sequence diagram related to Scenario Sc- 11

4.5.2 State Diagrams

According to the sequence diagrams presented, the sequence followed by the NP's trouble tickets is: detect, issue, re-estimate, update, clear.

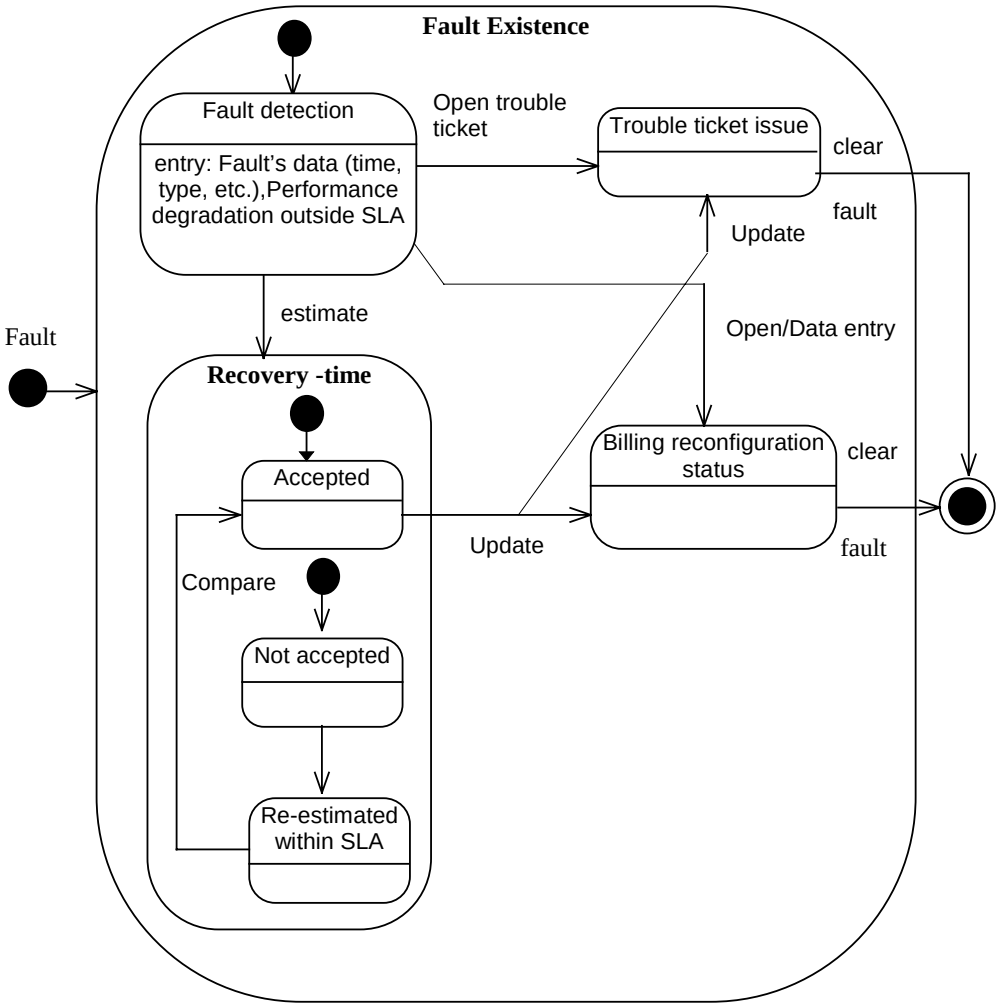

Figure 4.22: State Diagram of NP trouble Ticket class

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5 Management Application Class Model

5.1 Non-Repudiation of delivery

Considering the Domain Class Model, Scenario, Use Case, Sequence Diagram, and the State Diagram as well, the following Management Application Class Model is formed.

Here, the prevailing classes /relationships contained, deal primarily with the management of the Security Provider Services (non-repudiation of delivery).

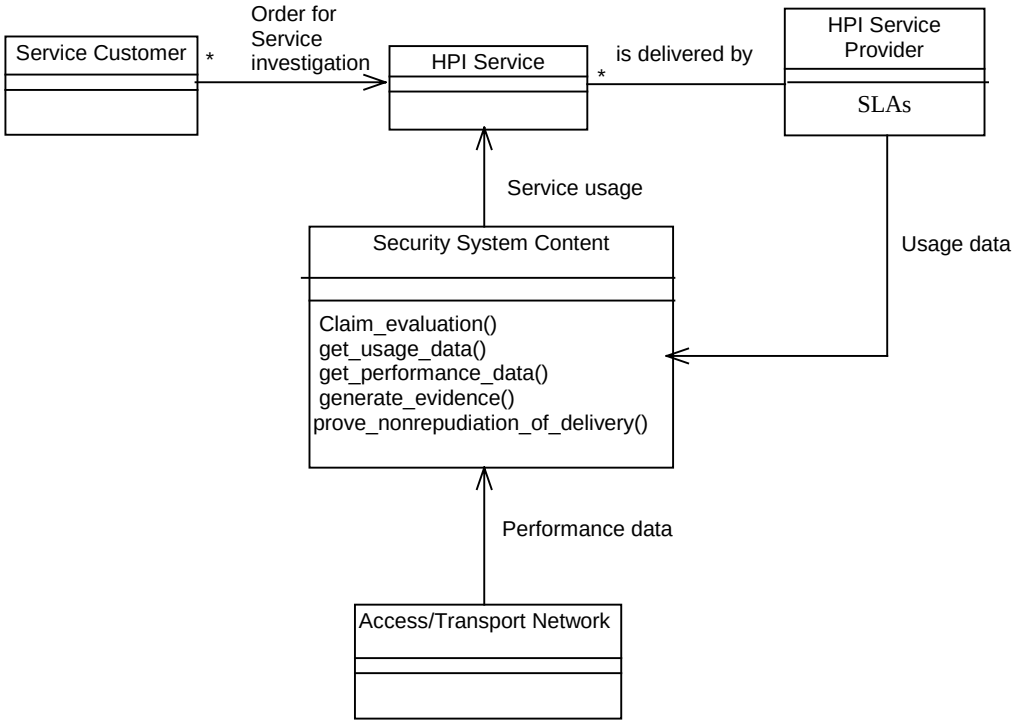

Figure 5.1 Security Services Content Application Class Model

The approach considered here in reference to the use case or Security Management (non-repudiation of delivery proof generation) reveals the class of the Security System Content as being the dominant one.

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Appendix A: Data dictionary

A data dictionary is a description of every concept used in the domain model. The data dictionary used is the following:

- Access Provider: Entity which provides and manages access communication networks.
- Actor: Every entity which interacts with the system.
- Bill: A Bill to pay for the service usage is issued to every Customer.
- Bill Detailed Records: Audit the use of the system by the Customer.
- Content Manager: Entity responsible for generating and upkeeping the contents.
- Content Provider: Entity which provides customers with information or value-added services for free, on a subscription base or a one-ticket charge (examples of Information Providers are a weather information provider or a news provider; examples of value-added Service Providers are a travel agency or a ticket agent service for theatre, concerts, sport events, etc.).
- Content Provider Financial Manager: Entity responsible for the contractual and economic relationships between the Content Provider and the other actors.
- Contract: Relationship established between the Customer and the HPI Service Provider in order to subscribe the service.
- Customer: Entity which subscribes the service and pay for the bills.
- Desired QoS: QoS contracted by the Customer.
- Effective QoS: QoS effectively provided to the Customer.
- E-Mail: One of the possible IP-Services provided to the Customers.
- End-User: Entity which actually make use of the service. Each End-user is associated with a Customer. Typically the Customer and the End-user role will be coincident, but sometimes they will be different and the service must support these cases.
- HPI Service Financial Manager: Entity responsible for subscriptions, service billing and accounting.
- HPI Service Integrator: Entity responsible for integrating the information provided by the Content Provider, as well as creating and maintaining the White and Yellow Pages.
- HPI Service Manager: Entity responsible for the operation and management of the service, including maintenance of the servers, configuration, alarm monitoring, security monitoring, performance, tracking, etc.
- HPI Service Provider: Entity which owns the infrastructure and runs it for the sake of delivering HPI services.
- HPI Security Provider: Entity responsible for the HPI security , including *forgery, repudiation, unauthorised access, denial of service* and *masquerade.*
- Internet Access: One of the possible IP-Services provided to the Customers.

- Network Manager: Entity responsible for the management of the access/transport network and the fulfilment of SLAs.
- Party: The Party class is part of the analysis pattern with the same name, and represents either a Customer, a Provider or the End-User.
- Performance Violation: It occurs when the Network or the Service Provider fail to deliver the QoS agreed in the contract.
- Profile: General party information related to the subscription and billing of the service.
- Profile Detail: Contains the detail of the party's profile.
- Subscription: A Customer must subscribe a service in order to be able to use it and allow others to use it. A Subscription refers to a Contract.
- Service Usage Detailed Record: It holds detailed information on usage for every service subscribed by a Customer.
- Tariff: The Tariff is the basis for the billing of the service. The Contract should specify the Tariff under which the Customer is charged.
- Transport Network Provider: Entity which provides and manages long-hand communication networks.
- Trouble Ticket: Whenever an error occurs, a Trouble Ticket is exchanged between two parties, describing the perceived problem.
- White Pages Management: (No documentation was yet written for this class.)
- Yellow Pages Management: (No documentation was yet written for this class.)

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