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## **ANSA Phase III**

# **Information Model for Federation**

**E. Jane Cameron and Rob van der Linden**

### **Abstract**

Today, much is published about the plethora of new services possible based on the advances in communications and computer technology. Collectively these services are referred to as the "Information Highway", the "Infobahn", or the "Electronic Future." Many of the current predictions are based on advances in hardware and transport technologies. However, software services will play a major role.

Reuse of software services will be critical to quickly designing, creating, and managing new software based communication services. However, because a client may be concurrently using more than one service, their collective behaviour must be what the client expects; because several users may be simultaneously interacting, the collection of services used must behave as expected. Designing services that can be readily combined to behave in predictable ways is difficult; little is known about the kinds of automated support which will aid designers, developers, and users in addressing this problem.

Here, information needed to present a comprehensive view of communications services is discussed. This information is intended to be stored in a repository. Users access the information via a MatchMaking service. This model is intended to capture behavioural and intentional aspects of services, in addition to the usual interface descriptions. It is intended to provide additional information needed to combine services to form larger more complex ones, while minimizing the impact of unexpected adverse behaviour. This is the first attempt at producing a summary of the information needed for composition of services.

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APM.1229.01

**Approved**  
Technical Report

13th December 1994

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**Distribution:**

**Supersedes:**

**Superseded by:**



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APM.1229.01

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The material in this Report has been developed as part of the ANSA Architecture for Open Distributed Systems. ANSA is a collaborative initiative, managed by Architecture Projects Management Limited on behalf of the companies sponsoring the ANSA Workprogramme.

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The authors acknowledge the help and assistance of their colleagues, in sponsoring companies and the ANSA team in Cambridge in the preparation of this report.

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# 1 Introduction

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## 1.1 Overview

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Advances in computer and communications hardware technology are important enablers for new services, collectively known as the Information Superhighway. Many current predictions are based on advances in hardware and transport technologies. However, software services will play a major role.

In an increasingly competitive market, new services must be more rapidly designed, created and adapted than ever before. New and existing services must be integrated and smooth migration ensured. Users will concurrently use several services, provided by different organisations.

Designing services that can be readily combined to behave in predictable ways is difficult; little is known about the kinds of on line support that will aid designers, developers, and users in addressing this problem.

A first step to solving this problem is to have all information which describes a service available in the same system in which the service is being provided. It will thus be necessary to find out what information is relevant and devise a way of making it available at all stages of a services life cycle.

An information model for federation helps identify the kinds of information which are needed to describe services in a way which enables correct use of those services. This information becomes part of extended service offers, which are stored in a service property repository [APM.1177] and used by a MatchMaking service (an extended trading service).

A prototype of the service property repository and MatchMaking service, using HP's AllBase and Iona Technology's Orbix is available. The requirements for the data structures it supports were derived from the information model described in this paper.

Once more detailed information about services is available in a system, then this information can be used to generate interceptors and gateways across boundaries which inevitably occur in large scale distributed systems. The results of this work are therefore relevant to the work on interception, which will be carried out under workpackage F4 in the 1993-1995 work plan for Phase III.

## 1.2 Structure of this document

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This document has two main parts:

- an analysis of the kinds of information which must or may be included in extended service offers (Chapters 2 - 9)
- an example of a video on demand service which can only be provided after cooperation amongst three separate service providers has been established (Chapters 10 and 11).

The analysis part of the paper consists of:

1. an introduction to MatchMaking (Chapter 2), in which the case is made for a more elaborate model which can elucidate the information needed;
2. a summary of all the information which is identified in the following chapters as necessary part of a service specification (Chapter 3);
3. an investigation of enterprise issues (Chapter 4), following the enterprise concepts of agent, activity and resource, as well as the relationships amongst these [APM.1017];
4. a discussion of enterprise issues which casts the formal model in examples drawn from “the real world” (Chapter 5);
5. investigations of the information, computational, engineering and technology issues, which translate into requirements for the addition of information in extended service descriptions (Chapters 6-9).

The video on demand example is in two parts:

1. an introduction, explaining the service and the basic technology involved (Chapter 10);
2. an analysis of the video on demand scenario using the boundaries identified in the federation manifesto [APM.1139] as candidates for properties of services and offers (chapter 11).

The scenario is being further developed in the DTI sponsored Enterprise Computing Project.

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## 2 Overview of the MatchMaking service

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### 2.1 Overview

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A MatchMaking service is a service which assists service providers and users achieve an agreement so they can cooperate. The MatchMaking service collects information about services offered by service providers and makes this information available to potential service users. Service users can use this information to establish a contract with a service provider.

Traditionally, a trading service provides this service. Trading has become associated with dealing only with a narrow set of information. The MatchMaking service deals with a much wider set of information.

To define this larger set of information, it is necessary to further analyse the issues which impinge on the relation between two entities required to interwork. The RM-ODP viewpoints can be used as a first cut categorisation of the information needed. Indeed, information that comes from computational, engineering and technology viewpoints and which is necessary for successful MatchMaking is described in separate chapters.

Many enterprise issues are also relevant. To elucidate these issues an enterprise model has been constructed, according to the method set out in [APM.1017]. This involves the identification of agents, resources and activities associated with the MatchMaking service and its users. The relationships amongst the agents, resources and activities are then examined. This results in a basis for a comprehensive information model.

The emphasis of the work is on determining what is necessary to establish a relationship between a service provider and a service user.

### 2.2 Simple MatchMaking service

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Initially a simplified model is used. Three agents are primarily involved:

- the “Provider” of the service (with service description information);
- the “User” of the service (and associated service description information);
- the “MatchMaker” used to provide access to service description information by users, and to users by information providers.

In addition two other agents are considered:

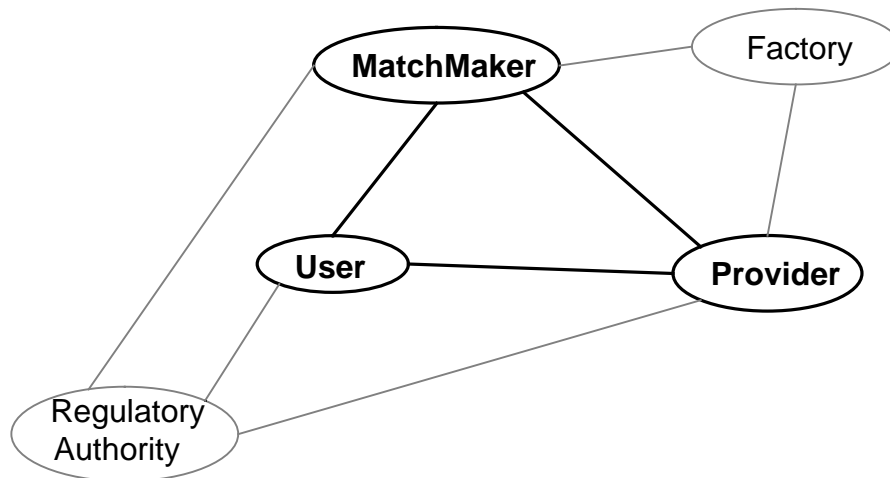
- a “Regulatory Authority”, which constrains all activities in the system, but to various degrees;
- a “Factory”, which is able to create instances of services.

Figure 2.1 illustrates the agents and their relationships in terms of the possible interactions.

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**Figure 2.1: Relationships between agents**


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In Figure 2.1, the User can be an organization made up of a number of individuals. The organization could be large or small; the individuals could be grouped into organizations as well. Thinking of the User as an organization can be useful in sorting out some of the roles played by members of the organization, and hence some of the activities they perform. That is by identifying the myriad roles played by a single user, the necessary separation of concern follows. Also, an individual may belong to several organizations, each having its own policies. Again, potential separate concerns are easier to identify, when the roles an individual play are identified. Thus by considering organizations and the roles of individuals within them, we found it easier to identify and separate the various concerns that the information model must address.

The service provided by the MatchMaker is in fact an information service. In discussing the MatchMaking service and its information model, an important distinction must be made between the policies and mechanisms of the MatchMaking service, and the policies and mechanisms of the offers listed in the MatchMaker. This distinction is critical to understanding this paper. We have attempted to identify policies of the MatchMaker and policies of the offers, as such whenever possible.

The Provider can itself contain MatchMakers, traders, or other information services. Again, just how the information and listings are organized is not within the scope of this paper, rather an identification of the kinds of information that must be included if a MatchMaker is to be used to locate services that can used as components of enhanced services in large scale distributed computing.

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### 2.3 Extending the model

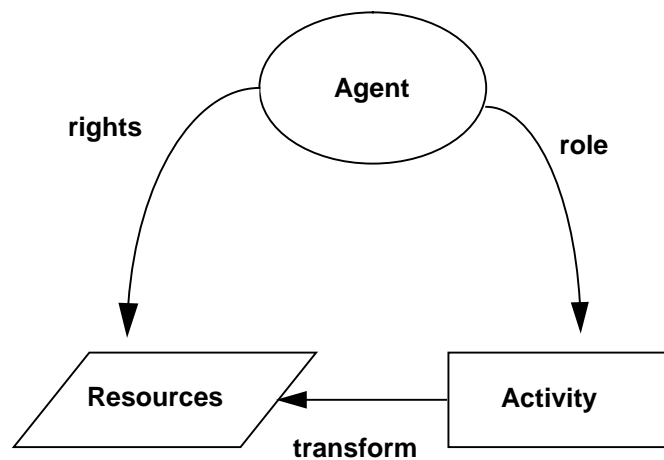
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A model which is restricted to agents is not complete. It is certainly inadequate for elucidating all the aspects which are important when considering the interactions between components in a multi-organisational distributed computing environment.

Previous work on enterprise modelling [APM.1017] suggests that in addition to agents, it is necessary to consider activities and resources and the six relationships which exist between the entities of type agent, activity and resource.

Figure 2.2 illustrates the entity and relationship types which need to be considered.

**Figure 2.2: Entity and relationship types**



In the following chapter resources and activities are identified first, followed by rights and roles. The relationships amongst them are then summarised; these relationships are what provide the enterprise model.

We have not identified all the agents, activities, resources, roles, rights and transforms; we have identified those that impact federating software services. In particular, we concern ourselves with the ones that involve crossing a boundary. To keep our model simple we stick to simple boundaries. The easiest ones to identify are those among User, Provider and MatchMaker.

Because we are dealing with large scale distributed systems, the services offered could belong in different domains, these concerns are addressed as well. We do not pay particular attention to distribution of activities or agents.

## 2.4 More complex MatchMaking services

In identifying the kinds of information necessary for an information model, we considered a MatchMaker that offered only very simple services. More services could have been added to the MatchMaker, however they could add unnecessary complexity to the work.

Our current model deals with very passive “MatchMaker” and “Provider”; these could be made active:

- MatchMaker notifies User when new Service Offers come in, or when Service Offers are removed.
- MatchMaker notifies Provider whenever its Service Offers are scanned.
- Provider notifies User when Services change.

The MatchMaker could also sell information/services based on monitoring the usage patterns of the User.

- MatchMaker, Provider, or User supply another party with or permit another party to monitor information about use as it happens.
- Notification of Users/Providers/MatchMakers or others about certain events
- User, MatchMaker, or Provider may sell/buy/give information about usage of services offered to other parties (governments, businesses, etc.) (Selling of mailing lists by mail order places, and usage reports on free-phone are examples of this)

The techniques used in creating the information model, can be used for these services as well. However, we elected not to present it here.

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## 3 Summary of Service Specification Details

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The information identified in each of the following chapters is summarised below.

### 3.1 Enterprise

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- Ownership
  - (i) With respect to the *service*, information about what rights exist to provide, consume, own, duplicate, use, reuse, create, destroy, block or deny access.
  - (ii) With respect to the *service offer*, information about what rights exist to provide, consume, own, duplicate, use, reuse, create, destroy, block or deny access.
- Authority
  - (i) Who has to authority to grant rights to agents?  
(This information is more likely to be enshrined in the MatchMaking service itself, not the offers which are posted there.)
- Remuneration
  - (i) With respect to *payment*, information about who pays, how payment is made, when payment is to be made, what currency is to be used.
  - (ii) With respect to *accounting practices*, information about what usage information is kept and how that information is used.
  - (iii) With respect to the *bill*, information about who gets it, what is on it and how often they are sent.
  - (iv) With respect to *settlement of bills*, information about what constitutes non-payment, what penalties may be imposed, how are these enforced, what legal system is assumed, what regulations exist.
- Management
  - (i) With respect to *services*, when services are available, where they are available, who will be notified when the service comes into existence, ceases to exist, is moved or otherwise altered (e.g. quality of service changes).
  - (ii) With respect to the *service offer*, time of registration and time of future removal.
  - (iii) With respect to *dependencies between services*, what other services need to exist, what other services should not exist, what compatibilities exist or should exist.

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### 3.2 Information

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Naming and language issues are related to the way in which information in service offers may be represented. Only the *additional interaction* concerns translate into extra information which may be included in a service offer.

Six concerns may be included:

- Order of Execution;
- Inconsistency or Incompatibility of Execution;
- Nondeterminism;
- Duplication of Processing;
- Removal of Need for Processing;
- Termination.

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### 3.3 Computation

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Operational and stream interface definitions should be explicit part of the service specification.

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### 3.4 Engineering

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Information about quality of service as well as quality of service management should be part of a service specification.

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### 3.5 Technology

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Detailed binding information should be part of a service specification.

For *interoperability*, information about the object reference source, the formatting of the binding information, and the on-the-wire format should be included.



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## 4 Enterprise issues: model

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### 4.1 Introduction

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The issues raised in this chapter are based on enterprise concerns of the service users, MatchMaker, and information/software/service providers. The service users can find desired services, by using the MatchMaker. The MatchMaker contains listings of service offers. The service provider sells *rights to services* to the service users. The MatchMaking service has two sets of customers, the service users and the service providers; each purchases rights to the offers in the MatchMaker. The rights of each must be respected as much as possible by the MatchMaking service. Often these rights can be in conflict; here the potential for conflict is identified, but not resolved.

As with any enterprise once rights are purchased, certain obligations arise. These can be obligations to provide the service purchased, obligations to pay the agreed upon amounts, or obligations to demonstrate that certain practices, such as accounting, were followed. Certain penalties can be assessed, when ever specific obligations are not met. These too will become part of the service offers.

### 4.2 Methodology

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The model is based on the enterprise modelling concepts described in [APM.1017]. The first step was to identify the agents involved in the MatchMaking service. Resources were identified next. Only those resources which are associated with agents were considered. Workflows and scenarios involving the agents and resources were then used to identify the activities.

The relationships between agents and resources (called rights) and those between agents and activities (called roles), were identified, again using workflows and scenarios involving the three entities. Dependencies are derived from the conceptual schema, or relationships among the resources. Finally, obligations were derived from the relationships among the roles. The relationships between activities and resources (called transforms) were not addressed, nor were activity-activity relationships.

This modelling effort is primarily concerned with federation issues, hence it focuses on entities and relationships that involve boundaries. The collection of micro-scenarios in [APM.1095] contains many of the scenarios used to create this model.

These results of applying the methodology are presented in the following sections.

### 4.3 Entity types and intra-entity relations

First, to construct the enterprise model, the entities had to be identified. The entity and relationship types are depicted in figure 2.2. After identifying the agent types, several workflows and scenarios involving Users, MatchMakers, and Providers were used to identify first the resources, and later the activities.

#### 4.3.1 Agents

As shown in figure 2.1 five agents have been identified. They are listed below:

- User
- Provider
- MatchMaker
- Regulatory Authority
- Factory

#### 4.3.2 Structural roles

Structural roles are derived from agent-agent relationships. The set of agents with which a particular agent has relationships defines the structural role for that agent. The following structural roles can be distinguished

**Table 4.1: Structural roles**

	User	Provider	MatchMaker	Regulatory authority	Factory
User		distributed systems service user			-
Provider	service provider		service provider	subject	service provider
MatchMaker	service provider			subject	service user
Regulatory authority	principal				principal
Factory	-	service provider		subject	

#### 4.3.3 Resources

To identify the resources of concern, only the ones that interest more than one agent are considered. Intuitively, if more than one agent is interested in a resource, then a boundary is involved. This criteria simplified the model and allowed us to consider only the following resources:

- Service
- Service offer (or offer)
- Bill
- Receipt
- Money

#### 4.3.4 Conceptual schema

The conceptual schema is derived from relationships amongst resources. Two conceptual schemata can be created: one focusing on finding, accessing and

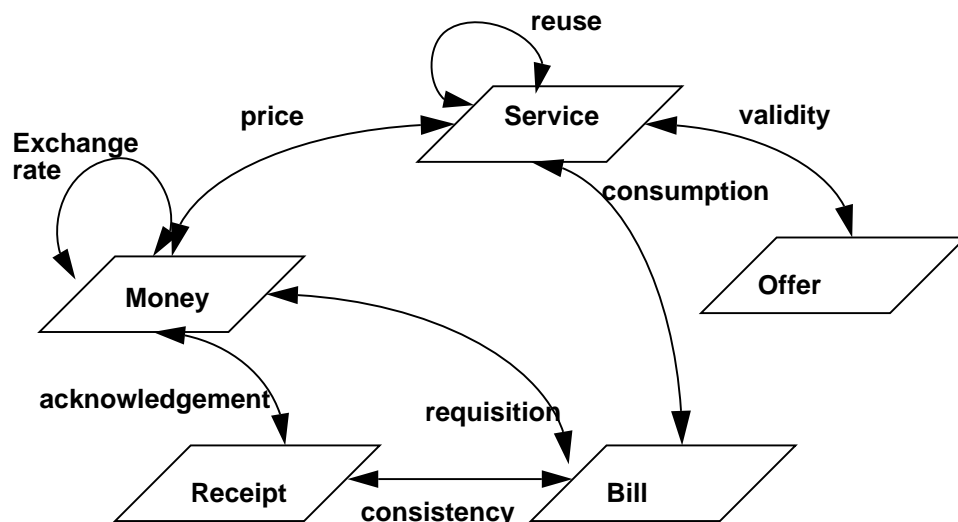
paying for services; the other on accessing and paying for offers. When focusing on services the following relationships are identified:

**Table 4.2: Conceptual schema (relationships)**

	Service	Service offer	Bill	Receipt	Money
Service	reuse	validity	consumption	-	price
Service offer		(reuse)	-	-	-
Bill			-	consistency	requisition
Receipt				-	acknowledgement
Money					exchange rate

The conceptual schema for services is illustrated next. (A similar schema for offers could also be created. However, including it in the figure would add unnecessary complexity.):

**Figure 4.1: Conceptual schema - Services**



#### 4.3.5 Activities

Activities were identified using scenarios involving Users, Providers, and MatchMakers manipulating Services, Service Offers, Bills, Receipts, and Money. Again, activities that address some form of boundary were of primary interest. Below are the activities identified:

- Create (a service)
- Destroy (a service)
- Provide (a service)
- Use (a service)
- Re-use (a service)
- Prevent use (of a service)
- Prevent re-use (of a service)
- Copy (a service)

- Prevent copy (of a service)
- Configure (provide access to a service)
- Manage (ensure a service works as expected)
- Administer (look after the business aspects of a service)
- Create (an offer)
- Register (an offer)
- Prevent registration (of an offer)
- Observe (an offer)
- Block observation (of an offer)
- Remove (an offer)
- Copy (an offer)
- Prevent copy (of an offer)
- Account (for use of a service)
- Charge (create a bill for use of a service)
- Not\_charge (not create a bill for use of a service)
- Pay (money)
- Not\_pay (money)
- Send acknowledgement (receipt)
- Receive acknowledgement (receipt)

#### 4.3.6 Activity-activity relations

Because of the large number of activities, the activity-activity relation is not shown here. The information derived from the activity-activity relations deals primarily with order of execution of the activities. This information, too, is included in service offers.

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#### 4.4 Inter-entity relations

Next, the Inter-entity relationship types are identified. This was done by creating tables involving the entities. The first type of relationship addressed is the agent-resources relation, rights.

##### 4.4.1 Rights

Rights are derived from the relationships between agents and resources. The rights of agents with respect to resources are reflected in the interactions between agents. These rights are therefore reflected in the service offers.

The top row lists the agent types, the left-hand column lists the resource types. The rights are listed in the table entries. (The rights are listed in the

table as verbs, this was done to save space. The table entry “use” should be read “the right to use”.)

**Table 4.3: Rights**

	User	Provider	MatchMaker	Regulatory authority	Factory
Service	use re-use refuse to use refuse reuse copy refuse copy	create destroy provide reuse prevent use prevt reuse copy configre manage administer	-	regulate	create reuse refuse reuse copy refuse copy configure
Service offer	observe refuse obsvn copy refuse copy	create register refuse regn observe prevent obsn remove copy prevent copy	register prevent regn observe prevent obvn remove copy prevent copy	regulate	observe refuse obsvn copy refuse copy
Bill	receive	send	-	regulate	-
Receipt	receive		-	regulate	-
Money	account	account charge receive	-	regulate	-

The rights that appear in the above table, are listed below:

- to use (a service)
- to reuse (a service)
- to refuse to use (a service)
- to refuse to reuse (a service)
- to copy (if possible a service)
- to create (a service)
- to prevent use (a service)
- to prevent reuse (a service)
- to configure (services)
- to manage (services)
- to administer (services)
- to regulate
- to create (a service)
- to destroy (a service)
- to observe (an offer)
- to refuse to observe (an offer)
- to copy (an offer)

- to refuse to copy (an offer)
- to create (an offer)
- to register (an offer)
- to refuse to register (an offer)
- to observe (an offer)
- to prevent observation of (an offer)
- remove (an offer)
- to prevent copying (an offer)
- to prevent registration of (an offer)
- to regulate (offers)
- to receive (a bill, a receipt. money)
- to charge (money)
- to account for (money)

#### 4.4.2 Roles

Roles, or functional roles are derived from the relationship between agents and activities. Permission for any activity is implied by the role which the agent assumes with respect to the activity. These permissions control interactions amongst the agents, and are therefore reflected in service offers.

The table below illustrates the functional roles which agents assume in carrying out their activities

**Table 4.4: Functional roles**

		User	Provider	MatchMaker	Regulatory authority	Factory
Service	Create	-	creator	-	regulator	creator
	Destroy	-	destructor	-	regulator	-
	Provide	-	service provider	-	regulator	-
	Use	service consumer	-	-	regulator	-
	Re-use	service consumer AND service provider	service consumer AND service provider	-	regulator	service consumer AND creator
	Prevent use	self-regulator	regulator	-	regulator	-
	Prevent re-use	self-regulator	regulator	-	regulator	self-regulator
	Copy	if possible as service consumer	service provider	-	regulator	creator
	Prevent copy	self-regulator	regulator	-	regulator	self-regulator
	Configure	IF re-user THEN configurer ELSE -	configurer	-	regulator	configurer
	Manage	IF re-user THEN manager ELSE -	manager	-	regulator	-
	Administer	IF re-user THEN administrator ELSE -	administrator	-	regulator	-
Service offer	Create	-	offer provider		regulator	-
	Register	-	offer provider	offer registrar	regulator	-
	Prevent registration	-	self-regulator	regulator	regulator	-
	Observe	observer	observer	offer keeper	regulator	observer
	Block observation	self-regulator	regulator	regulator	regulator	self-regulator
	Remove	-	remover	remover	regulator	-
	Copy	service consumer	service provider	offer keeper	regulator	creator
	Prevent copy	self-regulator	regulator	regulator	regulator	self-regulator

**Table 4.4: Functional roles**

		User	Provider	MatchMaker	Regulatory authority	Factory
Money	Account	accountant	accountant	-	regulator	-
	Pay	payer	payee	-	regulator	-
	Not_pay	debtor	creditor	-	regulator	-
Bill	Charge	debtor	creditor	-	regulator	-
	Not_charge	-	-	-	regulator	-
Receipt	Send acknowledgement	debtor	creditor	-	regulator	-
	Receive acknowledgement	debtor	creditor	-	regulator	-

The roles entered in the table are listed below:

- service creator
- service destructor
- service provider
- service consumer
- offer provider
- offer remover
- offer registrar
- offer keeper
- offer observer
- configurer
- manager
- administrator
- self-regulator
- regulator
- accountant
- payer
- payee
- creditor
- debtor

#### 4.4.3 Transforms

To complete the model the relationship between activities and resources must be examined to yield the transforms. The transforms table, along with the transforms are not shown here.

Some of the points addressed by the transforms are mentioned in the next chapter. Most of the transforms are relatively simple. However, the ones invoked by configure and manage can be enormously complex. Some of the dependencies among services are addressed in the next chapter. The configure



and manage activities must in fact use transforms that observe these dependencies to ensure that services composed of collections of other services will work correctly.

#### 4.5 Relationships between roles

If two agents have a business agreement, for example agent A will provide service to agent B for one month, if B pays A a fixed amount of money. Then agent B has the right to use the service, and agent A has the right to some of B's money. To ensure that the contract is met, certain obligations are placed on the roles of A and B to perform particular activities.

Thus, to satisfy the constraints that govern agents behaviours, roles must execute certain activities. These constraints give rise to obligations. Typically, an obligation placed on the role of one agent, ensures a right of another agent.

A collection of obligations has been added to our model.

##### 4.5.1 Obligations

Obligations are derived from relationships between roles. The following tables summarise the obligations amongst roles<sup>1</sup>.

**Table 4.5: Obligations (1)**

	"obliged"	service creator	service destructor	service provider	service consumer
service	service creator		inform about copies	demonstrate correct behaviour	-
	service destructor	-		only destroy what was requested	t.b.s.
	service provider	-	-		deliver paid-for service
	service consumer	-	-	use as described in the service offer	
offer	offer provider	provide offer	-	offer validity	offer validity
	offer remover	-	-	honour contract	-
	offer registrar	-	-	honour contract	-
	offer keeper	-	-	honour contract	-
	offer observer	-	-	-	consistency
service / offer	configurer	-	-	inform about dependencies	-
	manager	t.b.s.	t.b.s.	t.b.s.	-
	administrator	t.b.s.	t.b.s.	t.b.s.	t.b.s.
	self-regulator	-	-	-	-
	regulator	inform	inform	inform	inform

**Table 4.5: Obligations (1)**

	“obliged”	service creator	service destructor	service provider	service consumer
money	accountant	record use	record use	record use	record use
	payer	-	-	-	-
	payee	-	-	-	-
	creditor	-	-	-	-
	debtor	-	-	-	-

**Table 4.6: Obligations (2)**

	“obliged”	offer provider	offer remover	offer registrar	offer keeper	offer observer
service	service creator	-	-	-	-	-
	service destructor	-	inform	-	-	-
	service provider	validity	-	-	-	-
	service consumer	-	-	-	-	-
offer	offer provider		inform about listings	-	-	validity
	offer remover	remove only those requested		-	inform	-
	offer registrar	-	-		-	-
	offer keeper	not to change	t.b.s.	keep only what was registered		-
	offer observer	-	-	-	-	
service / offer	configurer	-	-	-	-	-
	manager	-	-	-	-	-
	administrator	-	-	-	-	-
	self-regulator	-	-	-	-	-
	regulator	inform	inform	inform	inform	inform
money	accountant	-	-	-	-	-
	payer	-	-	-	-	-
	payee	-	-	-	-	-
	creditor	-	-	-	-	-
	debtor	-	-	-	-	-

1. Please note that a single table (role vs role) has been divided into 4 separate tables, so as to fit them in the document.

Read the tables as follows: “The service creator (role) is obliged to inform to the service destructor (role) about copies” for the first entry in table 4.5 for instance.

**Table 4.7: Obligations (3)**

	“obliged”	configurer	manager	administrator	self-regulator	regulator
service	service creator	inform	inform	inform	-	obey
	service destructor	inform	inform	inform	-	obey
	service provider	-	-	-	obey	obey
	service consumer	-	-	-	obey	obey
offer	offer provider	-	-	-	obey	obey
	offer remover	t.b.s.	t.b.s.	t.b.s.	-	obey
	offer registrar	-	-	-	-	obey
	offer keeper	-	-	-	-	obey
	offer observer	-	-	-	obey	obey
service / offer	configurer		t.b.s.	t.b.s.	-	obey
	manager	t.b.s.		t.b.s.	enforce	enforce
	administrator	t.b.s.	t.b.s.		-	enforce
	self-regulator	inform	inform	inform		obey
	regulator	inform	inform	inform	inform	
money	accountant	-	-	-	-	obey
	payer	-	-	-	-	obey
	payee	-	-	-	-	obey
	creditor	-	-	-	-	obey
	debtor	-	-	-	-	obey

**Table 4.8: Obligations (4)**

	“obliged”	accountant	payer	payee	creditor	debtor
service	service creator	-	-	-	-	-
	service destructor	-	-	-	-	-
	service provider	permit monitoring	deliver service	-	-	-
	service consumer	permit monitoring	-	-	-	-
offer	offer provider	-	-	-	-	-
	offer remover	-	-	-	-	-
	offer registrar	-	-	-	-	-
	offer keeper	-	-	-	-	-
	offer observer	-	-	-	-	-
service / offer	configurer	inform	-	-	-	-
	manager	inform	-	-	-	-
	administrator	inform	-	-	-	-
	self-regulator	-	-	-	-	-
	regulator	inform	inform	inform	inform	inform

**Table 4.8: Obligations (4)**

	“obliged”	accountant	payer	payee	creditor	debtor
money	accountant		-	-	supply accurate records	supply accurate records
	payer	inform of payment		pay	-	-
	payee	inform of payment receives	accept payment		-	-
	creditor	-	-	-		send accurate bill
	debtor	-	-	-	accept bill or challenge	

#### 4.6 Summary

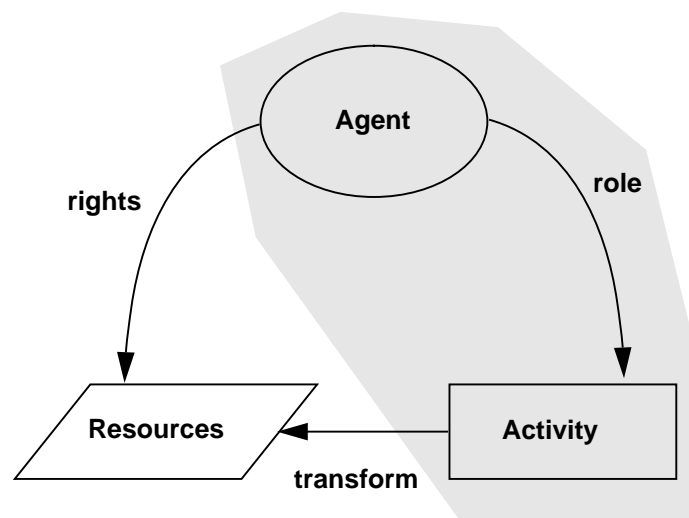
The model outlined above provides a framework for the discussion in Chapter 5. However, there is not enough detail supplied to generate the information needed for the service offers. To relate the model described here to the discussion in Chapter 5, it is necessary to make the following observations.

The concerns that must be addressed whenever boundaries are crossed were classified in the federation manifesto [APM.1193]. The relationships defined there include: Authorization; Management/Administration; Remuneration; Semantic; Access; and Infrastructure.

An important question is: “What do those relationships have to do with the relations defined in this model?”

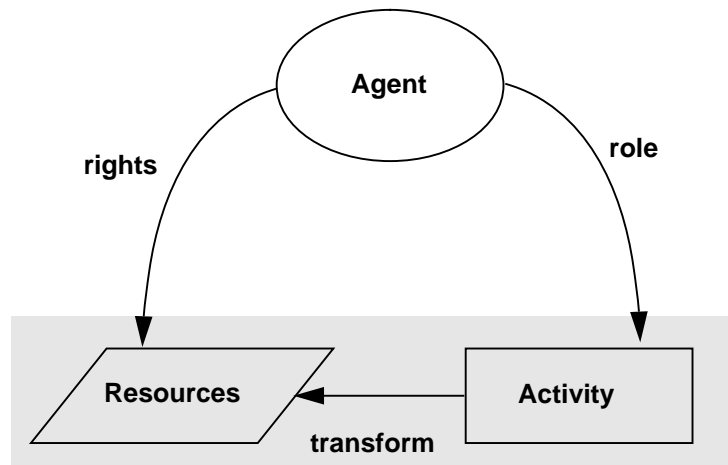
In Figure 4.2, the shaded region illustrates what entity and relationship types are concerned with the notion of “authorization”: authorities assign agents certain roles, within these roles they are permitted to perform certain activities.

**Figure 4.2: Entity and relationship types - authorization**



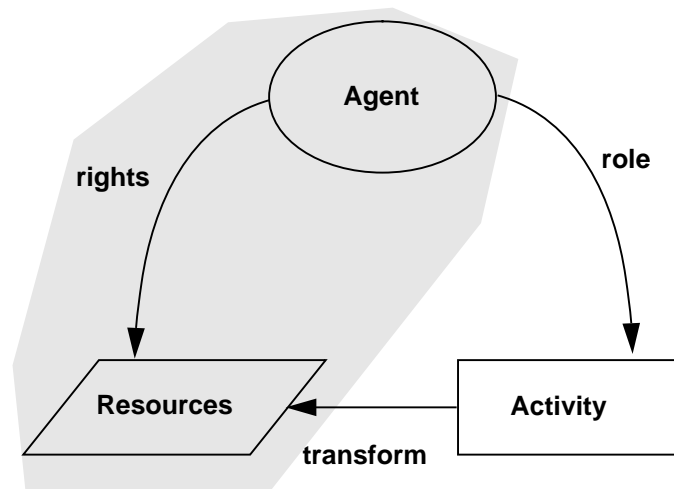
In Figure 4.3 the shaded region indicates what entity and relationship types are associated with management, administration and remuneration. Each is a collection of activities, transforms, and resources. When several types of resources are acted upon, obligations move from one role to another. For instance, when a bill is sent an obligation to send it changes to an obligation to pay money. When a service is delivered, the obligation to provide is turned into a right to some of the Users resources. Thus a balance of rights and obligations is maintained when the activities transform the resources as needed.

**Figure 4.3: Entity and relationship types - management, remuneration**



In Figure 4.4 the shaded area covers the issue of access and ownership. Typically in businesses this is what is bought and sold. This is very straight forward when goods are involved; the right to own a resource is bought and sold. When services are involved, various other rights are bought and sold. This issue is not covered in the federation manifesto [APM.1193].

**Figure 4.4: Entity and relationship types: access and ownership**



The discussion in Chapter 5, combines the model presented here and the notions presented in [APM.1193], to give a more detailed discussion of the enterprise related information that should be included in service offers.



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## 5 Enterprise Issues: discussion

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### 5.1 Introduction

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This chapter provides more detailed enterprise information to be included in service Offers. The discussion is based on the enterprise model presented in the previous chapter, but the concerns addressed are those presented in [APM.1193]. The mapping between the enterprise model presented in the previous chapter and the concerns addressed in [APM.1193] is presented in the summary of the previous chapter.

The business model involves the buying and selling of certain rights to resources. Once these rights are purchased, obligations arise. These can be obligations to provide the service purchased, obligations to pay the agreed upon amounts, or obligations to demonstrate that certain practices, such as accounting, were followed. Certain penalties can be assessed, whenever specific obligations are not met. These too will become part of service offers.

In this chapter, the agents in the enterprise model are named: User; MatchMaker; Provider; Regulatory Authority; and Factory. Figure 2.1 depicts these agents and the relations between them. Whenever other entities or relationships specified in the model are referenced, they too will be spelled with an initial capital letter.

### 5.2 Ownership / Business Model

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This section refers to the relationship between the User and the Provider. It concerns the buy-sell relationship between them. Information about precisely what is being sold, must be contained in the service Offers.

Computer software and electronic information share some fundamental properties that must be addressed at the enterprise level. Simply they can be copied in milliseconds and transported close to the speed of light. Thus the question of the right to own a copy, the right to duplicate (copy) information, the right to view information, the right to reuse information, the right to create and/or destroy, and the right to block or deny access to information are fundamental to any enterprise involved in electronic media.

In any enterprise, information about customers is collected. Such information includes customers buying patterns, customer profiles, and so on. In an electronic marketplace, where customer transactions rely on computer systems, large amounts of data about usage patterns can be readily collected via monitoring. This information is primarily used to improve business, but can be bought and sold as well.

This paper does not purport to be an in-depth study of these issues, only to raise them as they impact the kind of information that must be included in the information model.

## 5.2.1 Basis for Payment - Services

Here we address the issues of “How much of what for how long?” is to be paid for. That is, in the enterprise model presented in the previous chapter, “what” means quite specifically what rights are purchased for how long?

The right to use a service, reuse a service, own a copy of software, or make copies of software, are sold by Providers to Users. The blocking rights prevent use, prevent reuse, and prevent copy are mentioned as bullets in the respective categories, these typically are not sold but would be part of a contract.

### 5.2.1.1 *Right to own Copies*

Ownership of copies.

- a fixed number of copies.
- a fixed number of copies to be used in specific ways for specific periods of time. (specific ways would be specified in a contract)

### 5.2.1.2 *Right to duplicate (the right to copy)*

Duplication of copies

- no copies (i.e. prevent copy)
- a specific number of copies
- copies for specific purposes (contract)
- unrestricted copies

Here, there is a distinction made between the right to “own a copy” and the “right to make a copy”. In the previous chapter, for simplicity sake this distinction is not made.

### 5.2.1.3 *Right to use service*

Use service as is, for own purpose.

- a specific number of uses over a specific time period
- unlimited use for a specific period of time.
- the number of uses actually made in a specific period of time.
- no use (prevent use)

### 5.2.1.4 *Right to reuse service*

Service can be combined with other services to provided enhanced services.

- no restrictions on reuse service.
- reuse must be negotiated with provider service on a per instance basis
- reuse policy / obligations are clearly defined, (contract)
- no reuse (prevent reuse)

Other rights addressed in the previous chapter involve the right to create, provide, and destroy services. These rights are not sold by Providers to Users. They are typically obtained by Service Providers from Regulatory Authorities. Because Providers sell services, the Regulatory Authorities can impose obligations on the Providers. In choosing whether or not to use a service, the User may want to know who created the service, thus the name of the Agent creating the service could be part of the offer.



#### 5.2.1.5 *Right to create service*

The Provider can create services, and then use them to provide services for the offers listed in the MatchMaker. However, the Provider could also rely on a service Factory to create services, for offers listed in the MatchMaker.

- Provider creates service
- Factory creates services, and sells them to Provider

As part of the process of creating a service, either the Service Provider or the Factory may choose to reuse an existing service, either via an interface or by copying the software.

Each of these choices has implications on the administration, configuration, and management of services.

#### 5.2.1.6 *Right to destroy service*

To keep our Factories simple, only the Provider can destroy services.

- Provider destroys service

The issue of just what “destroy a service” means is subject to interpretation. For our purposes, it means that the particular service is no longer available. Other services that re-use it, via an interface will no longer be able to do so. However, the implications on services that have been implemented by making a copy of its software are not part of this discussion -- see right to copy (contract.)

Again, the copy and re-use have very serious implications on administration, configuration, and management when services are destroyed. Thus, these dependencies should be part of the information model for both services and offers.

#### 5.2.1.7 *Right to provide service*

In our model, only Providers can provide services:

- Provider provides service

#### 5.2.1.8 *Right to block / deny access to a service*

The User, Provider, MatchMaker, and Regulatory Authority may all want the right to block or deny access to services. However, what the User, Provider and Regulatory Authority want, may differ. Thus, some means of defining policies that determine which agent's desires take precedence is needed. The Manager role of the Provider must enforce them.

- User pays Provider to have service blocked
- Provider blocks access to User because of policy of Regulatory authority
- Provider blocks access to User because of failure to meet obligations on the part of the User. (See non-payment, for example)

#### 5.2.1.9 *Comment on “the right to destroy...” and “the right to deny...”*

To successfully run any enterprise involving software, services, or information these rights must exist. Without them, all software, services, and information must be maintained forever, and be accessible to all subscribers to the MatchMaker. However, the implications they have are impossible to underestimate.

Practically, we know how difficult they are to manage. Examples include everything from memory management in computer systems, to cancelling a credit card only to find direct payments for other services are also cancelled, to the problems of unlisted telephone number and services such as caller id.

### 5.2.2 Basis for payment - Offers - Users, Providers, and MatchMakers

Here, the MatchMaker has a buy/sell relationship with both the User and the Provider. Since other MatchMakers could exist, offers are treated as information; the MatchMaker is treated as an information service.

Because there are two different classes of customers (Users and Providers) and the MatchMaker is selling rights to each of them, the MatchMaker must have policies for managing these rights when they interfere with each other. In its Manager role the MatchMaker must ensure that these policies are enforced. Information needed to enforce these policies needs to be kept somewhere; possibly in the offers, possibly not.

There are several issues here. For example, if A runs a MatchMaking service and subscribes to B's MatchMaking service, can A simply offer B's listings, i.e. reuse B's information? If A builds a service based on a particular service offered by B, and B ceases to offer that service, what are B's obligations to A?

The MatchMaker can choose to sell or grant certain rights to Users. For example, a MatchMaker may be able to generate sufficient revenue through fees charged to Providers, if the pool of Users is large enough. However, the MatchMaker may charge Users, if the Users are willing to pay for its information.

In the following four subsections: right to observe; right to block observation; right to copy; right to block copying; the Factory has the same roles as the Service User. To save space, the Factory is not explicitly listed in the bullet items.

#### 5.2.2.1 *Right to Observe Offers*

This is simply the right to view the information in the MatchMaker. This becomes a bit complicated because one agent may purchase rights to resources on behalf of another agent.

- MatchMaker sells to User
- MatchMaker grants to User
- Regulatory Authority grants to User
- MatchMaker sells to Provider
- MatchMaker grants to Provider
- Regulatory Authority grants to Provider
- MatchMaker sells to Provider the right for some Users

It is reasonable to assume that a MatchMaker would grant a Provider the right to observe its own offers in the MatchMaker. However, what rights the Provider has to observe other offers is a policy decision of the MatchMaker.

Again, here the same categories arise as in right to use service, 5.2.1.3, as to just how to package what is sold. For brevity, these options are not listed with the above bullets.

### 5.2.2.2 *Right to block observation of Offers*

Again, one agent can purchase this right to block unwanted information from itself, or to block the observation of information by other agents.

- MatchMaker sells to User
- MatchMaker grants to User
- Regulatory Authority grants to User
- MatchMaker sells to Provider
- MatchMaker grants to Provider
- Regulatory Authority grants to Provider
- MatchMaker sells Provider the right to block access to offers to particular groups of Users.
- MatchMaker grants Provider the right to block access to offers to particular groups of Users
- Regulatory Authority insists MatchMaker block access to offers to particular groups of Users (business or government secrets)

The User may not want to be bothered by certain types of offers, (Video Nasties), and be willing to pay NOT to see them. Governments may have to grant Users the right NOT to be flooded by certain types of offers, (junk mail).

### 5.2.2.3 *Right to Copy*

To use a service listed in the MatchMaker, an agent needs the right to copy at least parts of the Offer. The interface reference must be copied by the client in traditional trading services.

- MatchMaker sells to User
- MatchMaker grants to User
- Regulatory Authority grants to User
- MatchMaker sells to Provider the right for Users
- MatchMaker sells to Provider
- MatchMaker grants to Provider
- Regulatory Authority grants to Provider

Discussion under right to observe, 5.2.2.1, involving one agent purchasing rights on behalf of another, is pertinent to this section, as well.

### 5.2.2.4 *Right to Prevent Copying*

Offers, like other information, are valuable. Their value may increase or decrease depending on how their copies are used.

- MatchMaker pays Provider for the right to prevent others from copying/ listing offers (exclusive offer)
- MatchMaker prevents other MatchMakers from making copies of offers
- MatchMaker sells to Provider the assurance the other MatchMakers won't copy/list offers
- MatchMaker prevents User from copying offer, except as needed to use the service

Service Providers most likely want some control over who can and cannot make service offers on their behalf. MatchMakers also may want to right to have exclusive offers.

In order to use a service, the User may need to make a copy of the service offer. Thus, Users are not prevented from making copies of offers, to use the service.

### **5.2.3 Basis for Payment - Offers - Providers and MatchMakers**

The next sections address the buy/sell relationship between the MatchMaker and the Provider. At stake here are the rights to create, remove, register, and refuse to resister offers.

#### *5.2.3.1 Right to Create*

Only Providers have the right to create offers. It is possible to grant this right to the Factory as well, but that adds complexity without adding insight.

- Service Providers have the right to create offers

#### *5.2.3.2 Right to Remove*

Either the MatchMaker or the Provider must be able to remove an offer. Each needs the right for clear business reasons.

- Provider can remove an offer.
- MatchMaker can remove an offer under prearranged circumstances.

Removing offers from the MatchMaker gives rise to many subtle issues. The major ones include: what to do about dependencies of other service offers on one that is removed; what kinds of notification etc., are required; should duration of the validity of an offer be part of its specification; who is responsible for the consequences of an offers removal?; etc. Due to the complexity of these issues, and the fact that different enterprises handle them differently, they are only mentioned here.

#### *5.2.3.3 Right to Register*

Before an offer can be listed in a MatchMaker, it must be registered. The registration process provides the MatchMaker a means of ensuring certain conventions are obeyed.

- MatchMaker sells to Provider
- MatchMaker grants to Provider
- Regulatory Authority grants to Provider
- Regulatory Authority insists MatchMaker sell to Provider

#### *5.2.3.4 Right to block Registration*

If an offer or the service it offers doesn't meet the criteria for registration, it should not be allowed in a MatchMaker. However, if a MatchMaker offers sleazy services, repudiable Providers may not want their offers listed therein. Finally, Regularity Authorities need to ensure that no discrimination is taking place, either.

- MatchMaker prevents Provider
- MatchMaker sells right to prevent other Providers to particular Providers (don't list competition)
- Provider refuses

- Regulatory Authority prevents Provider

The issue of validity arises between the services and service offers. What requirement is there for the service offers to represent actual services? If such a policy exists, i.e. either the MatchMaker or the service provider guarantees that service offers represent valid services, then the service manager must coordinate with the MatchMaker to ensure that this is in fact the case. This give rise to the obligations for the Service Destroyer role to inform the Offer Remover role about the destruction of any service.

Also, how can the MatchMaker ensure that service offers created by Providers are actually valid. Here, some requirement to demonstrate that such a service actually exists or could be created when needed, is required. This to is a dependency between the Services and the Service Offers. This may be handled by imposing obligations on the Offer Creator role to the Offer Registrar role.

#### 5.2.4 Monitoring Use -- Offers and Services

Another area of rights arises that is not addressed in the previous section: the right to monitor use of either services or offers. Clearly, some form of monitoring must take place for any enterprises internal purposes. However, such information is often very useful to others. To add this kind of information to our enterprise model, we could add another resource entitled "information gained through monitoring". If access to this information is viewed as a service, then one can simply apply the previous discussion on Services and Offers to this case. The same issues all arise.

What is important here is that those being monitored should have the right to know that such information is being collected, and if desired the right to block it being sold or given to others. Hence offers need to include information indicating that this is done.

### 5.3 Authority

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This concern deals with authorization for agents to fulfil certain roles. Here the policy decisions are made based on the purposes of the enterprise. For example, a "MatchMaking Service" specializing in listing on-line children's stories, may choose not to list pornography, etc. A restaurant "MatchMaker" may choose to list only five star restaurants, and so on.

To list all the bindings of roles to agents would be very tedious. The next few sections contain a representative collection of examples of the results of agents acting in particular roles. These roles are obliged to see that the rights to resources in the previous section are maintained.

#### 5.3.1 Authorization to register information in the MatchMaker

- MatchMaker can be in the Regulator role, and permit or prevent registration of Offers
- MatchMaker can be in the Offer Keeper role, and register Offers
- Provider can be in the Regulator role, and register or prevent registration of certain types of Offers in particular MatchMakers
- User can be in the Regulator role, and permit or prevent certain kinds of use specific information that is gathered to be registered in the MatchMaker.

### 5.3.2 Authorization to observe offers in the MatchMaker by the user (viewer)

- The MatchMaker, in the role of Offer Keeper or Regulator, permits or prevents users to view offers
- The user, in the role Observer or Regulator, permits or prevents being shown offers.

### 5.3.3 Authorization to use service provided Provider

- User, in the role of Service User or Regulator, can choose to or refuse to use service provided by Provider
- Provider, in the role of Service Provider or Regulator, can permit or prevent use by User

### 5.3.4 Authorization by Regulatory Authority

Typically Regulatory Authorities are governments, schools, and corporations. These authorities can regulate who sees certain kinds of information (businesses typically choose to block porn lines) or insist on equal access for citizens in areas such as employment opportunities.

- Regulatory Authorities can insist upon, grant, or prevent offers to be registered with particular MatchMakers
- Regulatory Authorities can insist upon, grant or prevent Users observing offers in MatchMakers
- Regulatory Authority can insist upon, grant or prevent Users using services provided by Providers

Here the notion sought after concerning insist upon vs grant is that “insist” means it is given to all members of group without asking, “grant” means that it is given when asked for.

### 5.3.5 Authority to remove information from MatchMaker

- MatchMaker may play the role of Offer Remover, and remove offers from the MatchMaker
- Provider, in the role of Offer Remover, may remove offers from the MatchMaker.

Basically, to remove offers is a very tricky issue. Once an offer is removed from the MatchMaker, what obligations exist on the part of the MatchMaker to inform others, who have already used the MatchMaker to obtain the offer, about it's removal, or to inform the Provider of those who have “obtained” the offer. What length of time is the offer good for, once it isn't in the MatchMaker any more.

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## 5.4 Remuneration

This section deals with the fiscal aspects of this model. The main concerns here are: payment; pricing; accounting; billing; and receipts.

### 5.4.1 Payment

#### 5.4.1.1 “Who Pays?”

Four means exist to pay for Service offers to be listed.

- The User pays the MatchMaker to access the Service Offers
- The Provider pays the MatchMaker to have Service Offers listed
- The MatchMaker pays Providers register Service Offers
- A group (or groups) to which the User belongs pays to have the Service Offers provided to the viewer (Governments, or Employers, for example)

Four ways to pay for the Services exist.

- Service is free of charge
- Provider pays Service Users to use service
- User pays Provider for the use of service
- A group (or groups) to which the User belongs pays the Provider for the User to use the service.

Currently some kinds of information are combinations of these categories. Newspapers are made up of articles, which presumably the readers pay to obtain; and ads, which the advertisers pay to place in the newspapers.

Just as there are entities that will pay to have access, there are those who will pay specifically to deny access. This issue is raised again here, because while one of the above entities is paying to provide access, another could be paying to block access. The policies surrounding these issues need to be worked out.

- Users pay for filtering or blocking of offers or services (don't want to see them)
- Providers don't want particular people to use services, or know about offers, and will pay for the privilege (pornographic movies, secret documents)
- Group (or groups) to which viewer belongs pays to block access to offers and services to members of the group, or to those not in the group (employers explicitly block access to certain kinds of information during work hours, but provide certain other information to their employees)

Clearly, conflicts can arise between these kinds of blocking services, and the services above. Resolving these is not an issue to be addressed here; such conflicts are identified to indicate how difficult it is to actually honour the various rights paid for. However, it is important to devise generic mechanisms to deal with conflicting services.

#### 5.4.1.2 *Method of Payment*

- Directly (money, electronic money)
- Indirectly (checks, debit cards, etc.)
- Third party (credit cards)

Service Offers need to include acceptable methods of payment.

#### 5.4.1.3 *Time of Payment*

This deals with when payment is to be made, and when it is considered overdue.

- Payment due before service/item is supplied (Up front)
- Pay as you go, i.e. pay along the way
- Pay after service/item is supplied. (Bill for Service) Here since the payment is made after the service/item is supplied, the issue must be

raised of: if the payment is not made at the specified time, when is it considered late?, not made?

Service Offers need to indicate when payment is due, what constitutes failure to meet payment schedule, and penalties that will be levied in case of failure to pay. Some of this could be included in a contract.

#### 5.4.1.4 *Currency for payment*

Service Offers need to indicate the type of currency accepted/offered. They could include exchanges that can be made, so that acceptable currency is used. They could also indicate other Services (or Service Offers) that could transform the currency.

### 5.4.2 Pricing

Service Offers need to include the price of the service.

Since the Service could be offered as part of a package, the Service Offer might include an indication of the Service Offers for the packages that include the Service.

Other pricing options may also exist, the Service Offer might include an indication of the Service Offers with these options.

What is important here is that the technology supporting the Service Offers and Services within a MatchMaker must be flexible enough to support different pricing policies, which could change quickly. The ability to support flexible pricing strategies raises non-trivial questions in the management areas of the engineering and technology viewpoints.

### 5.4.3 Accounting

This involves the keeping of records for remuneration purposes. Just what must be kept track of depends on just how goods and/or services are packaged and sold. However, for internal purposes it may be useful to keep track of more than the minimal amount of information. The information in these records has varying degrees of secrecy; which needs to be indicated as well.

Since what is being kept track of can change, issues of whether it is better to do the minimal job, and change it later, or to keep track of more things so that future changes will be easier to implement arise.

Service Offers need to indicate just what is being charged for, what records need to be kept, what has been paid for, who has access to these various kinds of records, etc.

One aspect of accounting is that the way the goods/services are accounted for determines the kind of monitoring that must be implemented. The kinds of monitoring that are possible/cost-effective to implement also determine how to package and price goods and services.

### 5.4.4 Billing

This is the mechanism for supplying the bill. Various options exist for this, they include:

- Who is responsible for payment?
- Who gets copies of the bill



- What information is placed on bill -- i.e. how is it itemized? again this depends on the business model.
- How often are bills sent, resent, etc.?

#### 5.4.5 Receipt

This has to do with once the bill is paid, how is the receipt handled.

- Who gets copies of the receipt?
- Who is responsible for issuing the receipt?
- What information is placed on the receipt?
- When is receipt sent?

#### 5.4.6 Non-Payment

What constitutes non-Payment for service? What penalties are imposed? How are these enforced? regulated?, etc.

Need some indication of the ramification of the penalties -- this can be tricky as well. For example, if in addition to the offer listing service the MatchMaker handles billing for the information providers, and a customer pays for some services but not others, what penalties can be enforced?

For example if customer paid for the viewing of the offers, i.e. the service offered by the MatchMaker, but for not of the services listed that were actually used, what is a reasonable penalty? Blocking use of those services whose accounts aren't paid? Blocking all access to all services that this errant user must pay for, i.e. he can only view ads? Blocking all access to MatchMaker? No penalty from the MatchMaker?

Here two main issues arise. Technology must be created to support whatever penalties are agreed upon, and technology must be created to minimize the damage to all concerned surrounding issues of non-payment.

What mechanisms are necessary to ensure that a charge will be paid. Thus mechanisms need to be created to insure that the payer has good credit -- this can be based on several things: past history, third party, co-signor, bank account, etc.

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### 5.5 Management or Administer

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#### 5.5.1 Temporal Issues / Duration of offers

Service Offers need to include the times they offer valid services. This could mean:

- time service becomes valid and time service is no longer valid
- time of day, day of week, etc.
- event which makes offer valid and event which makes offer invalid

Service Offers may also include temporal information about themselves:

- time Service Offer was registered,
- time Service Offer will be removed

The basic issue is if an offer is in the MatchMaker then there needs to be some either implicit (service of MatchMaker) or explicit (data in Service Offer)

definition of when the offers in the MatchMaker or “good”. This can range from “no guarantee” to a fixed period of time, to a known event.

### 5.5.2 Service Assurance

Some Services can create congestion or stress on a network. (Media sponsored dial in events, for example) To ensure that the network can handle other services as usual, to use such a service the User may be required to notify:

- Provider
- Regulatory Authority
- Network Manager, if different from the Provider.

From time to time Services will fail or operate incorrectly. Several concerns arise that need to be indicated in the Service Offer.

#### 5.5.2.1 *Who should be notified*

Here, when the Agent is has more than one role, more precise information needs to be supplied. Such information might be an interface reference, a phone number, or a mail address.

- Service User
- Service Provider
- MatchMaker
- Service Manager
- Service Administrator
- Accountant
- Regulatory Authority

#### 5.5.2.2 *Who is responsible for the notification?*

Service Offers need to indicate who is responsible for notifying the various stakeholders.

Again, when the agent plays more than one role, more precise information may be needed.

- Service User
- Service Provider
- Regulatory Agency
- MatchMaker
- Service Manager

#### 5.5.2.3 *Recovery Procedures*

Service Offers may include recovery procedures. These could be anything from indicating Service Offers for recovery services, to phone numbers for help lines. They could also include things that should not be done, such as safety procedures.

### 5.5.3 Dependencies

Because of re-use Services may depend on other Services. Such dependencies can include:

- Service A invokes Service B. To work correctly both A and B must exist and be valid.
- Service A requires that Service B has (not) been previously executed.
- Service A and Service B perform the same function, hence only one should be executed. (Both could invoke a particular billing service, say Service C)
- Service A and Service B are incompatible.
- A particular collection of Services won't terminate, when a user can reasonably expect them to.

Here a particular service may be dependant on other services/ or may have services dependant on it. When services from different Service Providers are combined, it could turn out that as long as each service works correctly in isolation, then neither Service Provider is responsible for ensuring that their combination works the way the Service User expects it to.

Examples include: with a payment scheme of charging items to a credit card, if the credit card is cancelled by the owner of the card (because the card was stolen) are the once a month charges to it no longer valid? if so who should be notified?, the creditor at the time the charge comes around, the card holder at the time of the reported theft? who? when?

These dependencies differ from enterprise to enterprise. However, identifying them so they can be managed is essential to offering Service Users friendly packages of services.

Also, it could be important for things like fault tolerance. If two different services are dependant on the same transport (fax and phone) for example then they will both fail if transport fails.

## 5.6 Summary of information held by MatchMaking services

In the context of each of the above sections, we summarise the information which derives from our enterprise analysis as follows:

- Ownership
  - (i) With respect to the *service*, information about what rights exist to provide, consume, own, duplicate, use, reuse, create, destroy, block or deny access.
  - (ii) With respect to the *service offer*, information about what rights exist to provide, consume, own, duplicate, use, reuse, create, destroy, block or deny access.
- Authority
  - (i) Who has to authority to grant rights to agents?  
(This information is more likely to be enshrined in the MatchMaking service itself, not the offers which are posted there.)
- Remuneration
  - (i) With respect to *payment*, information about who pays, how payment is made, when payment is to be made, what currency is to be used.
  - (ii) With respect to *accounting practices*, information about what usage information is kept and how that information is used.

- (iii) With respect to the *bill*, information about who gets it, what is on it and how often they are sent.
- (iv) With respect to *settlement of bills*, information about what constitutes non-payment, what penalties may be imposed, how are these enforced, what legal system is assumed, what regulations exist.
- Management
  - (i) With respect to *services*, when services are available, where they are available, who will be notified when the service comes into existence, ceases to exist, is moved or otherwise altered (e.g. quality of service changes).
  - (ii) With respect to the *service offer*, time of registration and time of future removal.
  - (iii) With respect to *dependencies between services*, what other services need to exist, what other services should not exist, what compatibilities exist or should exist.

---

## 6 Information

---

This chapter deals with some of the information aspects of the information model for federation. At first sight this may appear as an unnecessarily complex recursion. However, recall that the information viewpoint is about helping elucidate the meaning of interactions [APM.1017]. It therefore follows that this chapter is about the informational aspects of interactions between agents and should be read together with the chapters on computational and engineering aspects.

Three categories of issues are identified in this chapter:

- naming issues
- additional interaction concerns
- language issues

Each is well reported in past work on the architecture and references are supplied where appropriate.

---

### 6.1 Naming

---

Naming issues pervade all viewpoints [APM.1003]. The issue of what names to attach to what entities and those of identity are treated in some detail in chapters 8 to 12 of [APM.1017].

The existence of aliases and synonyms can cause many problems. To use, administer, and manage services correctly, these must be identified.

One way to identify aliases is to require that Offers clearly identify all names that have aliases, and list the aliases. However, if to use the service the User must also supply names of entities, then the User must also indicate names that have aliases, and where to find them. This may not always be possible.

The existence of synonyms also create problems for Providers. Again, indications of what information can be used to resolve them is needed, however in the case of synonyms this may be very difficult to obtain as each synonym is relative to a different context. Context identification is therefore of the utmost importance.

---

### 6.2 Additional interaction concerns

---

When combining services other concerns besides the kind of interface must be considered. Six concerns are:

- Order of Execution;
- Inconsistency or Incompatibility of Execution;
- Nondeterminism;
- Duplication of Processing;

- Removal of Need for Processing;
- Termination.

These issues all arise in many complex software systems, from call-processing software to query processors. What is important, is the need for a “service manager” akin to a query manager that can be used to identify when such situations arise so that corrective actions can take place. If possible, something beyond existing ad hoc methods is needed.

Each of these will be briefly discussed below.

### **6.2.1 Order of Execution**

Some operations can only be combined in particular orders. Thus some indication of which orders are acceptable and which are not is needed. Normally, the order of execution is controlled by the service provider. If the service delivered to a client is made up of several independent services then the client needs to be aware of correct execution orders.

A precedence relation may be needed in service offers which combine several services into one. This needs to include such notions as whether services can logically execute concurrently and whether or not a service can be viewed as atomic.

### **6.2.2 Inconsistency or Incompatibility of Execution**

One service’s logic prohibits the correct execution of another service’s logic. This can happen between groups of services as well, for example a collection of N services may be incompatible, but every group of N-1 services is fine.

### **6.2.3 Non-determinism**

The logic of the execution of a collection of services is non-deterministic; this may or may not matter, but needs to be indicated.

### **6.2.4 Duplication of Processing**

When services are created from other services, both may make use of another specific service. The function of the underlying service is then duplicated when they are combined. This can result not only in inefficiencies from duplication of work; but also in incorrect realization of the combined service. For example, it is important not to duplicate charges to customers.

### **6.2.5 Removal of Need for Processing**

One service, when executed, may remove the need to execute another, or complete the execution of another.

### **6.2.6 Termination**

Repeated execution of one or more services can lead to a variety of looping situations. These must be resolved if the resultant system is to behave in reasonable ways.

---

### 6.3 Language issues

---

Different systems will inevitably use different languages for expressing interface definitions for example. Details of which language is being used to express interfaces to services needs to be present in the service offer. This issue is of importance to all information in the service offer, but is currently most topical in the computational and engineering aspects of the interface specification.

Where differences between service definition languages exist, it is important to examine the options for translating from one form to another. An example of such work is currently being done by the Joint X/Open-NMF Inter Domain Management group (XoJIDM) on translations between GDMO and CORBA IDL specifications and SNMP and CORBA IDL specifications. Another example is the translation of GDMO specifications to ANSA IDL [Gay 94].

---

### 6.4 Summary

---

Naming and language issues are related to the way in which information in service offers may be represented. Only the *additional interaction* concerns translate into extra information which may be included in a service offer.

Six concerns may be included:

- Order of Execution;
- Inconsistency or Incompatibility of Execution;
- Nondeterminism;
- Duplication of Processing;
- Removal of Need for Processing;
- Termination.





---

# 7 Computational

---

## 7.1 Introduction

---

The computational concerns associated with a contract between two parties in a federated open distributed system are addressed in this section.

Although there are many computational models in existence (every programming language as an implicit computational model for a start), few have been made as explicit as the ANSA and ODP computational models [APM.1001] [ISO 94]. Both models are sufficiently close to be considered as one. The ANSA Computational Model was designed with distribution as the primary concern. It is appropriate to consider this model as a complete model for the purpose of the information model for federation.

For the purpose a contract between two parties, only one part of the computational model is of interest: the interaction model.

The ANSA computational interaction model and type system is in two parts; one is applicable to *operational interfaces* [APM.1001], the other to *stream interfaces* [APM.1108]. Recent work has shown how streams and signals can be incorporated into a single computational model with operational interfaces [APM.1108]. For detailed descriptions of the models please use the references.

For the purpose of deriving an information model for federation, a template for each is given below.

## 7.2 Operational interfaces

---

Operational interfaces are used for the usual procedure call style of interactions. Figure 7.1 shows a typical template for operational interfaces.

---

**Figure 7.1: Template for operational interfaces**

---

```
Interface {
  operation1Name (< typed parameter >)
  -> outcome1Name (<typed result >)
  :
  -> outcomenName (<typed result >);
  :
  operationnName (< typed parameter >)
  -> outcome1Name (<typed result >)
  :
  -> outcomenName (<typed result >)
};
```

Operational interfaces contain a set of named operations, each with a set of zero or more typed parameters. Each operation can result in one of several outcomes or named terminations, each with zero or more typed results.

---

### 7.3 Stream interfaces

---

Stream interfaces are used for interactions which use (high bandwidth) synchronised data streams, such as video and voice streams in a multimedia applications.

A stream consists of one or more flows, each with a direction and one or more signals. A typical template for stream interfaces is shown in figure 7.2.

---

**Figure 7.2: Template for stream interfaces**

---

```
Interface {  
  stream1Name (  
    direction (< typed signal >  
  :  
  streamnName (  
    direction (< typed signal >  
  });  
  
  where direction is "<<" or ">>"
```

---

### 7.4 Language issues

---

The notion of a computational model has always been well separated from the notion of a programming language [APM.1001]. To represent an interface specification, it is necessary to make choices about the language which will be used. Information about this choice should be included in the service offer.

The templates above should not be taken as prescriptions for language use, but as language neutral examples of the kind of form in which the relevant information can be placed.

---

### 7.5 Summary

---

Operational and stream interface definitions should be explicit part of the service offer.

---

## 8 Engineering

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In this section we identify the issues associated with the quality of the interactions. These generally translate into so called Quality of service (QoS) guarantees.

This is an area of active research in ANSA [APM.1137] and until a better understanding of the required mechanisms is achieved, not much can be said about what information should be contained in the service description.

---

### 8.1 Quality of service guarantees

---

Quality of service guarantees and means of expressing them are still open and active areas of research. Areas in which quality of service requirements and guarantees will be placed are, for example:

- performance
- dependability
- security
- application specific quality issues which may have a relationships to the issues listed above.

---

### 8.2 Managing Quality of Service

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#### 8.2.1 Monitoring and control

Management is concerned with administering the policies determined by the authorities of the client and server. The difficulty with management in a client and server co-operative venture is that in some cases both sides will want to exercise some monitoring and control facilities of their counter-parts. An important issue which involved management is that of ensuring end-to-end QoS is delivered and checking what has been delivered. This requires the client and server to provide:

- monitoring facilities - for checking that guarantees made are met
- control facilities - to administer the fulfilment of guarantees and selection where options/ranges are available. For example, by requesting the appropriate resources from the other party and ensuring that it is allocated.

Allowing a client or server to request the activation of monitoring or of a control function of their counter-part may require access control and means of authentication.

What is required in terms of matchmaking information is a description of the facilities and interfaces provided by the client and server to allow the other side to obtain the required overall QoS. This means that the information

framework developed in this paper has to be used to describe the management interfaces as well as the service interfaces.

### **8.2.2 Multi-organisational service provision**

When parts of a single service are supported by different organisations special arrangements have to be made to safeguard overall Quality of Service guarantees. From an engineering perspective, all that matters is that there exist mechanism which allow monitoring and control of QoS across organisational boundaries.

### **8.3 Summary**

---

Information about quality of service as well as quality of service management should become part of a service specification.

---

## 9 Technical

---

Distributed application platforms used by the client and servers may differ in many aspects. Those aspects that matter to the successful co-operation between clients and servers (and are therefore important for matchmaking) are described by binding information.

Binding information is the essential ingredient of any service offer which results from a reference seeking query to the Matchmaking service. For this reason, quite a lot of detail is provided in this chapter.

### 9.1 Matchmaking and binding

---

Communications between software components is increasingly hidden from programmers by a procedure call, or method invocation abstraction. The relation between the name of an interface (in which operations can be requested) and the interface instance (with the methods which execute the operations) is often referred to as a *binding*. When an operation request occurs in a different system from method execution, there is a need for external communication between the components.

Before two parties can communicate, it is necessary for there to exist a path along which messages can flow. For remote interactions, this requires common sets of protocols and data encoding. The MatchMaking process helps distribute information about this to binding processes which then try and achieve compatibility before interaction takes place.

In different systems, these processes have been implemented in different ways. The information which is exchanged is not always the same either because different assumptions are made about what needs to be conveyed.

Interacting components increasingly find themselves in different systems. The demand for cross boundary matchmaking and binding is therefore increasing.

### 9.2 Binding information

---

Binding information is bundled in different ways in different platforms. Examples are:

- Interface references in ANSAware [AIM 93]
- Binding handles in the Open Software Foundation's Distributed Computing Environment (DCE) [DCE 93]
- Object references in Orbix [IONA 93] and in OMG CORBA [OMG 92].

The common element in all of these is that they all provide information on the protocols and network addresses which are used at the service provider's location. Beyond this very basic information, there is lots of variation in the kinds of information provided. For instance, in ANSAware interface references one can find service replication information (enabling replication

transparency) as well as information which enables relocation transparency. DCE binding handles do not have this information, but hold a universally unique identifiers for interface and object, as well as interface version information.

In addition to differences in the content of the ANSAware interface reference and the DCE binding handle, there are also differences in the way in which similar information is represented: different data types and structures are used for instance.

### 9.2.1 ANSAware binding information

ANSAware binding information is contained in an interface reference. This consists of four components:

- group data
- a nonce
- for each member in the group a member record
- a sequence of relocator interface references

Each member record consists of a sequence of address records, one for each set of protocols that can be used to access a service. Each address record contains a tuple consisting of

- a protocol identifier
- a protocol address

Protocol identifiers and protocol addresses are names which have meaning within the specific communications network domain (context relative).

The ANSAware interface reference is defined in IDL below.

#### 9.2.1.1 ANSAware IDL description of the ANSAware interface reference

```

BaseTypes: INTERFACE =

BEGIN

-- Identifier used for capsules by both the Factory service
-- and the underlying Capsule library
ansa_CapsuleId: TYPE = CARDINAL;

-- Interface Reference structure

-- Protocol Identifiers
ansa_ProtocolLayers: TYPE = SEQUENCE OF OCTET;

-- Protocol Addresses
-- All octet sequences for addresses must be in
-- big endian, network, byte order
ansa_Address: TYPE = SEQUENCE OF OCTET;
ansa_AddressLayers: TYPE = SEQUENCE OF ansa_Address;

-- QoS offers
ansa_QoSOffers: TYPE = SEQUENCE OF STRING;
ansa_QoSLayers: TYPE = SEQUENCE OF ansa_QoSOffers;

-- Operations to which this AddressRecord applies
ansa_Operations: TYPE = SEQUENCE OF STRING;

```

```
ansa_AddressRecord: TYPE = RECORD [  
  -- Encode all fields in parrallel to conserve space when  
  -- any of these fields are not required.  
  -- layers      - list of named layers provides an index  
  --              into the other fields  
  -- addresses   - address for each layer  
  -- qos        - list of QoS offers for each layer  
  -- operations  - list of operations to which this  
  --              AddressRecord applies  
  
  layers: ansa_ProtocolLayers,  
  addresses: ansa_AddressLayers,  
  qos: ansa_QoSLayers,  
  operations: ansa_Operations  
];  
  
ansa_GroupMember: TYPE = SEQUENCE OF ansa_AddressRecord;  
-- A record for each protocol set used by the server (group  
-- member). If any record contains a multicast network address  
-- then all must.  
  
ansa_MemberList: TYPE = SEQUENCE OF ansa_GroupMember;  
-- Contains the set of addresses to be used for issuing  
-- requests to a group.  
  
ansa_Nonce: TYPE = ARRAY 20 OF OCTET;  
-- The Nonce must be unique for a given interface at a given  
-- location over a long enough period of time to ensure  
-- that messages cannot be mis-delivered to that interface.  
-- Mis-delivery includes:  
-- i) a message for another interface being delivered to  
-- the current i/f  
-- ii) a message for a previous incarnation of the current i/f  
  
ansa_InterfaceRecord: TYPE = RECORD [  
  -- Need one AddressHint for each distinctly addressed sub-group.  
  -- Because multicast addresses may reach multiple members then  
  -- the length of addressList may be less than the cardinality.  
  -- The cardinality is the number of members in the current  
  -- incarnation of a group and therefore defines the number of  
  -- expected replies.  
  -- Whenever the cardinality changes the incarnation is  
  -- incremented.  
  
  -- singleton interfaces have incarnation= 0, cardinality 1  
  -- empty groups have incarnation > 0, cardinality = 0  
  -- single member groups have incarnation > 0, cardinality = 1  
  
  nonce: ansa_Nonce,  
  incarnation: CARDINAL,  
  cardinality: CARDINAL,  
  members: ansa_MemberList  
];
```

```

ansa_InterfaceRef: TYPE = SEQUENCE OF ansa_InterfaceRecord;
-- The first record is for the application interface; subsequent
-- records are for interfaces to increasingly robust locators.
-- If invocation of the application interface using the first
-- record fails to reach the server then the locators are invoked
-- in order requesting a complete new InterfaceRef.

END.

```

## 9.2.2 DCE binding information

Since binding can be performed in different ways in DCE, the components which constitute binding information differ from one situation to another.

Potentially, binding information can encompass the following components:

- An interface UUID (Universal Unique Identifier) that identifies the RPC interface of a called remote procedure.
- An interface version, which identifies a specific generation of the interface.

Version numbers allow multiple versions of an RPC interface to coexist. Strict rules govern valid changes to an interface and determine whether different versions of an interface are compatible.

Together, the interface UUID and version number uniquely identify a given instance of an RPC interface across systems and through time.

- An object UUID, which identifies a particular object upon which an object-oriented remote procedure operates.
- A protocol sequence, which identifies a specific combination of communication protocols.
- Network addressing information, which includes the network address and the transport endpoint of a server.

Clients reference binding information using a binding handle. A binding handle is a reference to binding information that defines one possible binding for a given server.

This binding information includes an object UUID, a string identifying an RPC protocol sequence, a network address, and an endpoint. The object UUID is the universal unique identifier of an object (e.g.: a resource such as a file) on which the remote procedure operates. (It can be `uuid_nil` if no object is specially concerned). The network address identifies a specific host by a string whose format is specific to the network protocol identified in the protocol sequence. An endpoint is a transport-layer address that is specific to the transport protocol identified in the protocol sequence. It gives the server process addressing information. (There exist dynamic and well-known endpoints. See DCE documentation for more details about this [DCE 93]).

A string representation of binding handles can take the following format:

```
obj-uuid@rpc-protocol-seq:network-addr[endpoint]
```

For example:

```
b07122e2-83df-11c9-be29-08002b1110fa@ncacn_ip_tcp:16.20.15.25[2001]
```

Binding handles enable clients to recognize and find servers that offer a given RPC interface (and object). To establish a binding, a client must know the location of a server that has at least one compatible binding handle, which



contains an RPC protocol sequence that correspond to an RPC protocol sequence that is available to the client.

A client can obtain a compatible binding handle from either a directory service or from any string representation of the binding handle.

---

### 9.3 Binding information and Inter-operability

---

The OMG inter-operability initiative is currently looking at the minimal agreement necessary in order to be able to interwork between CORBA platforms. This involves a minimal level of agreement concerning the structure of the binding information to enable different platforms to recognize when they are dealing with information from a foreign platform.

Thus, what is necessary to enable Inter-operability between different platforms are:

1. an indication of the origin of the object pointer to enable it decoding.

The extended binding domain interface references must identify not only an interface name but also carry some indication of the binding domain (e.g. "ANSAware" or "DCE") to which they are relevant. These extended interface references conform to the ANSA naming model, insofar as they are context relative [APM.1003].

The use of this type of context relative naming is proposed as a means to allow the interoperation of CORBA Object Request Brokers (ORBs) in [ICL 94].

2. an indication of the formatting information or where to find it
3. an indication of the "on the wire format" in which (1) was encoded.

In addition, the client and server platforms have to include the mechanisms to deal with foreign interfaces and platforms. This can be done by using gateways or having platforms with multiple protocol stacks [ICL 94].

---

### 9.4 Summary

---

Detailed binding information should be part of a service specification.

For *interoperability*, information about the object reference source, the formatting of the binding information, and the on-the-wire format.



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## 10 Video on demand scenario

---

Video on demand is a service by which a consumer can electronically order a video at any time of the day or night and have that video screened immediately or at any specific time chosen by the customer. It eliminates trips to a video shop and any tape handling, but otherwise offers the same functions available from a video player via a remote control. Video on demand is a much talked about topic. It is a scenario which is easy to comprehend, since it is essentially distributing a function traditionally provided by a single piece of consumer electronics (viz. the video player).

The video on demand scenario concerns several players in different organisations all of whom will want to cooperate to offer a service to a customer. There is diversity of technology as well. In short, there is scope for exposing many issues which are pertinent to federation and trading.

### 10.1 Problem statement

---

In the Information Superhighway customers can seek for a video on demand service. The search for such a service and the negotiation which is required to become a subscriber can be handled completely in the context of the Information Superhighway itself. This places severe constraints on the speed and flexibility of service provision, requires support for electronic advertising, and places a different emphasis on the way in which dissimilar systems may be federated. It will also require rather expensive equipment at (potential) customer's sites.

Our scenario, assumes more mundane terminal equipment, as shown in Figure 10.1. A telephone is used for conveying the wishes of the consumer to the service provider. A wide band medium (cable) is used to serve the customer (with video in this case). In the short to medium term this is more realistic since much of this infrastructure is already in place. Also, terminal equipment at the customer site is cheap, resulting in better take-up of new services.

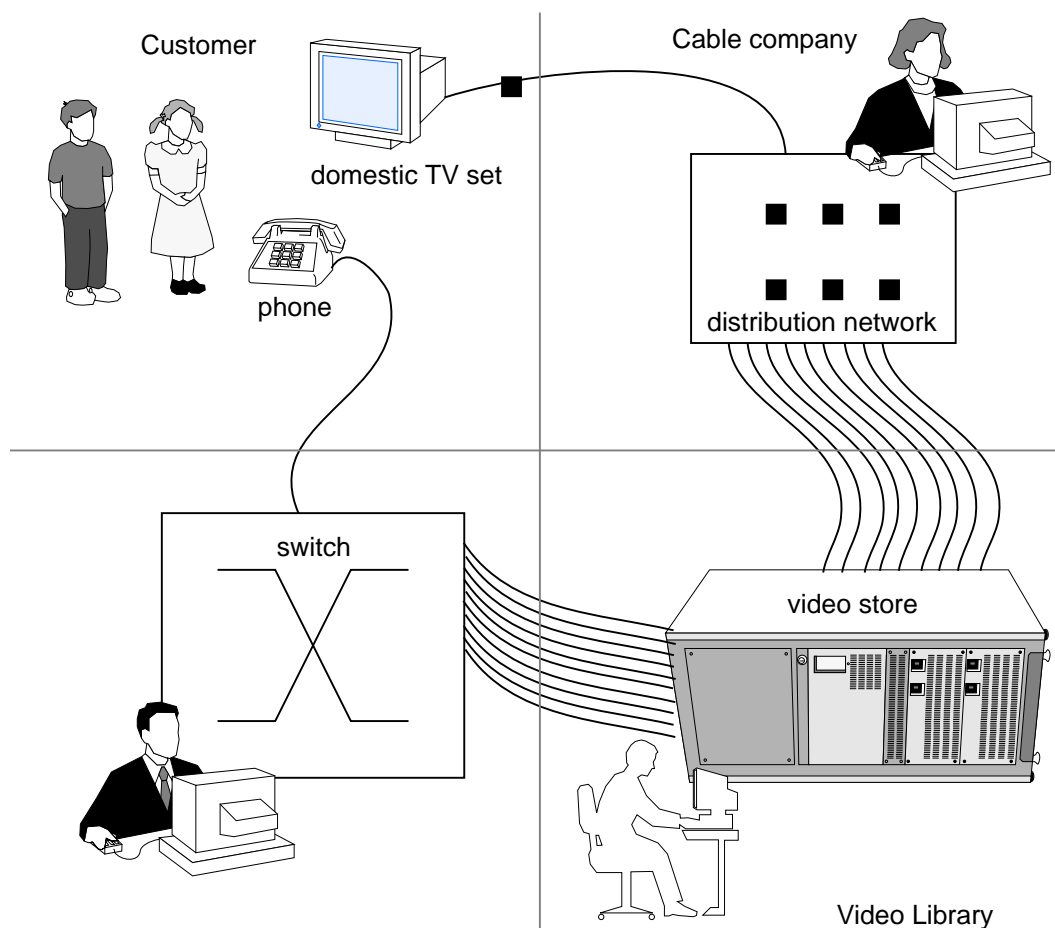
One customer for instance has a phone and a cable connection. She possesses a decoder and a television, a credit card account which she wants billed, and an interest in particular types of video films. She also wants to be able to block the screening of video nasties, and have access to her account to see how much is owed at any one time.

There are many different video on demand services available. Different decoder technologies are in use, different compression algorithms, different picture sizes and qualities, different charging schemes, and a host of additional facilities.

From the point of view of our customer, the only way to find out about differences between her requirements and those on offer is by being informed about the other services. The information provision takes the form of

(unsolicited) advertising and (solicited) browsing amongst the services available via the cable.

**Figure 10.1: Agents and equipment for basic Video on Demand service provision**



Once our customer has become a subscriber (is this necessary?) she will want to negotiate the particular films which will be shown. For this she uses the telephone to contact the video library. The phone is also used to direct the search through the title index. The titles and any other information are displayed on the television screen. A code on the phone can be used to view a set of film clips, further helping the selection process.

Once a film has been selected, it can be watched beginning to end (the phone connection is no longer needed in that case). If the customer wishes to interact with the player, several scenarios exist:

The interactions concern replay, pause, slow motion, stop, etc. Depending on the technology supplied, these signals can be processed locally or remotely.

When processed remotely (at the video server) then the phone connection can be kept open and commands are passed this way. If phone connections can be made quickly enough, it is possible to envisage a connectionless transport service as a basis for transmitting commands from the customer to the remote video server.

When processed locally, the local terminal will need to contain memory of some sort (chips, disc, or tape) onto which a film can be downloaded much

more quickly than it can be viewed. The local terminal (or video recorder) can then be used to control replay.

There is an obvious connection between these technological solutions and the (enterprise) issue of being able to obtain a copy of a film on a tape. The tape, once made, may be replayed several times, possibly with different audiences, hence devalue-ing the video on demand service.

We will (at least initially) assume that both video on demand service provider and user have prior agreements with the cable and phone companies, so that we can start with a simple two party negotiation between VoD service provider and user.

---

## **10.2 Analysis of the scenario**

---

The video on demand scenario is being analysed in the DTI sponsored Enterprise Computing Project. This analysis is done in terms of agents, resources and activities with their respective and mutual relationships. This analysis has not yet been completed.

The following chapter presents the results of the preliminary analysis of the scenario, done in terms of the ODP viewpoints and the classification of boundaries presented under the first deliverable for Federation in Phase 3 [APM.1193].



---

## 11 Analysis by property

---

This analysis follows the boundaries set out in [APM.1139]: “Boundaries and Domains”. It provides a real example to the abstractions derived in that paper.

We analysed the VoD example with respect to the distributed systems properties as follows:

- **authority**: who can see (the service or its results)
- **management**: who administers the service(s)
- **remuneration**: who pays (for access or for the result of provision)
- **service access**: how do I get access to the service? (config, i/f, infrastructure)
- **ownership**: who owns the service or its results?
- **semantics**: how is the result of the service provision (to be) used

In each case we attempted to break up the analysis according to the ODP viewpoints.

We also identified the principal stakeholders:

- supplier (of information)
- viewer (of information and videos)

In addition there are other stakeholders too; e.g. all agents in between supplier and viewer (e.g. in value chains). The cable and phone companies, as well as a credit card agency, are important examples in this particular scenario.

### 11.1 General issues

---

These general issues are brought out to foster a feel for the environment in which MatchMaking information is to be exchanged. The issues are not ordered, not complete, and not accurate. The analysis later on is to provide the detail and rigour which is necessary.

Two levels of matchmaking exist:

1. matchmaking for a video on demand service within the context of the telephone and cable connections; the result is the availability of a video on demand service with particular properties;
2. matchmaking for a film within the context of a particular video on demand service; the result is the service delivery (display of the film).

At the first level, negotiation is required about those things which will hold true over (a significant part of) the life of the subscription, such as:

- the connection technology
- terminal equipment: real time replay or caching (= copy)

- control (e.g. pause, replay, etc.) - if static for all films
- video compression (one or several - if several then further negotiation needed at the second level)
- charging policies
- barring of certain classes of films (perhaps at certain times).

At the second level the conditions under which a particular film will be watched must be negotiated:

- how much does this particular film cost to view?
- how do I pay for this viewing?
- how much control do I have (e.g. pause, replay, etc.)?
- what audio and video qualities apply (related to compression techniques)?

Two kinds of information are being transferred at each level of matchmaking:

1. Information about the connection technology (binding information?); for instance, the customer must know the phone number of the video on demand library, the library must know what frequency channel on which cable segment to use and what compression/encoding to use for this customer.
2. Information which is more application oriented.

The next sections analyse these issues in much greater detail.

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## **11.2 Service access: Interfaces**

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### **11.2.1 The Matchmaking service and the potential VoD user**

#### *11.2.1.1 Purpose of interactions*

To select a VoD service and a video library with particular properties.

#### *11.2.1.2 Meaning and context of interactions*

The matchmaking service in use by the potential VoD service user is the context of all interactions.

#### *11.2.1.3 Structure of interactions*

The interactions regarding the selection of a video on demand service from those available on the cable/phone system can take many forms. Here it has been assumed that these are inter personal interactions between the video on demand library and the service user.

#### *11.2.1.4 Quality of interactions*

The speed of visible response (via cable and tv) after selection (by phone) is important from the user's point of view. The VoD server will need to be able to handle the workload for a set number of users concurrently.

#### *11.2.1.5 Technology issues:*

Components here are the decoder, television, phone, and possibly the video library database of titles and films.



## 11.2.2 The VoD service provider and user

### 11.2.2.1 Purpose of interactions

The purpose of the interactions is to provide or to have access to the VoD service, to select films, to watch them with or without control over screening.

### 11.2.2.2 Meaning and context of interactions

The context of the interactions is formed by a particular VoD service offered by a particular VoD service provider, consumed by a particular service user.

### 11.2.2.3 Structure of interactions

Two interaction structures are needed:

- an operational interface to control the replay process
- a stream interface to screen the video.

The interface specification for the VoD service is in figure 10.1.

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**Figure 11.1: VoD service interface specification**

---

```

Interface Mode {
  select ( ) -> (Select: select)
  -> no_channel ( )
  -> no_account ( )
  play ( ) -> (Play: play)
  -> no_channel ( )
  -> no_account ( )
  bill ( ) -> (Bill: bill)
  -> no_channel ( )
  -> no_account ( )
};

Interface Select {
};

Interface Play {
  play ( ) -> ( )
  fast_forward ( ) -> ( )
  rewind ( ) -> ( )
  slow ( ) -> ( )
  frame_advance ( ) -> ( )
  to_start ( ) -> ( )
  to_end ( ) -> ( )
  stop ( ) -> ( )
  mode_select ( ) -> (Select: select)
  mode_bill ( ) -> (Bill: bill)
};

```

The structure of interactions follow a question and answer format with selection from lists at each stage until a selection of a watchable item, which may include a film clip, a trailer, or a complete movie.

Operational interfaces which do not have results in the operational definitions have their results expressed in changes in the AV signal in the video stream.

The selection interface has not been specified.

#### 11.2.2.4 *Quality of interactions*

The response to commands in the operational interface must be visible on the screen within acceptable delay. Audio and picture quality in the stream interface may be selectable.

The following is an example of the possible contents of an ANSAware interface reference for the VoD scenario. The type of protocol which can be expected to be used in such an application will be:

- MPEG - presentation level - an encoding standard for motion video
- ATM protocol, e.g. AAL5, VBR Service
- options which can deliver the requirements of video transmission are (probably determined on a cost basis):
  - broad band high performance network (B-ISDN, for example)
  - cable or phone wires for home video.

This will require the client to have the appropriate protocol stack and engine. The match making between the client and server can be carried out by a matchmaking service or by the binding agents of the client and server.

#### 11.2.2.5 *Technology issues:*

The video server with operational interface mapped to POTS and stream interface mapped over decoder, television and cable. At the service user end there may be a caching device with associated replay controls. This may be a local video recorder (but see authority issues: a need to avoid copying).

### 11.2.3 **Other agents or stakeholders**

Cable and POTS providers need to be able to transport data at rates appropriate for the VoD application.

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## 11.3 **Authority**

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There is a distinct difference between the VoD service itself and the results it produces. These will therefore be treated separately.

### 11.3.1 **Authority over the service (offer)**

#### 11.3.1.1 *Purpose of interactions*

The VoD service provider makes the VoD service visible to potential service users. The purpose of the VoD service provider is to encourage use of the service, so as to generate revenue.

The service provider reserves to right to refuse service to anyone, upon it's own discretion. There is no need for hiding service offers to achieve this goal.

The VoD service user has no authority over the VoD service offer.

The VoD service user has the right to use the results of a search in a directory for private purposes only. (this applies to directories holding VoD services as well as to directories of films in the context of a particular VoD service.) The results may not be used to provide further services on any carrier.

The cable company (as an agent) publishes the service offer on behalf of the VoD service provider in its directory of services. The cable company has a policy to only publish information about those VoD services it considers suitable, and whose services are likely to be in demand.

The cable company does not discriminate amongst its subscribers: they can all find out about all VoD services.

#### 11.3.1.2 *Meaning and context of interactions*

The context in which the service is made visible generally is a business context in which (unsolicited) advertising persuades potential service users to use this VoD service rather than another. In the general case there is no limit on the visibility of advertising material.

If a service is on offer in the context of a particular cable operator only, then advertising may be limited to the community of subscribers, specially if advertising costs money. It may be linked with the advertising for the cable company.

#### 11.3.1.3 *Structure of interactions*

The structure of the interactions is generally broad- or multicast. However, if an agent (e.g. a matchmaking service provided by the cable company) is interposed it will be structured as two request-response pairs.

#### 11.3.1.4 *Quality of interactions*

The service offer must be an accurate description of the VoD service.

The service offer must include information about the service and the results of delivery of that service.

#### 11.3.1.5 *Technology issues:*

Service offers can be directed at potential service users e.g. by (e-)mail or placed in strategic services, such that a potential service user (or his agent) will notice its existence. A matchmaking service is such a strategic service.

### 11.3.2 **Authority over results of service delivery**

#### 11.3.2.1 *Purpose of interactions*

The VoD service provider aims to satisfy the legitimate VoD service user so that he will come back for more and encourage others to join or do the same. (Only those who contribute to the VoD service providers welfare are classified as legitimate VoD service users.)

The VoD service user and provider must negotiate over the kinds of material which may be made available and when. A block on X-rated movies during the day time may be requested by the user and must be imposed by the provider.

The VoD service user has in general no authority over the results of service delivery. He may not tape and redistribute material obtained from the VoD server for instance, or provide a directory service based on cached search results (as mentioned earlier).

The VoD service provider will be subject to regulations governing such things as:

- the movie rating system imposed by government
- legislation regarding the broadcasting of copyright material.

#### 11.3.2.2 *Meaning of interactions*

The context is the VoD service itself, one in which the VoD service user selects films and other materials.

#### 11.3.2.3 *Structure of interactions*

The structure of the interactions is bi-directional. Selections can be made through the operational interface at the VoD server, whilst the results of these selections are made visible through the audio/video stream interface. The interfaces are defined later (see section 11.2).

#### 11.3.2.4 *Quality of interactions*

Information on which decisions are made as to which film to watch must be both accurate and complete. This will allow the service user to en-act its policy with regard to the kinds of films which he may wish to bar.

#### 11.3.2.5 *Technology issues*

Considerations in this viewpoint include caching technology which prevents copies being made for instance.

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## 11.4 **Management**

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### 11.4.1 **QoS management for the VoD service offer**

#### 11.4.1.1 *Purpose of interactions*

The purpose is to maintain the quality of the service on offer.

#### 11.4.1.2 *Meaning and context of interactions*

The context for interactions is formed by any one to one relationship between a service provider and a service consumer.

#### 11.4.1.3 *Structure of interactions*

See access (section 11.2).

#### 11.4.1.4 *Quality of interactions*

None identified.

#### 11.4.1.5 *Technology issues*

None identified.

### 11.4.2 **QoS management for the VoD service result**

#### 11.4.2.1 *Purpose of interactions*

The purpose is to select the appropriate quality of service at the start of a session.

For example, clients want to specify the quality of the picture they are expecting. This may be a combination of the quality by which the film was made in the first place and also of the jitter of the transmission line (also a performance issue).

#### 11.4.2.2 *Meaning and context of interactions*

The context for interactions is a session.

#### 11.4.2.3 *Structure of interactions*

See access (section 11.2).

#### 11.4.2.4 *Quality of interactions*

A service provider may specify performance by:

- carrier performance, e.g. the network *bandwidth* and also *jitter* in case the viewing is done at real time
- receiver performance: if the service provider sends information at a certain rate it may want assurances that the client can actually deal with the information either by storing or displaying it at real-time. Since the time the link between the client and server is open may effect the cost of the service this may be of importance to both parties.
- The server may impose a restriction on the level of re-transmission acceptable to it as part of its matchmaking requirement of the client. It is up to the server as to how to react if, for example, the re-transmission requests from the client exceed the specified rate.

The quality of interactions need to be managed. With parts of the service being supported by the Cable Operator and the Telephone Company it is necessary to construct a monitoring system which can detect and correct quality of service failures. The contract between the customer and the video library will stipulate certain response times (e.g. slow motion, frame advance etc. need to work as if a local video player was being used).

#### 11.4.2.5 *Technology issues*

Resource allocation algorithms which will guarantee resources as and when needed need to be considered here.

## 11.5 **Remuneration**

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### 11.5.1 **The VoD service (offer)**

#### 11.5.1.1 *Purpose of interactions*

The potential VoD service user has free access to service offers made by VoD service providers. (This may have to be moderated by time of access: early evening searches may be charged for to even out resource bottlenecks.)

The cable company charges VoD service providers for service directory entries.

#### 11.5.1.2 *Meaning and context of interactions*

All interactions are with the sole purpose of finding out about video on demand services and their properties.

### 11.5.1.3 *Structure of interactions*

Since no charges are levied to customers, no interactions need be specified.

### 11.5.1.4 *Quality of interactions*

No guarantees are given.

### 11.5.1.5 *Technology issues*

No specific technology issues arise.

## 11.5.2 **The VoD service results**

A simple model is assumed as a first step: payment after use and Mondex type payments, no credit cards.

A second scenario would extend this and require payment by credit or charge card before use.

### 11.5.2.1 *Purpose of interactions*

The VoD service provider sets and publishes charges for viewing the films in its catalogue. The charge is seen as a property of the service offer (the service being the display of the film). Charges will vary with the amount of control a user wishes to have over the display: many repeat and slow motion requests will push up the price for a viewing.

The VoD service user enters into a contract, agreeing to pay the charges attached to a film's viewing, upon selecting a film for display.

The VoD service provider will be subject to regulations governing such things as:

- royalties which performers must receive from displays of their artistic efforts.

### 11.5.2.2 *Meaning and context of interactions*

The charges are set in the context of a fixed monetary context (in the UK this is the pound sterling for the time being!).

Payments are expected to be made for services delivered. The display of a film is considered delivery of a service.

### 11.5.2.3 *Structure of interactions*

The exchange of accounting, billing, payment and optional receipts are based on payment after use, as follows:

1. VoD user uses the VoD service
2. VoD service provider accounts for this use (logs frequency and time of events) and translates accounting details to a bill stating a value in an agreed monetary system
3. VoD service provider sends the bill to the VoD service user
4. VoD service user sends payments in the form of monetary units
5. VoD service provider accounts for the receipt of payments
6. VoD service provider sends receipt (possibly on demand by the VoD user)

The italics above indicate information transfer between VoD service provider and user.

#### 11.5.2.4 *Quality of interactions*

The exchanges between VoD service provider and user with respect to accounting, billing, payment and receipt acknowledgement require the following quality of service guarantees:

- service use: see access
- sending a bill: need not be reliable, it can be repeated.
- payment & money transfer: needs to be atomic and preferably reliable
- requests for receipts need not be reliable; they can be repeated
- sending of receipts need not be reliable, it can be repeated

#### 11.5.2.5 *Technology issues*

The simplest technology just delivers the basic VoD service over the telephone and cable networks. All accounting, billing, payment and receipt generation is done using well established banking services

### 11.5.3 **Other agents or stakeholders**

Cable and POTS providers must be rewarded for carrying the data at appropriate rates.

Credit card companies may act as agents for the fund transfer between VoD service provider and consumer.

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## 11.6 **Ownership**

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### 11.6.1 **The VoD service offer**

#### 11.6.1.1 *Purpose of interactions*

The service offer is owned by the VoD service provider.

**Right to create:**

VoD service offers are created by the VoD service provider or its agents.

**Right to destroy:**

The VoD service offer as entered in the directory may be destroyed by either the service provider, its agents or the authority which governs the directory service.

A copy of a VoD service offer may be obtained by a VoD service user, usually from the directory. This offer may be destroyed by the service user.

**Right to modify:**

The VoD service provider has the exclusive right to modify its service offer, but will be constrained to do so without upsetting VoD service users.

**Right to copy:**

The VoD service provider may make copies of the VoD service offer so that it can be inserted in multiple directory services.

Each directory service may make copies in pursuit of more reliable or more available directory services.

VoD service users may only make private copies of VoD service offers, thereby reducing their own need to return to directory services. They may not copy VoD service offers with the aim to distribute these to other users for commercial purposes.

#### 11.6.1.2 *Meaning and context of interactions*

The VoD service offer is valid in a context set by the combination of the matchmaker and the service provider.

#### 11.6.1.3 *Structure of interactions*

A VoD service offer is treated as an interface in the ANSA computational model.

#### 11.6.1.4 *Quality of interactions*

A VoD service offer is treated as an interface reference in the ANSA engineering model.

#### 11.6.1.5 *Technology issues*

No special issues emerge.

### 11.6.2 **The VoD service result**

#### 11.6.2.1 *Purpose of interactions*

The presentation of results of VoD service provision do not transfer ownership of the material. As with any other entertainment material, the “purchaser” may be said to own the media on which the material is held, but not the material itself. In traditional systems, the ownership of the media is combined with the right to repeat the presentation of the material held on it (until the media wears out). With Video on Demand there is no media, and all that is paid for is the result of the performance.

##### **Right to create:**

The material which results from VoD service provision cannot be created by any of the parties of interest in this model.

The VoD service provider obtains access to copies of material and the rights to display this material.

##### **Right to destroy:**

The VoD service provider has the right to destroy the copies of material it holds in its library.

##### **Right to modify:**

None of the parties of interest in this scenario have the right to modify the material which results from VoD service provision.

Virtual modification may be allowed within the possibilities of such facilities as interactive CD (CD-I).

##### **Right to copy:**

The VoD service provider has the right to copy material only in pursuance of providing the quality of service negotiated with its service users (particularly availability).

The VoD service user may not make copies of the material obtained as a result of VoD service provision.

#### 11.6.2.2 *Meaning of interactions*

The interactions are all in the context of the contract agreed between the VoD service provider and the consumer.

#### 11.6.2.3 *Structure of interactions*

See access (section 11.2).



11.6.2.4 *Quality of interactions*

See access (section 11.2).

11.6.2.5 *Technology issues*

See access (section 11.2).



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