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Issue Status: Publicly Released

TINA Business Model and Reference Points

Version: 4.0

Date of Issue: May 22, 1997

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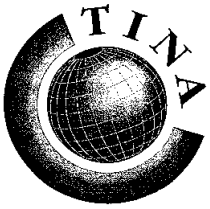

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Networking
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TINA-C Baseline

Issue Status: Approved Public Version

TINA Business Model and Reference Points

(formerly TINA Reference Points)

Version: 4.0

Date of Issue: May 20, 1997

Abstract: This document defines the business model and reference points in TINA. It includes the definition, the concepts, the list of TINA reference points, and the template used for their specification.

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Stream:	**Integration**
Workplan Task:	**Business Model & Reference Points**
File Location:	**/u/tinac/97/integration/viewable/bm_rp.ps**

Extended Abstract

This document defines the business model and reference points used in the Telecommunication Information Networking Architecture (TINA).

The business model defines a framework to specify reference points and propagate requirements on a TINA system. It provides the machinery to specify, add and modify reference point and business roles in a TINA system.

A TINA system is based on distributed computing (DPE). The implementations of the service architecture and the network resource architecture are applications that run on the DPE, i.e., they belong to the application layer of TINA. The reference points specifications describe the interactions between these applications as well as the supporting DPE platforms in all of the viewpoints used by TINA.

Reference points specify TINA conformance requirements. To claim conformance to TINA, one or more of the reference points have to be acknowledged. An implementation can conform to these reference points and conformance to the reference points can be tested.

The document includes:

- The concepts and framework for business roles and reference points (section 2.2, section 2.5, section 3).
- The identification/definition of an initial set of reference points (section 2.3, section 2.4).
- The template that is used for the specification of each of the reference points (section 4).
- High level description of, or reference to the initial set of reference points (section 5, section 6)

Two types of reference points are defined; inter-domain reference points and intra-domain reference points.

Inter-domain reference points: This type of reference point can be described as the specification of interoperability requirements between business administrative domains. The following inter-domain reference points are currently being specified in TINA based on the identification of initial business roles and business relationships in TINA:

- Retailer inter-domain reference point (Ret) (detailed specification in TINA document [8])
- Broker inter-domain reference point (Bkr)
- Third-party inter-domain reference point (3Pty)
- Retailer-to-retailer inter-domain reference point (RtR)
- Connectivity service inter-domain reference point (ConS) (detailed specification in TINA document [9])
- Terminal connection inter-domain reference point (TCon) (detailed specification in TINA document [10])
- Layer network federation inter-domain reference point (LNFed)
- Client-server layer network inter-domain reference point (CSLN)

In figure 1 the business model used for the initial set of TINA reference points is illustrated; this model shows five “key-business areas” between which relationships are identified. The selection of these business roles is based on both the ODP Enterprise viewpoint, the fundamental architectural properties of TINA and market analysis. The business relationships in the business model are used to identify/define the application related inter-domain reference point parts.

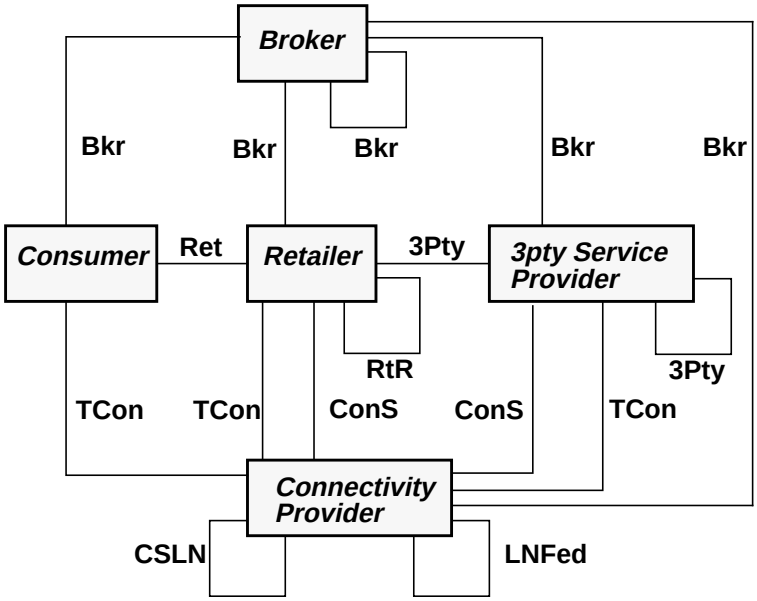

Figure 1. The TINA initial business roles and business relationships

Intra-domain reference points: This type of reference point can briefly be described as specification of conformance requirements for interoperability between components that interwork within an administrative domain.

The following intra-domain reference points have been defined:

- Terminal intra-domain reference points (Term-RP)
- End-to-end communication intra-domain reference point (EECom-RP)
- Network management layer intra-domain reference point (NML-RP)
- Element management layer intra-domain reference point (EML-RP)
- Connection management configurator intra-domain ref. point (CMC-RP)

To identify intra-domain reference points, the computational object model of TINA is used (see figure 6-1). Intra-domain reference points are a set of interfaces identified because they are the most likely to be provided by different component vendors.

The intra-domain reference points as well as the inter-domain reference points can be used as conformance requirements to vendors who want to provide components that can be used to build a TINA system.

Table of Contents

1. Introduction

The purpose of this document is:

- To define the mechanisms that rule the interaction between business roles in TINA. This will allow the creation and enhancement of TINA business roles and reference points (Chapter 2, Chapter 3 and Chapter 4), basically the ‘HOW’ of TINA business roles and reference points,
- To identify the first set of reference points likely to be used in implementations of TINA (Chapter 5 and Chapter 6), basically the ‘WHICH’ of TINA business roles and reference points.

Applying both will guarantee that TINA is an open architecture.

The ‘Business Model and Reference Points’ document was created after the TINA architecture had been defined. It does not intend to modify the existing TINA concepts and principles as defined in the architecture (TINA-C documents [4], [5], [6]). It aims at giving an additional structure which eases the application of TINA in a multi-stakeholder, multi-vendor environment. It does so by defining the interaction between business administrative domains in terms of contracts, business roles, business administrative domains and reference points. It also provides a framework for the definition of these reference points and a set of high level descriptions of the initial reference points. The actual definition of the reference points in terms of the informational objects and the computational interfaces it exposes is done in separate documents (TINA-C documents [8], [9], [10]), defining the prescriptive part of TINA to allow conformance testing (see Section 3.1 on page 3-29) of reference point implementations and guarantee interoperability between stakeholders as well as vendor equipments.

Document History

This version of the document adds a more formal business model to the previous version (v3.1) of the document to highlight the flexibility of the concept of the TINA reference points.

Audience

This document is targeted to:

- TINA-C member companies that want to operate a system that acknowledges conformance to TINA prescriptive specifications and
- TINA-C member companies that want to implement systems (or components of systems) that acknowledge conformance to TINA prescriptive specifications.

2. The TINA Business Model

2.1 Scope of the Business Model

The TINA Business Model is based on both the ODP Enterprise viewpoint (see 'RM-ODP viewpoints in TINA context' appendix A on page 51), the fundamental architectural properties of TINA and market analysis and provides the means to apply TINA in a multi stakeholder environment.

The TINA Business Model specifies:

- A common business framework (chapter 2.2) for all TINA players. It defines a set of conditions under which the following can be done:
  - The creation of new business roles and reference points, so they will be able to interwork with existing ones,
  - The enhancement of existing business roles and reference points to cope with the changing roles (needs) of TINA players using already defined and implemented reference points.
- An initial set of business roles (chapter 2.3) and business relationships (chapter 2.4) to apply the TINA methodology using the present day drivers for the Telecommunication and Information services market.
- Requirements, imposed on a TINA system to cover a particular set of services [2] and propagated down to requirements on business roles and interactions on the reference points of the TINA players owning the sub-systems (chapter 2.3.1 till chapter 2.3.5).

In addition, examples (chapter 2.6) of the application of the TINA business model are given. They depict the use of business roles and reference points in various 'real-life' situations. This provides a means to understand the application of the business model and highlights some typical application situations that might not be obvious from the definitions below.

2.2 The Definition Framework

In figure 2-1 the concepts and relationships in the business model are given. All TINA reference points and business administrative domains will have to obey these relationships.

The basis of the TINA (sub-)system are the informational, computational and engineering objects owned by a business administrative domain and separated by reference points. Thus specifying the regulations and interactions between TINA business administrative domains comes down to specifying the visibility and rights on each type of object in the domain with regard to related domains. These rights and visibility are laid down in a contract. A contract is a context defining constraints for the reference point (or points) to operate under[1]. The contract is established between business administrative domains and can be negotiated on- or off-line. When contract set-up is on-line it can speed up the dynamics of business relationships.

1. n.b. contract in this setting is not to be confused with the notion of contract in Computational Modeling Concept (Object Grouping), which defines the computational interface visible from the computational entities outside of a computational object group.

2.2.1 Contract

A contract provides the basis for the contexts defined in the other viewpoints (e.g. in the informational viewpoint the management information to be exposed). Within the constraints specified in the contract, the contexts in the other viewpoints can be modified (negotiated) on-line or off-line. However, the contract can never be modified as a result of the negotiations in other viewpoints, since a single viewpoint only provides a partial view of the interactions between the business administrative domains and might (accidentally) violate the policies negotiated for the other viewpoints (e.g. expose computational interfaces that give access to management information that is not exposed in the informational viewpoint).

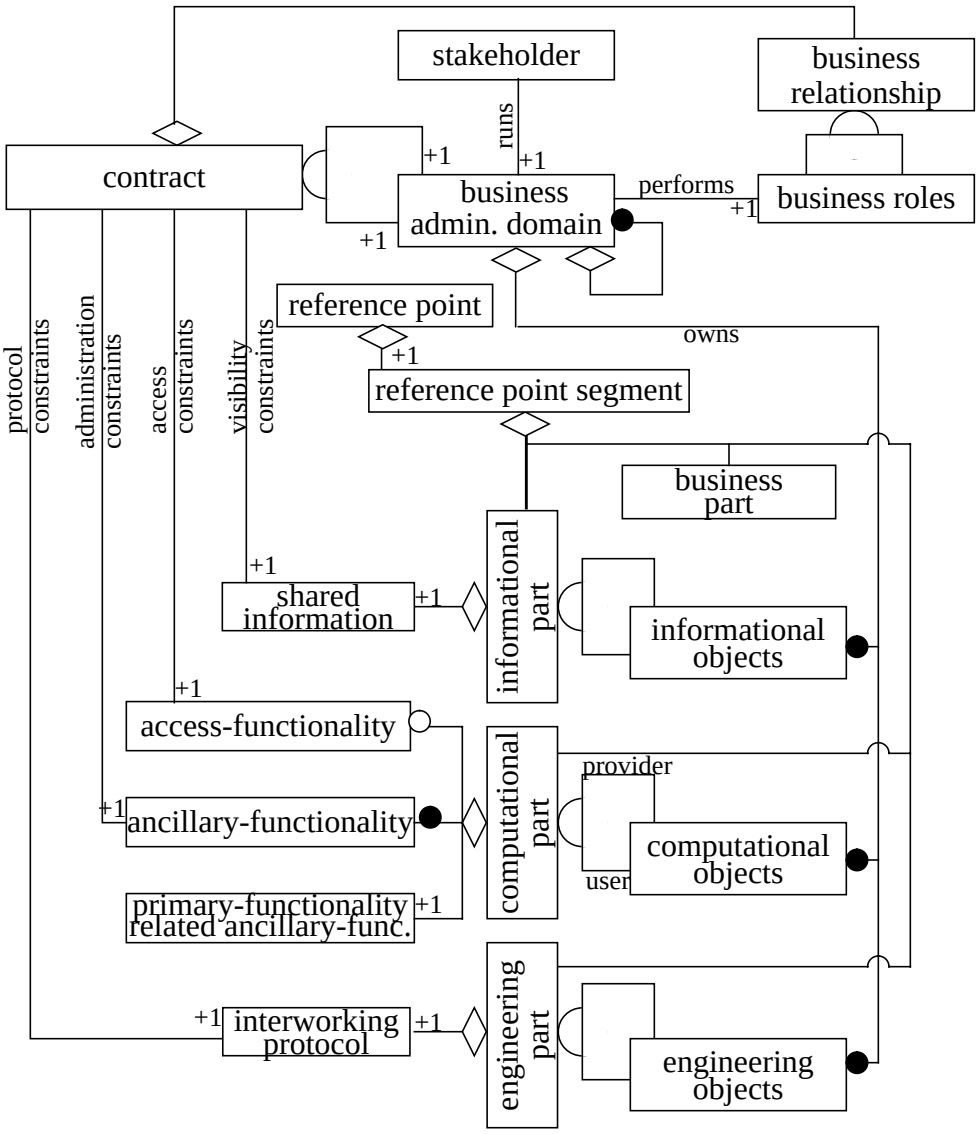

Figure 2-1. OMT relationship model of the business framework

2.2.2 Business administrative domain

A business administrative domain is defined by the requirements of a (number of) business roles (see 'Combination of business roles into business admin. domains' section 2.5.1 on page 18). Business administrative domains will interact with each other through reference points, which are the implementations of the business relationships.

To allow business administrative domains to contact each other they will have a single point of access (contact), i.e., a (persistent) object that serves as a receiver of requests for services by other business roles[2]. Typically, information about this access point is registered and managed by the broker business role (see 'Broker' section 2.3.3 on page 10).

The concept of business administrative domain is based on ownership and belongs in the enterprise viewpoint. Ownership implies the universal privilege of managing the entities inside the domain. This privilege can be delegated to domain concepts in other viewpoints (e.g. the management domain in the informational viewpoint) to address a specific problem (e.g. fault management) or a concern (e.g. network management of a particular network under the ownership of a business administrative domain). In the other views the business administrative domain can be divided and merged[3] into other types of domains in order to more easily address particular problems and concerns.

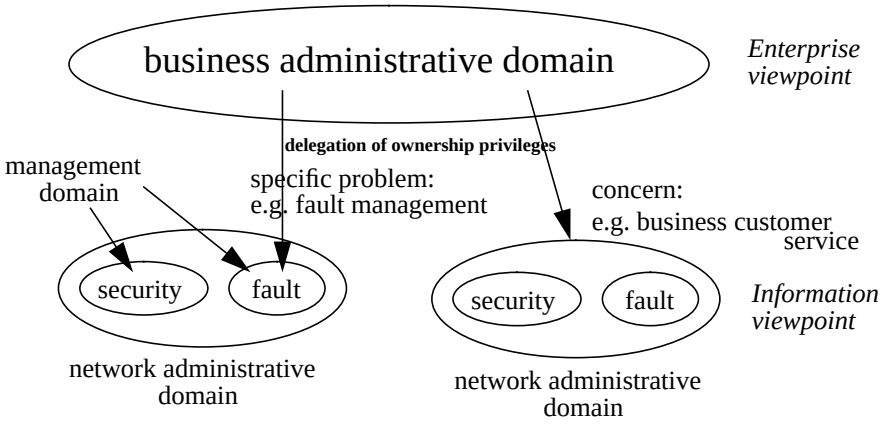

Figure 2-2. Domain mappings

The specific mapping is dependent on the type of business role(s) performed by the business administrative domain.

2.2.2.1 Management domains

In the network management area, both network administrative and management domains are specified. The network administrative domain is the notion similar to the business administrative domain in the previous explanation, but the authority of network administrative domain is limited to network management issues. Thus, the network administrative domain is mapped onto a part of, or the complete the business administrative domain. The concept

2. Replication of the access object is possible (for instance for load sharing)
3. Currently, this model cannot support the merger of business administrative domains to form another type of domain. This is for further study.

of the management domain is the function-based classification[4] of network resource information in the network administrative domain. Thus, the management domains are the sub-domains of the network administrative domain. Both the network administrative domain and management domain mostly address the subjects on network resources in the information view, and are related to (or derived from) the subjects of particular business roles (see 'The initial set of business role types identified for TINA' section 2.3 on page 8).

2.2.2.2 Naming domains

The business administrative domain delegates the authority of the assignment of names to the naming domain and name services. Since the authority of the naming domain is also considered as the privilege delegated by the business administrative domain, the naming domain or its sub-domains can be a portion of business administrative domain or the whole business administrative domain. The naming domain can be formed with several business administrative domains according to other criteria, e.g., technology (because the larger scale of naming domain may provide better name service) and scope (the naming domain provides more intuitive service (e.g. single name for a company in a telephone directory instead of all its employees separately)[5].

2.2.3 Reference Points

The reference point will consist of several viewpoint related specifications governed by a contract. As such it is an aggregation of these specifications and has no direct meaning in relation to a business administrative domain. To promote re-use and modular implementation of reference point specifications, a reference point is spilt into reference point segments (see 'Segmentation of reference points' section 2.5.2 on page 19). Each segment is a meaningful, self consistent specification.

Since the specifications in the ODP viewpoints will be interdependent, the reference point needs to be a complete set of the specifications of all the viewpoints. The reference point will contain the following specifications (for a complete specification see 'Specification template for application related TINA reference points' section 4 on page 37):

- Business part: scope limitations, functional and non-functional requirements posed on the business relationship by the business roles. It is derived from the requirements of the business roles for their interaction (see 'The business model' section 4.1 on page 37).
- Informational part: defines the information which is shared between the business administrative domains (examples are: names, management information, see 'The information model' section 4.2 on page 37).
- Computational part: defines interfaces on computational objects to be made accessible to the other domain, see 'The computational model' section 4.3 on page 38. To promote re-use and manageability the computational interfaces can be grouped into 4 different types according to their use (see 'Segmentation of reference points' section 2.5.2 on page 19).
- Engineering part: defines the separations of the DPE in DPE nodes, kTN links, supporting OS's and protocol stacks needed for interworking between the business administrative domain (see 'The engineering model' section 4.4 on page

4. System Management Function (FCAPS) + Connection Management Function

5. For example, a nationwide telephone directory service seems better than locally-limited service.

40). By the current definition of the business model, the DPE is considered an integral part of the business administrative domain and thus a separate 'DPE provider' business role is not considered.

- Miscellaneous part: defines other constraints, e.g. limitations on other specifications (not defined in TINA documents) imported into the reference point specification, allowed limitations on compliance (see 'Miscellaneous' section 4.5 on page 40).

2.2.4 Business roles and business relationships

The initial set of TINA business roles are identified by analyzing the current business relationships in Telecommunication and Information Services. The separations are driven by the following types business separations:

- **Technical**: areas of different development speed of technology are placed in different business roles (e.g. separation between retailer and connectivity provider = speed of service development vs. speed of network development)
- **Economic**: business roles which are considered consumers and producers of services in todays' information market are assigned to different business roles (e.g. separation between consumer and other business roles and separation between the retailer and third party service provider).
- **Regulatory**: due to regulatory constraints certain separations of business roles are induced (e.g. between broker and other business roles to allow fair and equal access to retailers).

The following types of business roles were identified for the initial set in TINA (see figure 2-2 on page 2-5):

- The consumer business role is introduced through economic considerations, as it is the only business role consuming the TINA services and not trying to make money of them. All other types of business roles are characterized as producers or middlemen.
- The broker business role is introduced through regulatory considerations to allow all business roles to have fair and equal access to the information that allows them to find services and other stakeholders in the TINA system.
- The connectivity provider business role is introduced through technical considerations, since the pace of technological development in the transport resources (mainly hardware based) will be different from that in the services resources (basically software based).
- The retailer is separated from the third party service provider business role through economic as well as well as technical considerations. Using present day models (e.g. supermarkets) as an example. The production of services (e.g a movie) requires a different business setup and technical skills than the offering of this movie (e.g. a videoshop). The retailer business role is oriented towards customer management and value adding, while the third party service provider is oriented towards production and maintenance of the service.

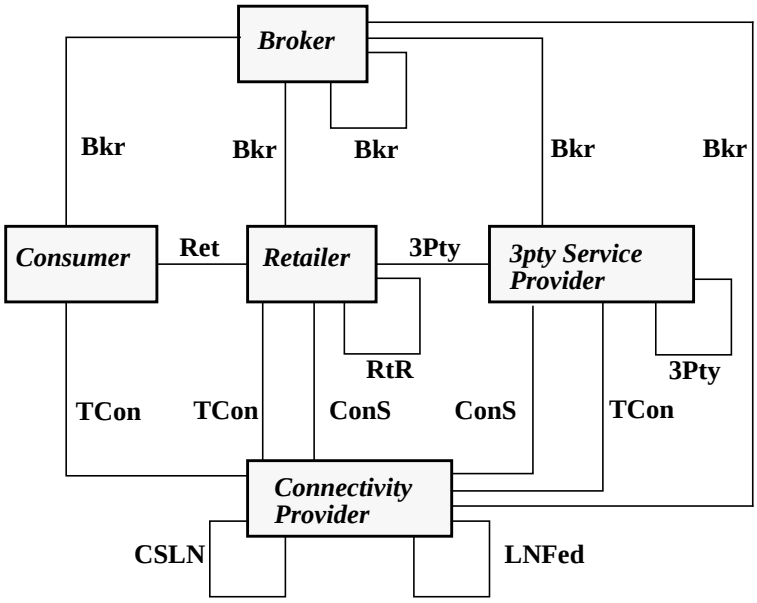

Figure 2-3. Initial TINA business relationships types

All of these business roles play the role of user and provider towards specific other business roles (e.g. a retailer *provides* services to the consumer and thus preforms the provider role, but *uses* services from the connectivity provider and thus performs the user role). Whether a provider or user role is played is determined by the contract governing the interaction between the business roles.

Business roles can be combined in business administrative domains to suit the needs of the stakeholder for its particular business (see 'Combination of business roles into business admin. domains' section 2.5.1 on page 18). In this translation, the business relationships, which express the interaction requirements between the business roles are mapped into reference points.

The types of business roles briefly described above are further explained in the following five subsections. At the end of each sub-section a list of high level requirements is given.

2.3 The initial set of business role types identified for TINA

2.3.1 Consumer

A stakeholder in the consumer business role takes advantage of the services provided in a TINA system, in the sense that the consumer business role has no interest in making revenues by being engaged in the development of a TINA system (as a specific technology). If a TINA system can offer the facilities that satisfy these stakeholders, they will be part of the TINA system. If not, other types of systems (Internet, proprietary on-line networks, B/N-ISDN, PSTN, Datacom networks, DAVIC compliant systems etc.) will be used. This means that stakeholders exclusively in the consumer business role will not, in general, invest in a TINA system for the sake of promoting it. However, this type of stakeholders will be the economical base for a TINA system, by paying for the usage of services offered in the TINA system.

The number of stakeholders that are exclusively in the consumer business role can potentially (and will hopefully) be very large - one or several magnitudes larger that the rest of the stakeholders combined. The stakeholders in a TINA system that are in the consumer business role can range from big companies to individuals - much like the Internet users.

The configuration of a TINA CPE (customer premises equipment) will consequently range from small home computers or set-top boxes to large corporate networks (with ten, hundred or more terminals/nodes). The technology used within these CPEs will of course differ, it is not in the scope of TINA to prescribe the CPE internal configurations.

The consumer business role can also be performed by a stakeholder engaged in one or several of the other types of business roles defined in the TINA business model. For example, a stakeholder in the retailer business role that wants to test services within his own domain before making them “public”, might perform the consumer business role within its own domain.

The high level requirements on the TINA sub-system of this business role are:

- Obtaining location of retailers, service providers, and other consumers,
- (De)registration at retailers,
- Initiating service relationships that include service providers and other consumers,
- Indicating availability to retailers (for receiving invitations),
- Accepting invitations to join sessions from other consumers or retailers,
- Accepting downloads from retailers to upgrade the interaction capability with the retailer.

2.3.2 Retailer

A stakeholder in the retailer business role serves stakeholders in the consumer business role. The number of retailers that can be engaged in a global TINA system can be anything from a few to thousands. A stakeholder in the retailer business role can be anything from a large corporation to a small “garage” company, much like Internet WWW providers.

Stakeholders in the consumer business role can use one or more stakeholders in the retailer business role. This indicates that the “life time” of a relationship between a particular consumer and a particular retailer can vary from seconds to years. For example, a consumer might use a particular service offered by a retailer only once. Another example is a consumer that is a faithful client to a particular retailer for a long time and use the retailer as a “one-stop-shop”.

A retailer can deploy a new service for immediate use by any consumer in the TINA system without consulting/standardizing the services with other retailers. This is an absolute requirement that will allow a TINA system to be an attractive and dynamic system for the future. This also enables rapid service deployment.

Since the retailer will be the focal point of the cash flows in TINA, it will be necessary to have a limited number of accounting mechanisms to simplify management both between retailers to consumers and between third party service providers. Eventually usefulness of these mechanisms will decide which mechanisms will become de-facto accounting standards. TINA however does not exclude or favor any specific accounting mechanism.

The retailer provides a supermarket or special feature shop to consumers. In order for a retailer to provide its services, support from other providers might be used. In the business model three categories of such supporting business roles are defined, i.e. broker, third party provider and connectivity provider, see below.

Again, a stakeholder in the retailer business role can also be in one or more of the other business roles defined in the business model. E.g. a particular stakeholder can be in the business role of retailer, broker and a connectivity provider “at the same time”. This will probably be the case for companies that own their own transport networks and want to make revenues in the new markets TINA makes possible, i.e. provisioning of new services.

The high level requirements on the TINA sub-system of this business role are:

- Manage (de)registration to obtain various services (including person-to-person communication, if desired) by consumers,
- Manage (de)registration to provide various services by third party service providers,
- Authorization prior to service usage,
- Maintenance of session-level user service profiles and treatment policies,
- Session Management, communication to establish and maintain the association list of parties and resources that partake in a session with session owners and session policy information for the purpose of establishing access to the session,
- Control and management of stream flow connections (supported by the connectivity provider) related to the session,
- Manage download to consumers and service providers to upgrade the interaction capability with them,
- Collecting accounting information for the purpose of billing, in the general, for each invoked service (including network connectivity[6]) as well as for the services of the retailer (optional)

2.3.3 Broker

Stakeholders in the broker business role have a specific mission in the TINA system, which is to provide stakeholders with information that enables them to find other stakeholders (business administrative domains) and services in the TINA system.

In a distributed system (like TINA) the possibility exists for any stakeholder to establish a logical contact with any other stakeholder, i.e., a contact that in the TINA system is established with generic interactions and after that, driven by any type of (service specific/provider specific) protocol. The opportunity to obtain address information of other stakeholders or services has to be supported by generic mechanisms (the broker). The broker provides the service of finding the requested (object) reference in the TINA system. This service has a common value for all stakeholders who do not want to stick with a set of “hard-coded” (fixed) references to other stakeholders and services in the TINA system. The service provided by the brokers enables “surfing” in a TINA system.

The following basic information is assumed to be provided by a broker:

6. For this function, network connectivity billing must be associated with the retailer for the associated services.

- In response to a name provide references to business administrative domains (instances)
- In response to a set of criteria provide names of services (class of services, not instances) matching the criteria, as well as the list of attributes (when requested and allowed)

The first bullet provides the White Pages function where given a business administrative domain name, a computational interface reference of the point of contact is provided.

The second bullet provides the Yellow Pages function where given a set of attributes a matching service (and a provider of the service, depending on the search mode) is found. The name of the provider can then be resolved into an point of contact reference using the White Pages function.

For maximal simplicity, a TINA broker is only engaged in two-party interactions, i.e. a single client of the broker uses the operations specified by the broker to retrieve (get), store (set/update) or delete information managed by the broker.

Again, a stakeholder in the broker business role can also be in one or more of the other business roles defined in the business model. E.g. a particular stakeholder can be in the business role of retailer and broker “at the same time”.

A specialization of the broker is the so called Level 1 Gateway (L1GW). The L1GW is a service that ensures consumers to have “equal access” to various service providers.[7] An interface to a L1GW can offer a list (menu) of service providers that appears on the consumer’s screen. This facilitates the consumer to choose any of the service providers presented.

In the Internet “broker services” are of great interest. It is clear that effective utilization of the Internet depends on retrieval of address information. In Internet, both librarians and publishers (like Yahoo, Webcrawler, Whois, etc.) exist. Also a Domain Name Server hierarchy and partly X.500 for directory services are implemented. Currently, IETF-drafts are being prepared for protocols such as service location protocols (SLP), invitation/announcements to conference sessions, etc. For a TINA system it is important that brokers are introduced in a more consistent way to allow a generic use.

The difference between a broker and a DPE trader is that the broker operates as a specific service provider which can be accessed globally by any stakeholder. The broker keeps information about available services and stakeholders (business administrative domains) in the TINA system. The broker has a commercial value, it handles subscription, accounting, security etc. This in contrast to the trader, which is a part of a specific DPE implementation, it keeps track of object interfaces (typically within a business administrative domain). In general, the interfaces to a DPE trader do not need to be exported outside a business administrative domain. A comparison of the scope of the broker can be made with the OSF DCE Global Directory Agent. The scope of the trader can be compared with the OSF DCE Cell Directory Service.

The high level requirements on the TINA sub-system of this business role are:

- In response to an identifier, provide a unique end point address or set of addresses,

7. Introduced in U.S. by F.C.C. to promote competition between service providers.

- In response to a service category, provide a list of identifiers associated with that service category,
- Manage the information used to provide the above,
- Introduce, update and remove information on business administrative domain instances and service offerings.

2.3.4 Third party service provider

The aim of a stakeholder in the business role of a third party service provider is to support retailers or other third party providers with services. These services can be regarded as “whole sale” of services. The third party service provider can be a service logic provider or a content provider or both.

The difference between a third party service provider and a retailer is that the third party service provider does not have a contractual relationship with stakeholders in the consumer business role. But, a stakeholder can of course be in the business role of retailer and third party service provider “at the same time”.

The accounting method used between a third party service provider and a retailer (or another third party provider) typically will not be the same as the one used between consumers and retailers (but can be if appropriate).

The high level requirements on the TINA sub-system of this business role are:

- Obtaining location of retailers,
- (De)registration at retailers,
- Indicating availability to retailers,
- Accepting download from retailers to upgrade the interaction capability with the retailer,
- Providing uploads to retailers,
- Establishment of provisioning relationship to other third party service providers,
- Collecting accounting information for the purpose of billing for service usage,
- Provision and management of services,
- Value adding of services from other third party providers.

2.3.4.1 Content Provider

A specific specialization of the business role of the third party service provider is that of content provider. This stakeholder is purely focused on the generation of content.Examples include movie production companies for VoD and distribution services, stockprice publishers to provide raw material for portfolio management companies.

The content provider business role will give rise to the following additional high level requirements on the TINA sub-system:

- authoring of content
- delivery of content
- management of content (version control etc. copyright protection, licensing) either locally or in the domain of the third party provider,

- access provision to content, either for cashing in the third party provider domain or for usage by consumers directly.

Since the content provider is one of the many roles that can be derived from the third party service provider and no study has been undertaken yet on the reference points of the third party service provider, the role of the Content Provider is not elaborated further in this document.

2.3.5 Connectivity provider

A stakeholder in the business role of connectivity provider owns (manages) a network (switches, cross-connects, routes and trunks). This network can constitute a transport network to support stream binding[8] in TINA (to support user connections) or can constitute (a part of) the kernel transport network to support computational binding in TINA by supporting the DPE node interconnections.

The transport network is controlled by TINA Connection Management, typically through the ConS business relationship (see 'The initial set of business relationships types identified in TINA' section 2.4 on page 14), while the kernel transport network is controlled by the DPE nodes through first party control, typically through the TCon business relationship. The management functions however are the same, typically done through the TCon business relationship.

The connectivity providers offer an interface (typically ConS) to retailers and third party service providers which enable them to request connections between arbitrary end-points in the global network.

The connectivity providers have to “federate” with the stakeholders (consumers, retailers and third party providers) that terminate the connection, at the rim of the network, much like UNI (user-to-network interface) in legacy systems.

The transport network of a connectivity provider is (probably) not a global network that connects all the consumers, retailers and third party service providers in a TINA system. The global transport network is most likely to be segmented in a number of subnetworks controlled by different stakeholders (in the connectivity provider business role). The connection management of each one of these segments belongs to a certain business administrative domain. To allow management (set-up, removal etc.) of connections routed through two or more network segments belonging to different connectivity providers, the connectivity providers have to federate. The same principles that apply to NNI (network-to-network interface) for bearer services in legacy systems apply to federation among connectivity providers.

TINA supports the “paradigm” of layer network - this implies that another type of relation (than federation, peer-to-peer) can exist between connectivity providers. A client/server relationship exists between the connectivity provider that manages the client layer network and the connectivity provider that manages the server layer network. The client layer network uses resources of the server layer network.

8. The TINA Network Resource Architecture document includes the communication session that handles stream binding. It is not included in the connectivity provider business role.

Accounting between the connectivity provider and its clients, as well as accounting between connectivity providers are important issues. The same type of accounting methods as defined between consumers and retailers is not necessarily assumed.

It is an obvious possibility to “substitute” the TINA Connection Management carried out by the connectivity provider with another type of “bearer service” facility (like IP networks, B-ISDN, N-ISDN, PSTN, Data communication networks, etc.). This can be done in many different ways. Two main options are outlined:

1. The connectivity provider “wraps” the legacy system so that no difference is visible for the clients of the connectivity provider (consumers, retailers and third party providers).
2. Instead of the connectivity provider (à la TINA), a legacy system is used for bearer services. This implies that the reference points offered to clients (consumers, retailers and third party service providers) will have to mapped from legacy interfaces, which in general will limit the functionality on the reference point. section 4.5 on page 4-40, ‘Miscellaneous’ is used to describe constraints in these situations.

The substitution options are not part of the specification of reference points (this document), but, it is important to realize that they can be made without loosing the benefit of TINA in the service layer.

Again, a stakeholder in the connectivity provider business role can also be in one or more of the other business roles defined in the business model. E.g. a particular stakeholder can be in the business role of retailer and connectivity provider “at the same time”. As a comparison, legacy systems operated by PNOs (Public Network Operators) offer transport services together with higher level services.

The high level requirements on the TINA sub-system of this business role are:

- Set up and manage binding between network flow endpoints either with or without connections,
- Adding and modifying these bindings (e.g. adding branches or media to a connection configuration),
- Managing these bindings (e.g. fault, security),
- Collecting accounting information for the purpose of billing for network connectivity; the billing point is associated with this information.

2.4 The initial set of business relationships types identified in TINA

To allow the five business role types described in the previous sections (see figure 2-2 on page 2-5) to interact a set of business relationships types is described in the sections below. Some of the relationships appear more than once in figure 2-3 on page 2-8, denoting multiple occurrence of the same business relationship type between different business roles (e.g. a consumer, retailer, third party service provider and connectivity provider will have the same interactions with a broker). However, although the business role types and thus the interactions are the same, the information carried can be entirely different.

The interaction requirements of each of the business relationship can be split into two parts, which are treated separately below.

2.4.1 Generic access inter business administrative domain interactions

These interactions are generic to all the inter business administrative domain interactions described in section 2.4.2 to section 2.4.9 and support to the establishment of a administrative relationship between the business administrative domains[9]. These interactions need to be performed before any of the other interactions can take place:

- initiate dialogue between the business administrative domains,
- identify the business administrative domains to each other (n.b. either domain can remain anonymous dependent on the interaction requested),
- establishment, release and management of a secure association,
- establishment of billing/accounting conditions in relation to,
- service (including management services) discovery and start.
- establishment of the initial management context (setting the policies for e.g. availability, reliability and fault handling).
- negotiation of the initial usage interactions (i.e. exposing the information objects and computational interfaces for provisioning of services).

2.4.2 Retailer business relationship (Ret)

The Ret business relationship is used between stakeholders in the consumer business role and stakeholders in the retailer business role. The following interactions are performed in this relationship:

- generic access interactions (section 2.4.1),
- discovery and start of operational (e.g. VoD), management (e.g. customization of VoD) and administrative (e.g. subscriber profile management) service offerings,
- control and management of sessions (e.g. announce, stop, suspend, invite, notify changes, negotiate transfer of control rights) on the entities participating in the session as described by the session graph [4],
- control and management of stream flow bindings [5],
- control and management of stream flow content (n.b. specific interactions such as operations for “pause”, “rewind” (VoD) and “next page” (Magazine Browser) will not be specified in TINA and are not part of the Ret-RP reference point. specification, they can be implemented in a proprietary way or using legacy protocols and protocol mechanisms),

2.4.3 Broker business relationship (Bkr)

The broker business relationship provides access to / management of the information controlled by the broker business role by any other TINA business role. The broker can provide different kinds of information to different business roles for different purposes. The consumer can interact with the broker to e.g. get references to available retailers. The retailer can

9. The access segment of different inter-domain reference points may actually posses slightly different functionality between different reference points due to of the mapping of business relationships into reference points.

interact with the broker to e.g. get references to consumers for invitations or to third-party service providers for provisioning. Other brokers can also interact with the broker to complement their own information using the same interactions as all other TINA business roles.

The following interactions are performed in this relationship:

- generic access interactions (section 2.4.1),
- (de)registration of business administrative domain instance names,
- (de)registration of service offers and their attributes,
- management interactions (e.g. update, delete, add) on the above information.

2.4.4 Third party business relationship (3Pty)

A stakeholder that is in the retailer business role can interact with a stakeholder in the third-party service provider business role to provide a broader range of services to its consumers without actually possessing the services.

The following interactions are performed in this relationship:

- generic access interactions (section 2.4.1),
- interactions defined for the Ret business relationship,
- control and management interactions for services and/or service content,
- management interactions for service offerings in the retailer domain or another third party service provider domain (e.g. version control).

2.4.5 Retailer-to-Retailer business relationship (RtR)

The RtR business relationship will re-use the functionality from the 3Pty and the Ret business relationships considering the fact that the information passed over the reference point may be different, but the actual interactions are not.

2.4.6 Connectivity service business relationship (ConS)

The connectivity service business relationship is defined between the connectivity provider business role, providing the network transport services (point-to-point and point-to multi-point) and the business roles (typically the retailer and third party service provider) using the transport connectivity services (on behalf of their customers). Connections are established between arbitrary Network Access Points in the network resource layer of a TINA system. The business role requesting the connections need not be connected to any Network Access Points (third party control). The following interactions are performed in this relationship:

- generic access interactions (section 2.4.1),
- control and management of third party connections between the parties defined in the Physical Connection Graph [4][5] information object.
- setting and management of management contexts for the connectivity service (e.g. accounting method to be used, configuration to be reported)

The motivation for adopting the separation between connectivity and other functions at level of the Communication Coordinator / Physical Connection Graph in the ConS-RP is given in see ’Choices considered for ConS-RP’ appendix C on page 55.

2.4.7 Terminal connection business relationship (TCon)

The TCon business relationship provides the link management between the connectivity provider business role and the business roles of the parties involved in the Physical Connection Graph. Thus the TCon business relationship will be closely tied in with either the Ret or 3Pty business relationship for which it performs the connection termination. Since the Network Termination Points will be technology dependent (e.g. ATM, B-ISDN, N-ISDN, Internet (IP)), the implementation of the interactions on the TCon business relationship will also be technology dependent. The following interactions are performed in this relationship:

- generic access interactions (section 2.4.1) if not covered by the Ret or 3Pty business relationship implementation,
- negotiation about and control of the layer network interconnection (e.g. configuration of concentrators, selection of channels)
- control of first party connection setup (e.g. in case where the connectivity provider provides kernel transport network connections)

2.4.8 Layer network federation business relationship(LNFed)

The LNFed business relationship is a federation relationship between connectivity provider business roles. This allows the provisioning of a connectivity service spanning multiple business administrative domains implementing the connectivity provider business role through the ConS business relationship of one of these. It is achieved by allowing the control of tandem connections in (a portion of) the layer network(s) that belongs to the other business administrative domain performing the peer connectivity provider business role [5]. The interactions performed are of the same nature as those performed by NNI signalling for bearer services in legacy systems:

- generic access interactions (section 2.4.1),
- control and management of tandem connections,
- management of topological links between the connectivity provider’s networks, (e.g. to support dynamic rerouting in fault conditions).

2.4.9 Client-server layer network relationship (CSLN)

The CSLN business relationship provides the use of layer networks between business administrative domains performing the connectivity provider business role [5]. This will happen where more sophisticated routing is added to a basic connectivity network. Typically the adding of a ATM switched VC network on top of a cross-connect VP network, or the adding of Virtual Private Network capabilities on top of a switched network. The following interactions are performed in this relationship:

- generic access interactions,
- control and management of trails in the server’s layer network.

2.5 Dynamics in the business model

2.5.1 Combination of business roles into business admin. domains

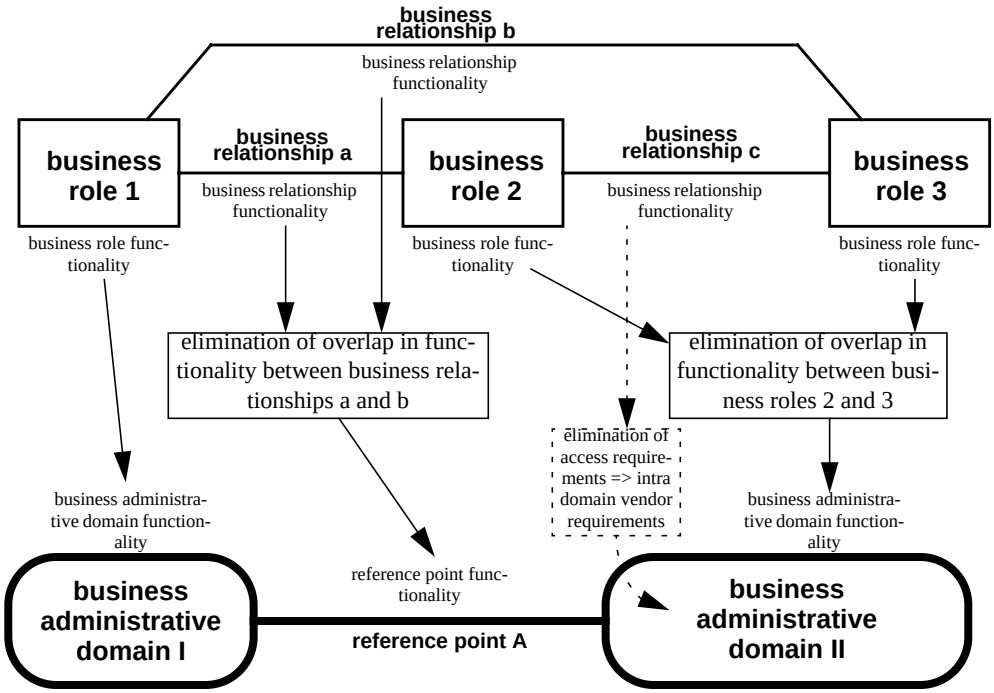

Figure 2-4. Combination of business roles into business administrative domains

In figure 2-4 the steps to be followed when combining multiple business roles into a single business administrative domain are shown. The functionality required by the business roles is tested for:

- overlap (the functionality is carried only once into the business administrative domain), e.g. the access functionality of business roles 2 and 3 is carried only once into business administrative domain II
- cancelation (the functionality is not carried into the business administrative domain), e.g. functionality related to export of fault conditions by business role 3 which is not used business role 2 is eliminated form business administrative domain II

Similar considerations apply to the combination of business relationships into reference points.

Additionally, when the functionality of business roles 2 and 3 is implemented separately in business administrative domain II, the business relationship c between them can be used as vendor interoperability specifications. The functionality related to inter business administrative domain interaction can be eliminated (see chapter 2.5.2.1).

2.5.2 Segmentation of reference points

To allow modular implementations of the reference point specifications can be segmented (illustrated in figure 2-5). This will be of particular interest in situations where TINA reference point are introduced gradually into legacy environments and parts of the reference point functionally are already covered by the legacy interactions.

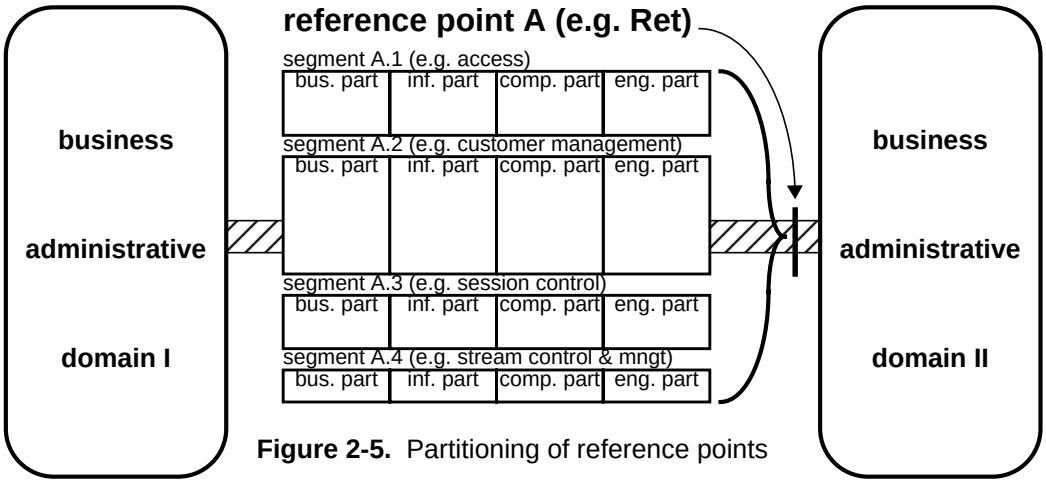

Figure 2-5. Partitioning of reference points

A reference point **segment** is a meaningful and consistent cross-section of the reference point specification. For example if in figure 2-5 the reference point specifies the Ret business relationship, segment A.1 could represent the inter domain access related part, segment A.2 could represent the consumer management related part, segment A.3 could represent session control related part and segment A.4 could represent stream control and management related part.

Different combinations of segments can be used to implement business relationships according to the actual need of the business administrative domains performing the business roles related to the business relationship. Thus these slightly different versions of the business relationship can exist. Each of these sightly different versions is called a **profile** of the business relationship. A profile is implemented by the reference point. An example is included below:

Business relationship: Ret

- Profile 1: *Lightweight_Ret* (is implemented as reference point using the segments:
  - Segment 1: *Generic_Access*
  - Segment 2: *Customer_Management*
  - Segment 3: *Streamless_Simple_Session_Contro*
  - Segment 5: *Browsing* (can be non TINA)
- Profile 2: *Premium_Ret* (is implemented as reference point using the segments)
  - Segment 1: *Generic_Access*
  - Segment 2: *Customer_Management*
  - Segment 4: *Stream_Binding_Control*

- Segment 6: *Full_Session_Control*
- Segment 7: *VoD_control* (can be non TINA)

Business relationship: ConS

- Profile 1: *Full_Connectivity_Control* (is implemented as reference point using the segments):
  - Segment 1: *Generic_Access*
  - Segment 8: *Connectivity_Control*
  - Segment 9: *Connectivity_Management*

Thus the reference point segmentation will depend on the business relationships that are combined into the reference point and the actual functionality introduced by the business relationships into the reference point. No rules are given in the business model on where the segmentation should take place in the reference points, however there are two generic segmentations that are made in TINA for practical reasons:

- segmentation of reference points into access related functionality and usage related functionality
- segmentation of reference points into primary functionality and ancillary functionality

2.5.2.1 Access and usage segmentation

The segmentation into access and usage is driven by the isolation of functionality controlling and managing the business administrative domain interaction (access functionality) from the other functionality providing and managing services (usage part).

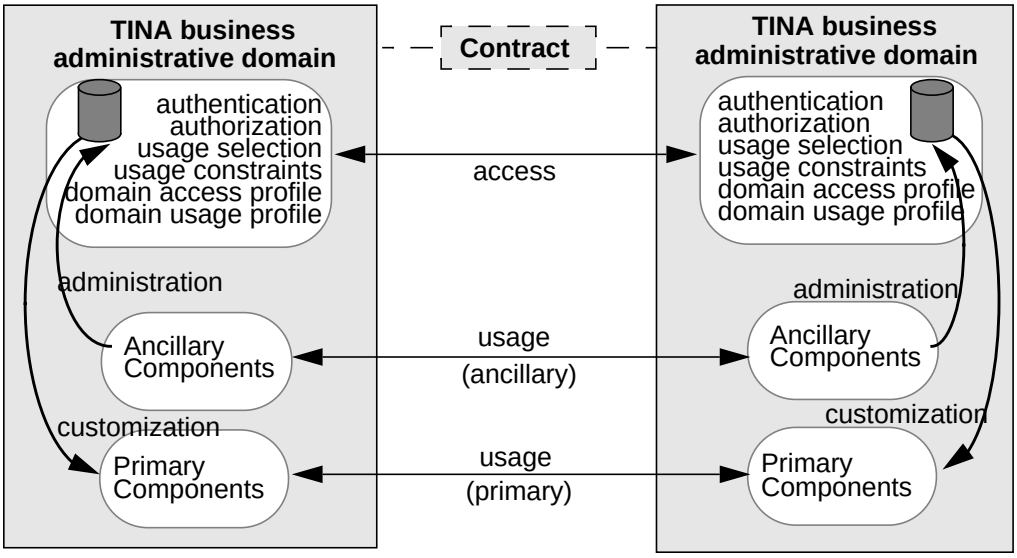

Figure 2-6. The general access/ usage segmentation.

The benefits are:

- Since the access segment will be more or less the same for any type of inter domain interaction, the segmentation allows re-use of access functionality amongst reference points. In figure 2-7 the access segments on reference point A and reference point B can be identical and thus needs to be specified only once.
- For reference points that are not impacted by inter domain operation (e.g. because the informational, computational and engineering objects interacting belong to the same business administrative domain) the access segment of the reference point can be dropped.

Functions of the access segment of the reference point are (see figure 2-6).

- initiate dialogue between the business administrative domains,
- identify the business administrative domains to each other (n.b. either domain can remain anonymous dependent on the interaction requested),
- establish a secure association between the business administrative domains,
- set up the context for the control and management of usage functionality:
  - the context specifies which services are offered and under which conditions
  - the context can dynamically be changed over time dependent on the task at hand using a usage (management) service.
- initiate usage between the business administrative domains.

The usage segment deals with the actual services provided between the business administrative domains. These services can be partitioned again to promote more re-use and added flexibility for implementation, according to:

- their use (direct: e.g. a Video on Demand (VoD) service versus indirect: e.g. fault management for VoD)
- their impact (provisioning vs. management vs. administration) in the domain

2.5.2.2 Primary and ancillary segmentation

Thus usage reference point functionality can be segmented into:

- primary usage
- ancillary (administrative and management) usage

Primary usage covers the usage that aims to meet the main objective of the contract between the TINA business administrative domains. Functions for the primary usage segment of the reference point are:

- control the services life-cycle (e.g. setup, release, suspend, resume)
- exchange of service content (e.g. pictures, but content can also be object code to be deployed in the other domain to extend functionality)

Ancillary usage covers functionality that is supportive of the primary usage or access. Functions for the ancillary usage segment of the reference point are:

- set and manage the context for a specific service or set of services (e.g FCAPS management for a service)

- set and manage the context for domain administration (e.g. the modification of subscriber information) i.e. functions that are not specific for a single service or set of services.
- carry out administration functions
- carry out management functions
- control the life-cycle and attributes of ancillary usage services;

The ancillary usage part does not fulfil the primary contractual purpose of the relationship, it has no independent value, but rather adds value to the primary usage part. The ancillary usage part may modify data and policies that are used for decision making in the access part. Typical examples are subscription services, mobility arrangements and payment/billing services.

2.5.3 Delegation

The segmentation of reference point specifications not only allows the segments to be used in other reference point specifications, but also allows functionality to be shared between reference points. This is illustrated between reference point A and B in figure 2-7 and is called delegation. This will typically take place where a business administrative domain does not add value to the particular reference point segment. In figure 2-7 business administrative domain II does not add value as reference point segment A.1. B.1, part of the business relationship between II and III, is considered functionality identical to A.1 in this example. If allowed by the contract between I, II and III the reference point segment interaction A.1 can directly take place between business administrative domains I and III.

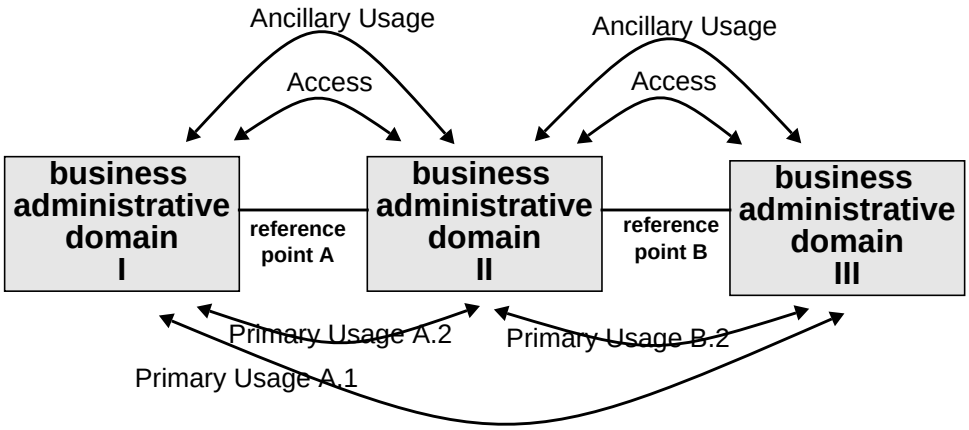

Figure 2-7. Access/Usage example showing the separation of access and primary usage

Delegation can be static or dynamic. Static delegation is used where the delegated segments do not change over the contract duration. The reference point specification may be different from the default one but will not change within the contract. Dynamic delegation will occur when the delegated segments may vary over time during the contract. This can only be done if a reference point segment that can manage and control the changes in delegated segments is present in all concerned reference points.

In figure 2-8 on page 2-23 a computational example is given of a delegation example. The usage part of the 3Pty-RP is identical to the usage part of the Ret-RP. This allows the possibility for a retailer to delegation the service usage part (service session interactions) to a

third-party service provider. Business administrative domain John accesses business administrative domain Telecom to use a specific video conference service. Telecom does not provide this service itself but has a contract with business administrative domain Conference Co. performing the third-party service provider business role that provides this service. Instead of executing the service in the domain of Telecom or passing on all the interactions, the service is executed in the domain of Telecom and the interactions are directly passed from John to Conference Co. This can be done without any impact to “John”, i.e., to him it appears like Telecom is offering and providing this service. Telecom is responsible for John’s interaction with Conference Co and performs John’s subscription management, customization etc. John pays Telecom for the service usage, and Telecom pays the Conference Co.

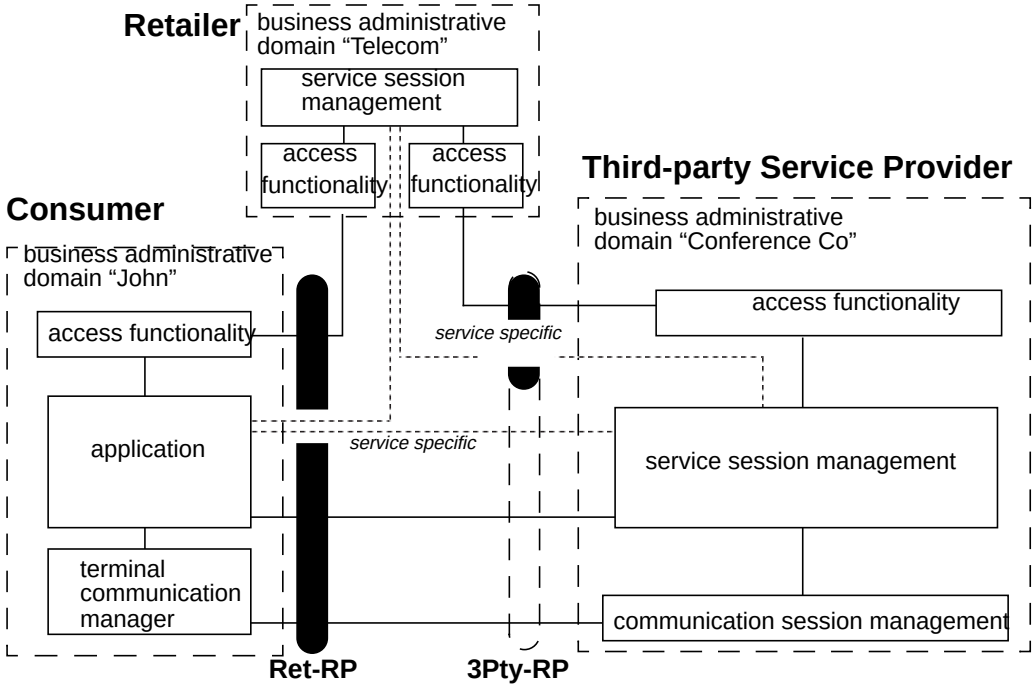

Figure 2-8. Functionality example of delegation

2.6 Examples

In the figures below, instance diagrams of the relationship diagram of figure 2-1 on page 2-4 are given to illustrate some of the key features of the business model.

2.6.1 Present day VoD example

In figure 2-9 an example of the TINA business model applied to a present day Video on Demand service as can be found on cable TV systems. The following features are shown:

- The possibility to map two business roles (retailer and connectivity provider) into a single business administrative domain (Coax) (see ’Combination of business roles into business admin. domains’ section 2.5.1 on page 18).
- The possibility to hide contracts. In the contract between the consumer (William Watcher) and the retailer (Coax) a portion guaranteeing the provisioning of special Pay TV services from R-Movie is included.

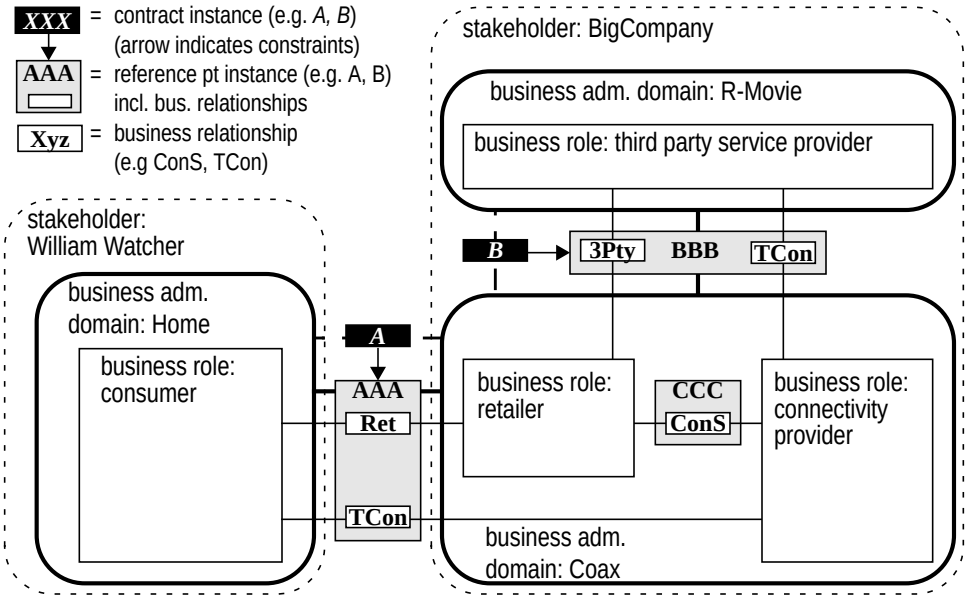

Figure 2-9. Example instance diagram of pay TV provisioning

- The possibility to have one stakeholder (BigCompany) run two business administrative domains (R-Movie and Coax).
- The possibility to perform delegation by the retailer to the connectivity provider to set up connections between the consumer and the third party service provider.
- The possibility to implement a business relationship as a reference point within a business administrative domain as an interoperation requirement for components from different vendors (ConS within Coax).

2.6.2 Connectivity value adding example

In figure 2-10 simple value adding is shown. The figure shows the situation where a stakeholder in the business of connectivity provision (BasicServiceProvider) sells connectivity to consumers by its retailer business role (e.g. to Christine Caller). A stakeholder performing the business role of adding value (e.g. for Video Conferencing) buys connectivity as a normal consumer and utilizes it to support its value adding business. Both providers have ordinary customers as well (Christine Caller and Charley Conferencer). The following features are shown:

- The possibility for a stakeholder to map multiple business roles into a business administrative domain even when there are no predefined TINA business relationships between them. In this case the value added provider (GetTogether) contains both the functionality of a normal consumer towards the retailer role of BasicServiceProvider and a retailer role towards the consumer role of Charley Conferencer supporting the one application that provides the video conference service. The business relationship between the consumer and retailer in GetTogether is different from the Ret business relationship.
- The possibility to have the same business relationship under very different contracts. In this case the Ret business relationship is used for a single ordinary customer (Christine Caller) as well as to a large volume customer (GetTogeth-

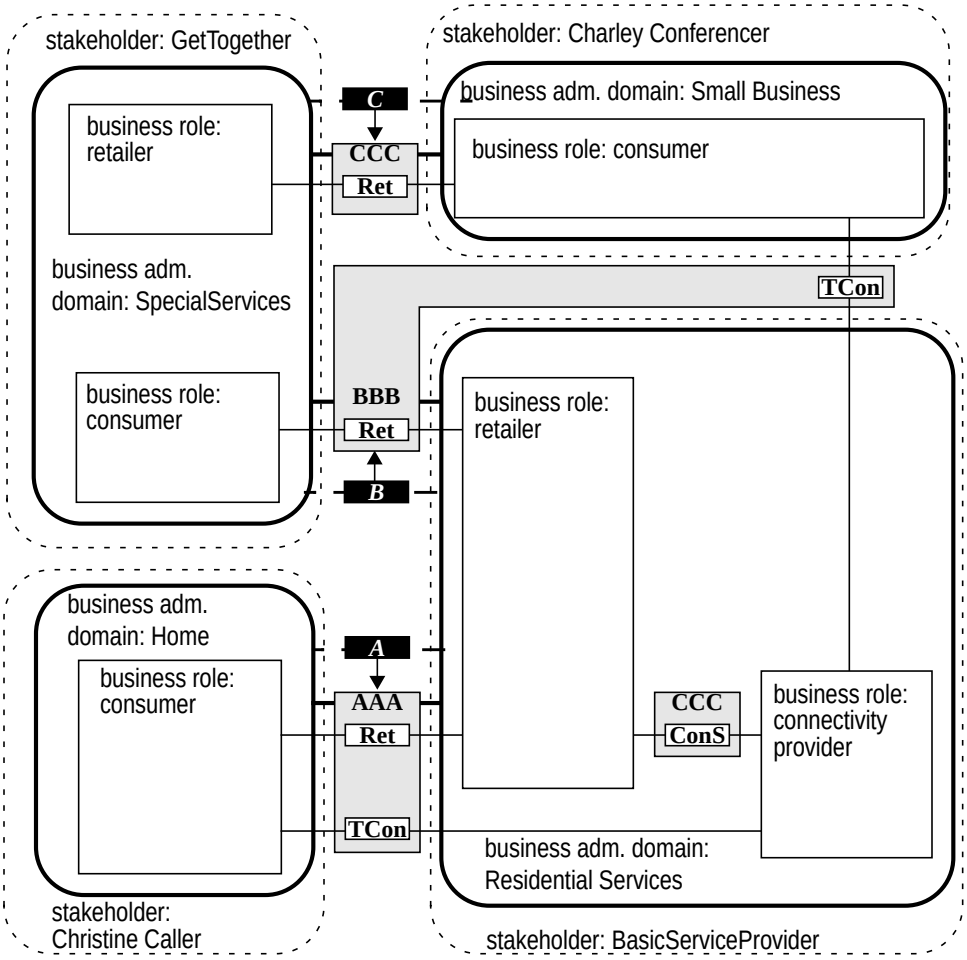

Figure 2-10. Example instance diagram of connectivity value adding

er). The difference is implemented through the use of different profiles for the reference point (see 'Segmentation of reference points' section 2.5.2 on page 19). The implementation of the differences can e.g. be performed by picking different segments for management (e.g. different accounting policies)

- Again, the possibility to perform delegation under a contract. The contract between Charley Conferencer and GetTogether will include the provisioning of the TCon business relationship to gain access to the network run by BasicServiceProvider. This business relationship is incorporated in both the contract between GetTogether - BasicServiceProvider and between GetTogether - Charley Conferencer.

2.6.3 'Internet' home business example

In figure 2-11 the situation is shown where a stakeholder (typically a small home business) provides services similar to those currently offered on the internet. The following features are shown:

- The possibility for OnLine to outsource part of its service provisioning to other parties (the third party service provider side of Harry Hacker).

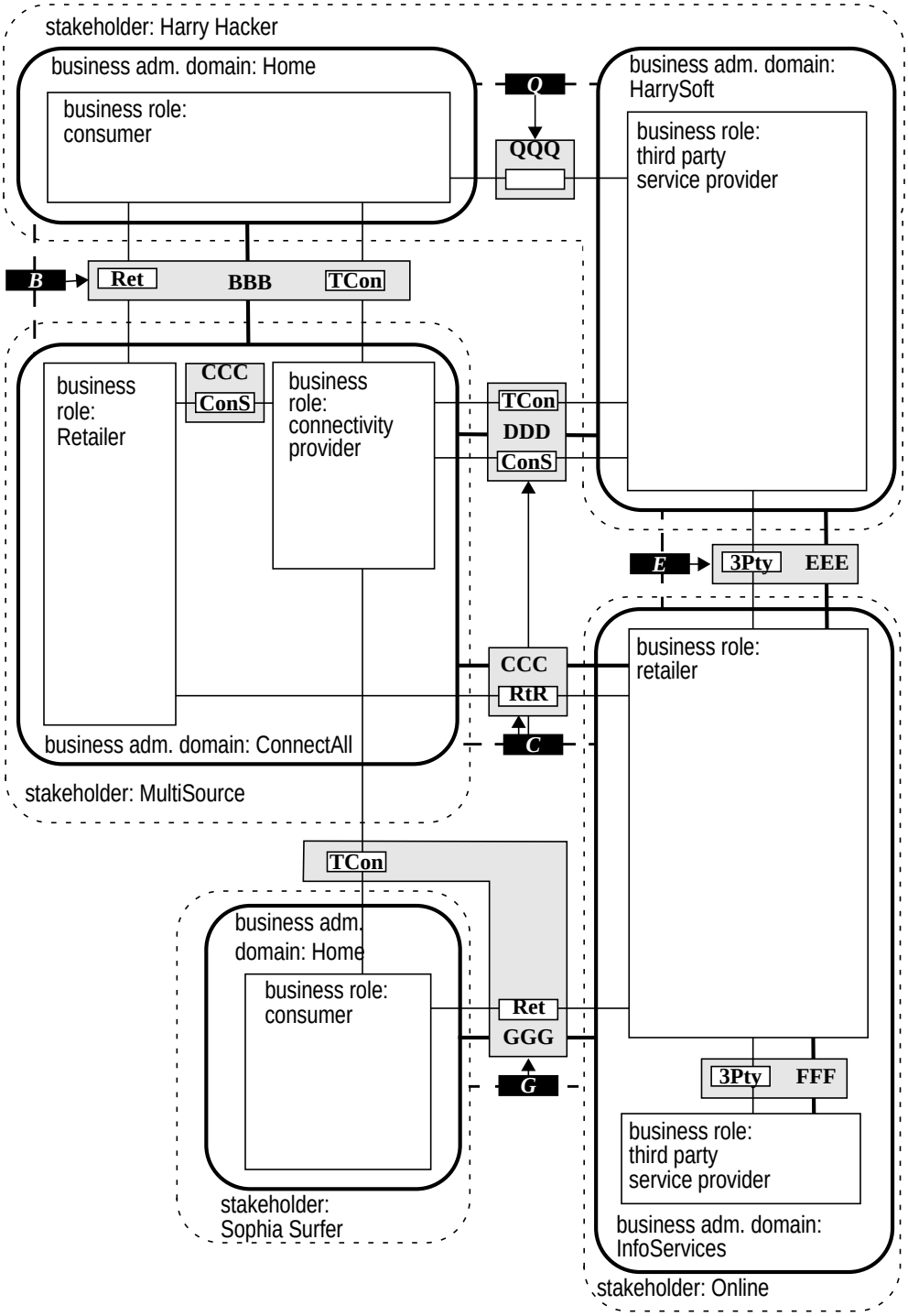

Figure 2-11. Example Internet like service provisioning

- The possibility for retailers to refer customers to each other through the RtR business relationship. In this case the consumer side (Home) of Harry Hacker can access the services provided by Online through its retailer Multisource although Harry is not directly subscribed to Online as a customer. Visa versa,

Sophia Surfer can set up a communication with the consumer side of Harry Hacker using a connectivity service provided by Multisource through her retailer Online.

- The possibility to have contracts that govern the constraint between more than 2 parties. In the contact between the retailer OnLine and the connectivity provider MultiSource (tagged: C) there is a portion dealing with special connectivity conditions that Online's external third party service providers (HarrySoft) are supplied with (e.g a primary-rate connections on special terms with special tariffs). The same can apply for management conditions e.g. MultiSource providing special services for managing all of the connections for all Online's independent third party service providers.
- The possibility to use the TINA mechanisms inside a stakeholder in a proprietary way. In this case to have a contract between the two business administrative domains of Harry Hacker. This serves the purpose of specifying the security and access constraints between the two domains. Thus the implementation of the reference point between the two business administrative domains within Harry Hacker and the constraining contract can be seen as the 'firewall' between Harry's two business roles. Although the business relationship is not defined as one of the TINA initial ones, the mechanisms in the business model can be applied.

2.6.4 Outsourcing of management example

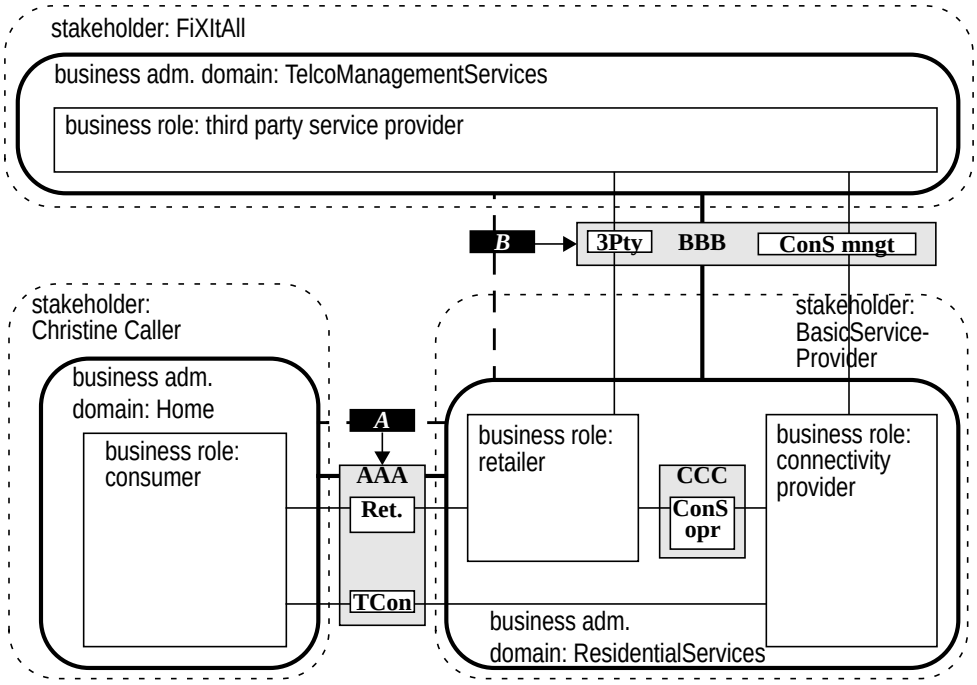

Figure 2-12. Example outsourcing of management

In figure 2-12 the situation is shown where one business administrative domain has outsourced its management to an other business administrative domain The following features are shown:

- The possibility to separate the segments of a reference point (e.g. ancillary and primary segments) of a reference point between different administrative domains. In this case, ConS is split in an ancillary part providing management function (mngt) and a primary part providing operational (opr) functionality. BasicServiceProvider provides the operational part whereas FixItAll provides the management part. These separations still fall under the same contract and business relationship definitions. Ancillary services that have a profound impact on the internal operation of a domain (e.g. element management of a connectivity provider) and still need to be outsources are considered to be implemented in this way.
- The capability to provide the same management services provided by FixItAll for BasicServiceProvider to any customer as a separate service through the retailer role of BasicServiceProvider. This method is considered for ancillary services that are less intrusive (e.g. version management of software).

3. Reference point types in TINA

The mechanisms in chapter 2 can be used to formalize any type of interaction between domains. In this chapter the concept of reference point is detailed by applying two separations:

- application vs. support functions (section 3.2 on page 3-29) related to the use of a DPE in TINA,
- inter vs. intra business administrative domain usage of the reference point (section 3.3 on page 3-30) related to conformance purposes.

3.1 Conformance in TINA

An implementation of a TINA (sub)system conforms to TINA, if one or more of the reference points defined in TINA are conformed to. Thus the TINA reference points are prescriptive.

To the descriptive parts of the TINA documentation no conformance testing can (will) be done. The descriptive information is provided for guidance to promote the understanding of TINA, and as implementation proposals.

An implemented (and deployed) TINA system can host many different services. These services have to conform to basic principles (conformance requirements specified in the reference points). A large portion of the specifications of the services however will be service specific without bearing on TINA (e.g. start and pause of a video stream, operations to retrieve multimedia mails, joystick commands). These types of specifications are considered proprietary from the viewpoint of the system architecture (TINA). These proprietary specifications (either bi- or multi-lateral agreements) must conform to the TINA architectural principles in order to fit in the TINA environment of the reference point. They have to be able to exchange messages through the DPE to their peer as well as to computational interfaces of applications. Thus they must be “well behaved”.

3.2 Classification of reference point parts

TINA is an architecture based on distributed computing supported by a ubiquitous DPE. The TINA service architecture and network resource architecture are applications running on the DPE. They use the DPE facilities to interact between objects. Thus the reference point can be split into two parts:

- part related to the application
- part related to the DPE supporting the application

Objects in the application layer interact using mechanisms in the DPE layer, e.g. binding to computational interfaces and utilization of network communication resources (kernel transport network). However, the interactions of the application layer can be specified independently of the DPE interactions, just as the DPE (node) interactions can be specified independently from the application layer interactions[1]. Thus the specifications of interoperability in the application layer can be separated from the specifications of interoperability in the DPE layer. Thus the reference point specifications can generally be split into two parts that are ‘more or less’ independent from each other and thus promote re-use and hide complexity (see figure 3-1):

1. Of course, the DPE must be able to support the interaction requirements of the applications.

- Application related reference point part (Business, Informational and Computational Viewpoint interactions see figure 2-1),
- DPE related reference point part (Engineering and Technology Viewpoint interactions see figure 2-1).

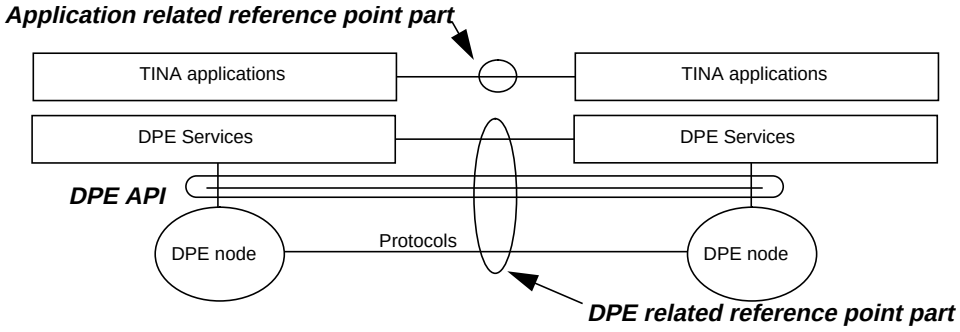

Figure 3-1. Main types of reference point parts[2].

3.3 Application related TINA reference point part.

Two types of conformance requirements are relevant to TINA:

1. Conformance requirements for interoperability between TINA sub-systems of different stakeholders.[3]
2. Conformance requirements for TINA components developed by different vendors.

The first purpose concerns requirements on stakeholders: A TINA system is a world wide information networking system, that is made up of a large number of interconnected computers, from servers controlling huge databases to workstations, desk-top PCs, lap-tops, set-top-boxes and maybe wireless hands-sets. All this equipment is owned by different stakeholders. These stakeholders can be anything from private persons, small garage companies to large corporations. The stakeholders can have different reasons for being part of the TINA system, e.g. to simply use a Video-on-Demand service for home entertainment or to provide many different services to a large number of other stakeholders. In order for a stakeholder, of any type, to properly become a part of the TINA system, some conformance requirements have to be fulfilled. The conformance requirements are expressed in terms of reference points. If one or more of the defined reference points are fulfilled, the stakeholders subsystem is a part of the TINA system[4].

The second purpose concerns requirements on vendors: This is an off-line component interworking issue within a business administrative domain. It allows a service provider to build a TINA system at low cost with components from different vendors picking the most suitable from each vendor. It allows a user to install supplementary software on a PC to run a new service or improve the user environment. It is a TINA requirement that they should

2. The DPE API is not part of the reference point specification as treated in this document but can be seen as a conformance requirement for the TINA Architecture. it is further explained in [6].
3. "TINA subsystems of different stakeholders" equals "administrative domains".
4. Compare with Internet; if a computer conforms to TCP/IP protocol suite and is physically connected to another computer on the Internet that computer also becomes a part of the Internet.

able to go to software vendors and purchase the software without specifying proprietary information about the installed TINA software they already have, e.g., DPE manufacture, or Access Session Software provider.

A stakeholder (e.g. operator) can claim conformance to a certain set of inter-domain reference points. A stakeholder can also use inter-domain reference points as specifications of interoperability within its administrative domain. figure 3-2 illustrates the following:

- Interfaces in TINA (I/F)
- Interfaces for which conformance requirements apply (requirements on vendors and requirements on stakeholders)
- Grouping of interfaces in reference points
- Inter-domain reference points

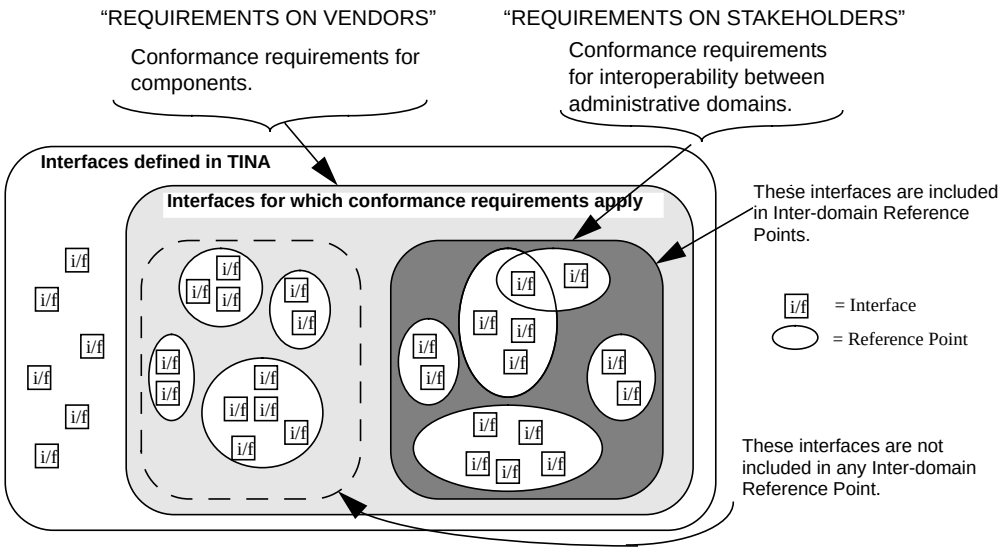

Figure 3-2. Classification of reference points/interfaces.

3.3.1 Inter-domain reference points

The inter-domain reference points are the specifications of the TINA conformance requirements applied to interoperability between administrative domains. This leads us to the following definition of TINA inter-domain reference points:

- An inter-domain reference point is the specification of a set of interfaces which are defined as conformance requirements that apply to a relationship between business administrative domains.

The inter-domain reference points should be used for conformance testing of business administrative domains[5].

5. It is currently unclear whether the TINA-C Core Team should provide the specifications of procedures for conformance testing (test suites, etc.).

Conformance to one (or more) inter-domain reference points is required to allow an business administrative domain to be defined as a part of a TINA system. figure 3-3 illustrates, as an example, the relationship between the concept of inter-domain reference point and the concept of “TINA system”.

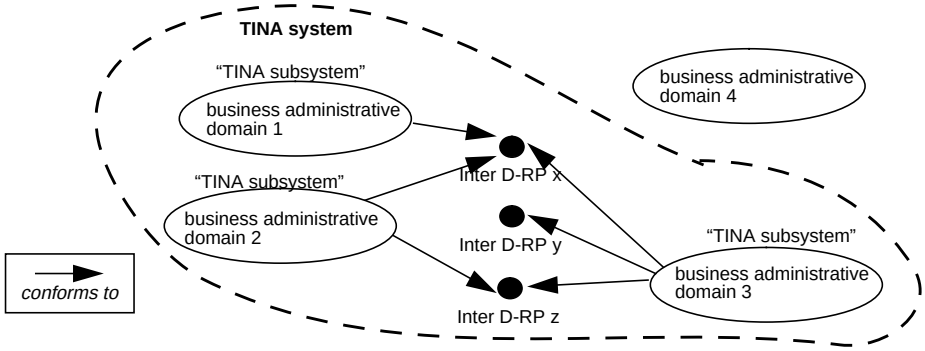

Figure 3-3. Inter-domain Reference Points and TINA system.

The example in the figure assumes that three inter-domain reference points are defined (the number here is not important). This means that these three inter-domain reference points are prescribing some common interactions between business administrative domains. In this example, business administrative domain 1, business administrative domain 2 and business administrative domain 3 have a different degree of conformance to TINA. They all use one or more reference points in order to interact with other business administrative domains - they are therefore part of the TINA system. However, business administrative domain 4 does not conform to any of the inter-domain reference points, though it may provide services through proprietary interactions. Because business administrative domain 4 does not conform to any of the inter-domain reference points it is not a part of TINA system. Hence:

- A business administrative domain in a TINA system can conform to one or more of the inter-domain reference points. If an administrative domain does not conform to any inter-domain reference point it can be regarded as a stand-alone TINA system or a non-TINA system.
- A business administrative domain is not per se limited to support a particular set of the inter-domain reference points. The degree of desired conformance will depend on the business interest of the particular stakeholder.

Business administrative domains can also interact according to proprietary specifications, which implies that a mutual agreement exists among the stakeholders involved. This type of interaction is not submitted to any TINA conformance requirement and is by definition outside the scope of TINA. However, proprietary interactions are anticipated within a TINA system, i.e. service specific interactions will be an important part of a deployed TINA system. The initial set of TINA Inter-domain reference points is given in chapter 5.

3.3.2 Intra-domain reference points

These reference points enable stakeholders to build (compose) a system of components that are developed by different vendors. The intra-domain reference points specify conformance requirements that exclusively apply within an administrative domain, hence the name “intra-domain reference point”. chapter 6 provides the list of currently defined intra-domain reference points.

figure 3-4 shows how the intra-domain reference points are used to combine components of different vendors.

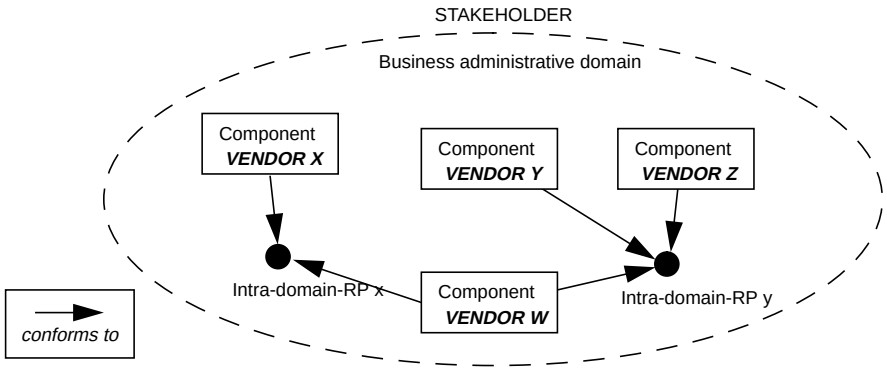

Figure 3-4. Intra-domain Reference Points.

3.4 DPE related reference point part

The DPE related reference point part is not detailed in this document. It is expected that the DPE related reference point part will comply to a standard being defined outside TINA. At present the OMG CORBA specifications concerning interoperability (COSS and IOP) are the closest to fulfilling the requirements generated for a TINA DPE reference point part. (see [6]).

The DPE related reference point part is primarily used for inter business administrative domain interactions. However it can also be used in intra-business administrative domain interactions as illustrated in figure 3-5:

- situation 1: where a single DPE implementation is used within a single business administrative domain to support two business roles, or
- situation 2: where the two business roles are supported by different DPE implementations using the DPE related reference point part as interoperability specification[6].

6. If each business role requires different DPE functionality, the business administrative domain may assign a different DPE profile for each role. In this case, some proprietary specification/ technology can be used for the interoperability between DPEs

•

RP =reference point including bus. relationships

BRel =business relationship (e.g ConS, TCon)

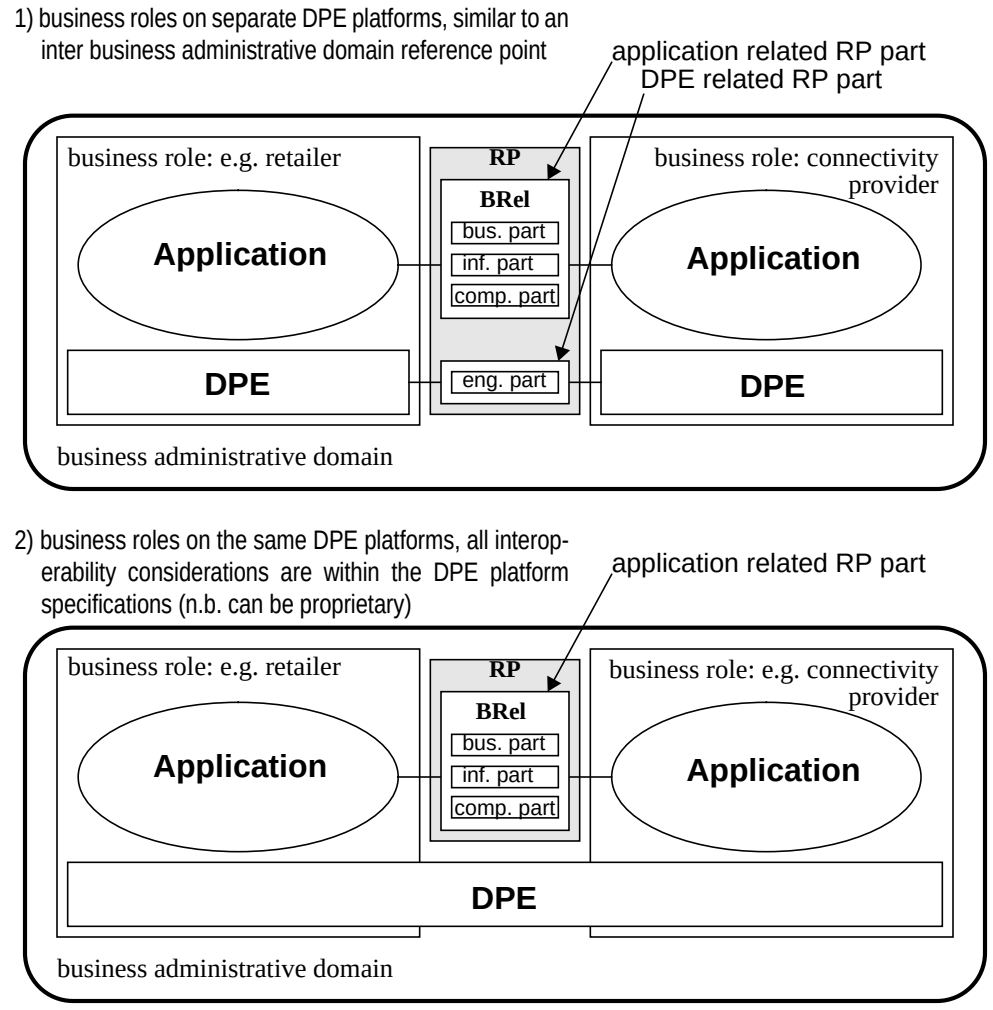

Figure 3-5. DPE related reference point part situations

3.5 Scope of the work on reference points in TINA-C

The documents produced by TINA-C concerning the application related reference points are organized as follows:

- A document containing the definition/identification of reference points and the template that describes how the reference points are specified, i.e. this document (the shaded boxes in figure 3-6).

- Separate documents containing the actual specifications of the reference points (the two white boxes in figure 3-6).
  A consistent document set of reference point specifications will be produced according to the template defined in chapter 4. Documents [8], [9], [10] are the first versions of these specifications of the Ret, Cons and TCon reference points defined in chapter 5.
- Currently, no specification work is being done within the Core Team concerning DPE related reference points (dashed box in figure 3-6). It is expected that specifications can be referenced form OMG as part of the current work on [6] the DPE Architecture.

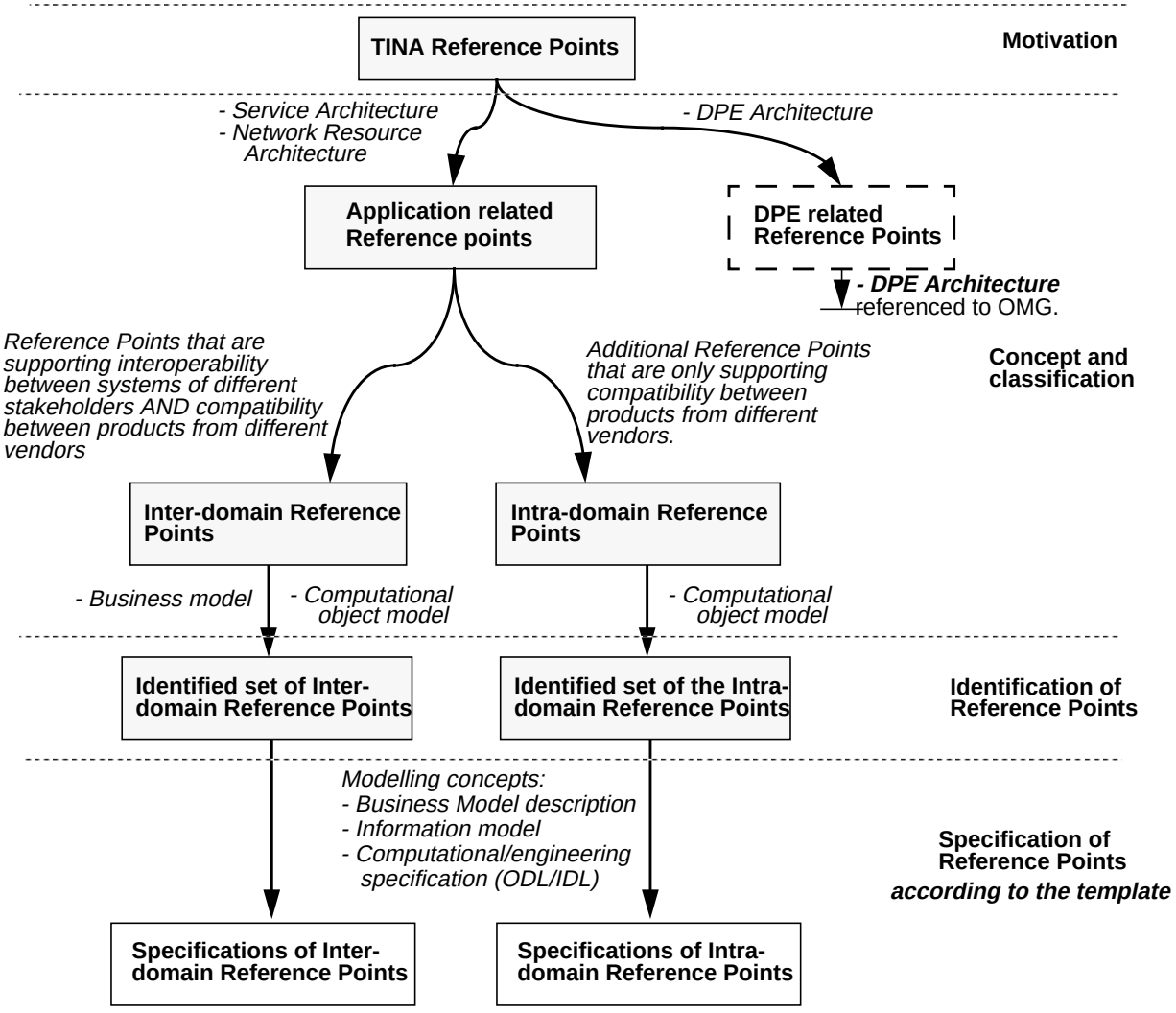

Figure 3-6. Scope of the work on reference points in TINA-C.

4. Specification template for application related TINA reference points

This chapter describes the template used for the specification of application-related reference point parts, i.e., it applies to both inter-domain reference points and intra-domain reference points. This template is prescribed for the specification of the TINA reference points.

A brief example of the connectivity service reference point is provided as an illustration (in *italic* font).

4.1 The business model

Natural language (English) is used to describe the following:

- **Businesses performed by stakeholders involved in the reference point.** This is a high-level description based on the TINA business Model.
  Example: *The connectivity service reference point (ConS-RP) is defined between service providers (of retailer or third-party service provider type), and connectivity providers.*
- **Overall functionality of the reference point and scope.** The overall functional relationships and requirements are described here.
  Example: *The overall functionality of ConS-RP is to provide a transport service between network flow endpoints. If necessary, possibility to perform transport technology adaptation function to transport application information across different layer networks within a transport network.*
- **Functional requirements**. The major types of interactions that are performed over the reference points are to be described, such as description of the access and service usage invocations. This approximately corresponds to the overall description of operations performed by the interfaces that are included in the reference point. Security should also be considered.
  Example: *The major types of interfaces and operations (functions) that are performed over ConS-RP are the following: Authentication, request of a connectivity service for desired transport connections, control and management of the transport connection, request of additional transport resources for new transport connections, control and management of the behavior, life-cycle of the transport session and its transport connection.*
- **Non-functional requirements**. Real-time constraints, fault tolerance, availability, scalability and performance requirements should be included.

4.2 The information model

The language used to describe the following is quasi-GDMO (Guideline for the Definition of Managed Objects) with GRM (General Relationship Model), and OMT (Object Modelling Technique) for the diagrammatic representation. The information model might be complemented with a description in natural language:

- Specifications of information that needs to be made visible between the business administrative domains in order to fulfill the requirements for both business roles in the business relationship. This includes the specification of information

objects, their classification into object types, their relationships, constraints and rules that govern their behavior in the processing of information through the reference point.

Example: *Figure 4-1 provides the information model for the "physical connection graph" as utilized at the ConS-RP (see figure 4-11 in the network Resource Architecture [5]* for more explanation).

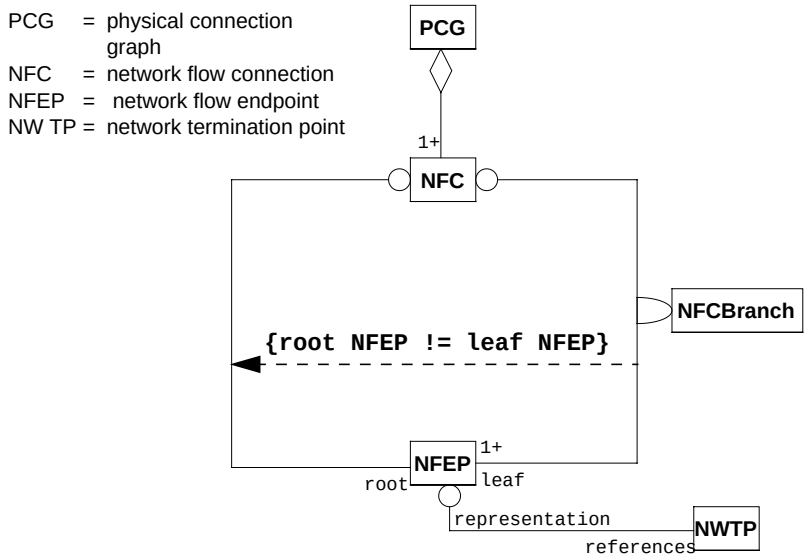

Figure 4-1. *Information model*

4.3 The computational model

The computational model is the major part of the reference point specifications. It consists of five parts:

4.3.1 The object model

This is the description of all the interactions between computational objects directly involved in the specification of the reference point (i.e., all the computational objects that represent end-points of the relationships specifying the reference point). The domain-internal computational interactions can also be described whenever useful. The object model description includes:

- Graphical representation of objects and relationships between objects
  Example: *Figure 4-2 gives an example of an object model for the ConS reference point [9].*

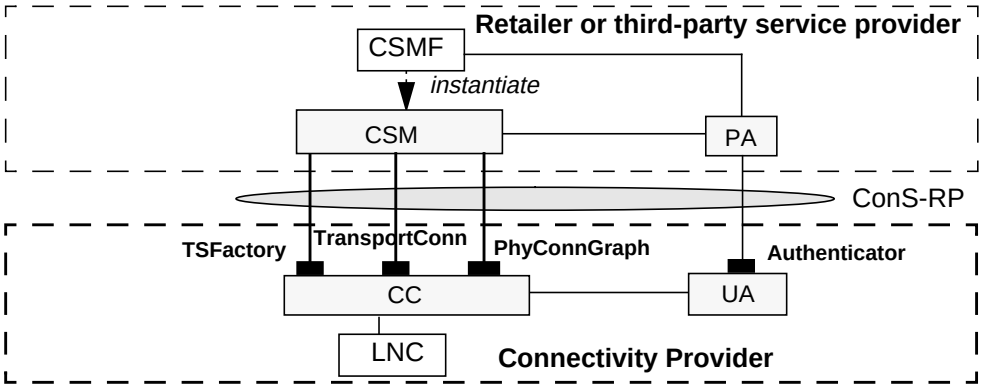

Figure 4-2. *Example of object model for the ConS-RP.*

- Description of interfaces as well as their requirements, in natural language.
  Example: *The authenticator interface is always required by any service provider in order to protect the integrity of its resources and charge for the use of the resources, etc.*
- Description of operations performed by interfaces in natural language.
  Example: *The authentication interface has two operations: (1) The operation "reqRN ()" starts authentication process...(2) The operation "reqAuth ()" authenticates the client by comparing the result with...*

4.3.2 The event traces

This model specifies the dynamic behavior of objects, i.e., the sequences of operations, with the following information:

- Operations and attributes (parameters): Name of the operation and attributes corresponding to the information flow.
- Exceptions: Operations and attributes (parameters) shown in case of exceptions, e.g. failure.
- Timeliness: Time allowed before receiving a response, etc. The values can be relative.

In order for these event traces to be useful, all the interactions occurring among objects involved in a particular task (e.g., authentication, Figure 4-3), should be represented.
Example: *Event trace for authentication, Figure 4-3. For simplicity, Figure 4-3 shows interactions between PA and UA only, whereas this interaction also involves objects like the CSM factory, the CSM and the CC.*

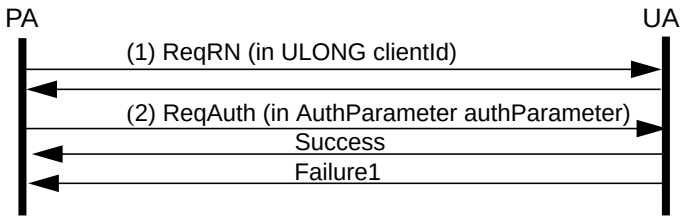

Figure 4-3. *Example of event traces for the authentication part.*

A formal language can be defined and used for the representation of event traces.

4.3.3 Specification of computational objects

The language recommended to specify the following is ODL (Object Definition Language)[1]:

- Interfaces: These are the operational and stream interfaces, including requirements on the service such as QoS.
- Objects, (groups if useful).

4.3.4 Segmenting information

Several reference points may have a number of interfaces in common: For re-use purpose, groups of computational interfaces can be defined as segments of the reference point and referred to in other reference points.

4.3.5 Interface life cycle

The interface life cycle specifies the time duration of the individual interfaces that form the reference point. It is important to specify which interfaces are persistent and which are temporary. For instance, some interfaces are instantiated for the duration of the session only, and other interfaces' life cycle exceeds the duration of a session.

4.4 The engineering model

This part describes the interworking protocols to be used for both kernel transport network and transport network.

4.5 Miscellaneous

In this section statements on non-TINA interactions that are part of the reference point can be expressed (e.g. the use of the DSMCC protocol for control of a VoD data stream).

1. If ODL can not be used IDL may be used, however the reference point specification will become less clear.

5. Definition of TINA inter-domain reference points

5.1 The reference point specifications

As described in section 2.5.1 on page 2-18 the business relationships can be mapped to reference points depending on the grouping of business roles into business administrative domains and the actual specific businesses performed by the business administrative domains.

To provide a initial set of TINA reference points to base TINA products on, the initial business relationships defined in chapter 2.4 have been mapped to reference points. To provide the maximum functionality in each of the reference point specifications, the business roles are mapped on a one-to-one basis to business administrative domain. Thus the initial set of business relationships is mapped to the reference points below.

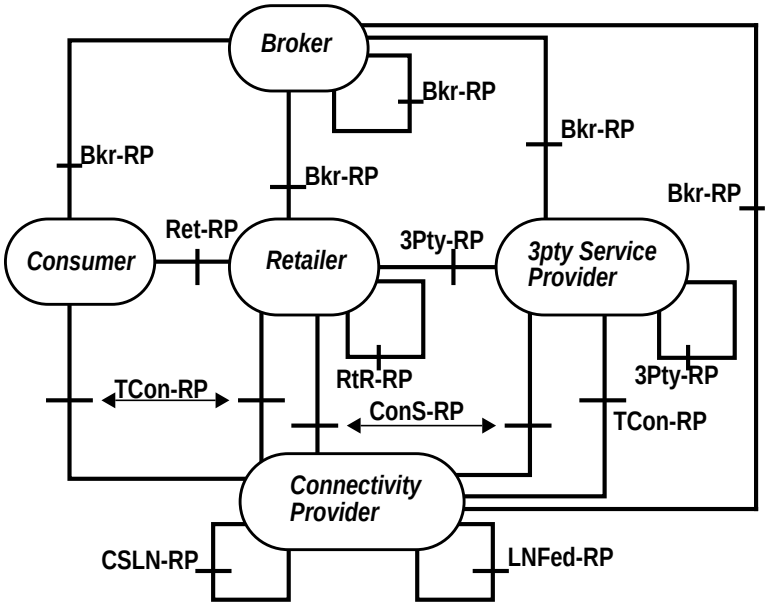

Figure 5-1. Initial set of TINA reference points

Due to the volume of work involved, three high priority reference points have been specified first. They can be found in the following documents:

- The Ret Reference Point (Ret-RP) [8].
- The ConS Reference Point (ConS-RP) [9].
- The TCon Reference Point (TCon-RP) [10].

These documents contain the prescriptive specifications of the reference points needed to be able to provide interoperability between stakeholders running different business administrative domains in TINA.

It is expected that in the near future the following reference points will be specified:

- The 3Pty Reference Point (3Pty-RP).
- The RtR Reference Point (RtR-RP).

- The Brk Reference Point (Brk-RP).

The other reference points are considered lower priority due to the fact that reasonable legacy specifications exist that could be used to provide inter business administrative domain operation:

- The LNFed Reference Point (LNFed-RP).
- The CSLN Reference Point (CSLN-RP).

5.2 Conformance to inter-domain reference points

Example 1a

There are our business administrative domains are defined in this example, see figure 5-2.

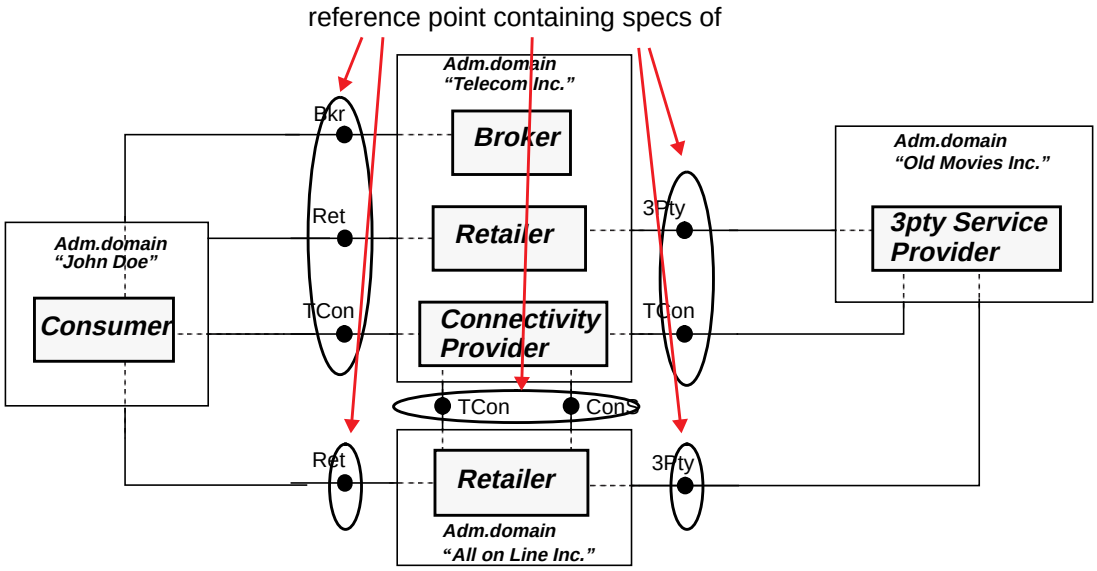

Figure 5-2. Example 1a.

- Business administrative domain ("John Doe"); this stakeholder is only in the consumer business role. The business administrative domain conforms to: the specification of the Brk (user of "Telecom Inc."), Ret (user of "Telecom Inc." and "All on Line Inc.") and TCon (user of "Telecom Inc.") reference points[1].
- Business administrative domain ("Telecom Inc."); this stakeholder is in the broker, retailer and connectivity provider business roles. The business administrative domain conforms to the specification of the: Brk (provider to "John Doe"),

1. Since the specifications of TCon, Ret and Brk will all provide the same access functionality, this needs to be implemented only once on this reference point controlling all the usage parts of the reference point specifications (similar considerations apply to the access part of the other reference point implementations)

Ret (provider to “John Doe”), ConS (provider to “All on Line Inc.”), TCon (provider to “John Doe”, “All on Line Inc.” and “Old Movies Inc.”) and 3Pty (user of “Old Movies Inc.”) reference points.

- Business administrative domain (“All on Line Inc.”); this stakeholder is in the retailer business role. The business administrative domain conforms to the specification of the: Ret (provider to “John Doe”), ConS (user of “Telecom Inc.”), TCon (user of “Telecom Inc.”) and 3Pty (user of “Old Movies Inc.”) reference points.
- Business administrative domain (“Old Movies Inc.”); this stakeholder is in the third-party service provider business role. The business administrative domain conforms to the specification of the: 3Pty (provider to “Telecom Inc.” and “All on Line Inc.”) and TCon (user of “Telecom Inc.”) reference points.

Example 1b

Three business administrative domains are defined in this example, see figure 5-3.

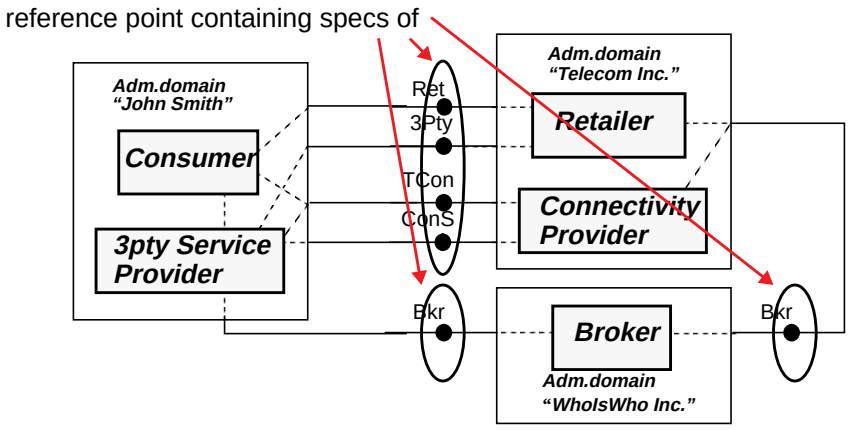

Figure 5-3. Example 1b.

- Business administrative domain (“John Smith”); this stakeholder is in the consumer business role, but also in the third-party service provider business role. The business administrative domain conforms to the specification of the: Brk (user of “WhoIsWho Inc.”), Ret (user of “Telecom Inc.”), TCon (user of “Telecom Inc.”), 3Pty (provider to “Telecom Inc.”), ConS (user of “Telecom Inc.”) reference points.
- Business administrative domain (“Telecom Inc.”); this stakeholder is in the retailer and connectivity provider business roles. The business administrative domain conforms to the specification of the: Brk (user of “WhoIsWho Inc.”), Ret (provider to “John Smith”), TCon (provider to “John Smith”), 3Pty (user of “John Smith.”) and ConS (provider to “John Smith”) reference points.
- Business administrative domain (“WhoIsWho Inc.”); this stakeholder is in the broker business role. The business administrative domain conforms to the specification of the: Bkr (provider to “John Doe” and “Telecom Inc.”) reference points.

6. Definition of TINA intra-domain reference points

The application related intra-domain reference point parts are defined in this chapter. Chapter 2 provides the business model as the support for the identification of inter-domain reference points. These inter-domain reference points can also be used as conformance requirements for components that can be used when implementing a TINA sub-system. However, the business model does not provide enough granularity to identify all the candidate interfaces for component composition purposes. Indeed, the business model reflects the potential domain boundaries, without any information on the internal structure of a domain. The interfaces and their grouping are represented in the computational viewpoint, i.e., the computational model is used for the identification of intra-domain reference points.

The motivation for defining only a limited set of inter-domain reference points was to determine the important interfaces which are likely to be offered between two domains. A similar reasoning is adopted for the identification of intra-domain reference points. The important reference points are determined by both technical (or architectural) and business reasons. The TINA architectural model is then the basis for discussion on business and technical needs to define an intra-domain reference point at a specific location.

6.1 Computational Model

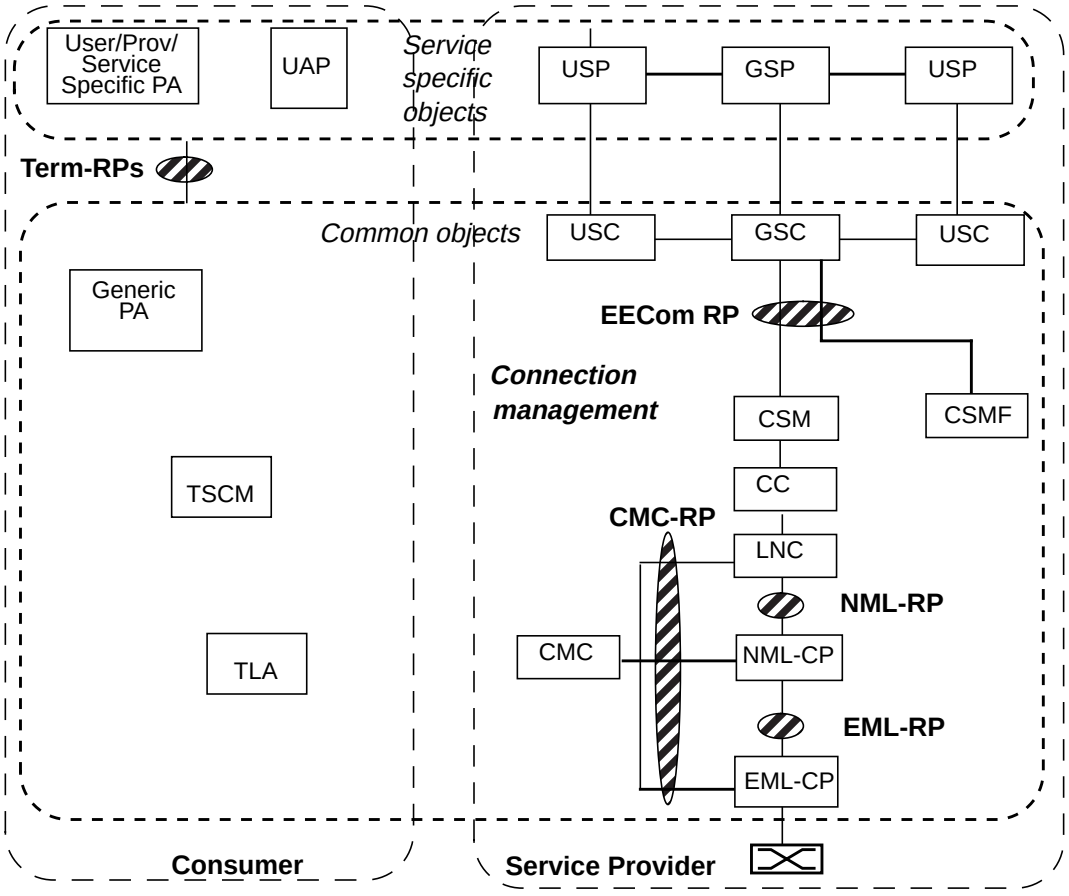

Figure 6-1. TINA computational model

Figure 6-1 represents the TINA computational model. The important intra-domain reference points (i.e., the ones that must be defined with priority) are illustrated in the figure. The inter-domain reference points are not illustrated in the figure for simplicity reasons.

6.2 Intra-domain reference points

6.2.1 Terminal intra-domain reference points (Term-RPs):

The objects in the terminal comprise service/provider/user specific objects (the specific objects) and generic objects (the common objects). The common objects are provided by default in any terminal and constitute as such the basic requirements that must be fulfilled by any “TINA terminal”. They perform basic services such as initial access, initial negotiation with the retailer, UA configuration, service provider selection, downloading, environment handling, etc. The specific objects perform advanced/customized functions such as specific provider or service access/usage functions.

In order to ensure compatibility between default software (common objects) and software supplied by ANY other vendor (specific objects), intra-domain reference points are defined. These reference points are referred to as Terminal RPs (Term-RPs).

Term-RP represents the interfaces involved in the interactions between common objects, and specific access objects, in order to provide the following functions:

- First access to the generic provider agent upon a service/provider access request.
- Handling of an incoming session request (message forward to service/provider specific objects).
- Etc.

6.2.2 End-to-end communication intra-domain ref. point (EECom-RP)

This reference point has long been considered as a candidate for the connectivity service inter-domain reference point. Appendix C explains why this reference point is not an inter-domain reference point.

This reference point is however important as it reflects the separation between service session that provides service specific and generic session functions, and communication session management that provides stream binding services between source and sink flow endpoints (Stream Interfaces). These two groups of objects can indeed be provided by different vendors, those who provide pure service components (service logics and generic session), and those who provide stream-binding interfaces.

The functionalities that should be provided by this reference point are the following:

- Request for stream binding service (communication session factory interface).
- Modification of the behavior and configuration of connections.
- Modification of the overall behavior and configuration of a communication session (logical connection graph interface).

6.2.3 Network management layer intra-domain ref. point (NML-RP)

This Reference Point provides subnetwork connection management capabilities. Given the current trend in ATM Forum (M4 Network View) and ITU (SG15 work on Network Level Model), this RP is important to identify and serves an immediate business need for stakeholders in connectivity business.

6.2.4 Element management layer intra-domain ref. point (EML-RP)

In the TINA Connection Management Architecture, computational objects are defined to manage layered networks, with a view on the network that varies from the end-to-end communication (at the levels of CSM), to the level of the individual switch (EML-CP). Within one layer network (each layer network being coordinated by an LNC in one domain), a number of NML-CPs manage a group of switches that are gathered for connection management (setup, modification, release) purposes.

For a number of reasons (including low cost, maintenance, internal policies, etc.), a connectivity provider is likely to own switches from different equipment vendors. In a TINA environment, switches will probably be provided together with the components that individually manage them, i.e., the EML-CP. It is thus important to ensure compatibility between the EML-CP and the components that will be interacting with the EML-CP. There are two of such components: The NML-CP that is responsible for a group of EML-CPs for setting up subnetwork connections, and the Connection Management Configurator (CMC) that provides support for the network resources management.

The defined reference point (EML-RP) should provide the following functions:

- Sub-network connection interface for call-by-call connection setup. The NML-CP uses this interface.

6.2.5 Connection management configurator intra-dom. ref. point (CMC-RP)

The Connection management configuration interface supports installation, removal, activation/deactivation, reservation, control and status of the EML-CP, the NML-CP and the LNC. The CMC supports the interfaces for performing the above operations.

Other interfaces may be described as intra-domain reference points, but are currently considered as “less important”. As it is the case for the inter-domain reference points, this list may evolve in the future.

References

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[3] *Definition of Service Architecture*, Document No. TB_MDC.012_2.0_94, TINA-C, December 1994

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[5] *Network Resource Architecture*, Version 3.0, TB_FS.001_3.0_97, TINA-C, 10th February 1997

[6] *TINA Distributed Processing Environment*, Document No. TR_PL.001_1.3_95, TINA-C, December 1995

[7] *TINA-C Glossary of Terms*, Version 2.0, TB_HM.001_2.0_970107, TINA-C, 7th January 1997

[8] *The Ret Reference Point*, Version 1.1, TINA-C, 2nd December, 1996 (interim version)

[9] *The ConS Reference Point*, Version 1.0, TINA-C, 12th February, 1997 (interim version)

[10] *The TCon Reference Point*, Version 1.0, TINA-C, 21st October 1996 (interim version)

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[11] *TINA Broker in the Service Layer*, Version 0.3 (Draft), Document No. EN_RCJ.031_0.3_96, February 1996.

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Other documents:

[14] ISO/IEC 10746-1 / ITU-T Recommendation X.901, *ODP Reference Model of Open Part 1: Overview*, International Organization for Standardization and International Electrotechnical Committee, 19-29 July 1994.

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Realization. Globecom ‘93, Houston, Texas.

Appendix A: RM-ODP viewpoints in TINA context

TINA is an architecture that is based on the concept of distributed computing, i.e. that implies, for example, that location transparency is provided to the TINA application programmer in a certain phase of application construction.

As a help to describe TINA, the RM-ODP modeling concepts are used. The RM-ODP states that one can view distributed applications from five viewpoints, these are the enterprise viewpoint, the information view point, the computational viewpoint, the engineering viewpoint and the technology viewpoint.

Each of these viewpoints describes a distributed application in a particular way taking into account a specific set of properties. Viewing an application in one viewpoint reduces the amount of information that has to considered. The viewpoints are used to reduce the complexity in description/specification (design) of distributed applications. The viewpoints are helping us to describe TINA, the specifications and descriptions becomes more comprehendible.

The viewpoints have been used to describe the TINA service architecture and the TINA network resource architecture. The DPE architecture is a collection of requirements that address the properties needed in an implementation of the TINA distributed processing environment. An implementation of the TINA DPE architecture is the environment or platform to which implementations of the service architecture and network resource architecture are based upon (and uses). In addition to this, included in the DPE architecture are also requirements of so called DPE services. The DPE services are generic support functions that any application can utilize e.g. a trading service. The DPE services are specified as “ordinary” applications.

Because implementations of the TINA service architecture, the TINA network resource architecture and the TINA DPE services are distributed applications, they can all be described with the ODP viewpoints. See Figure 0-1.

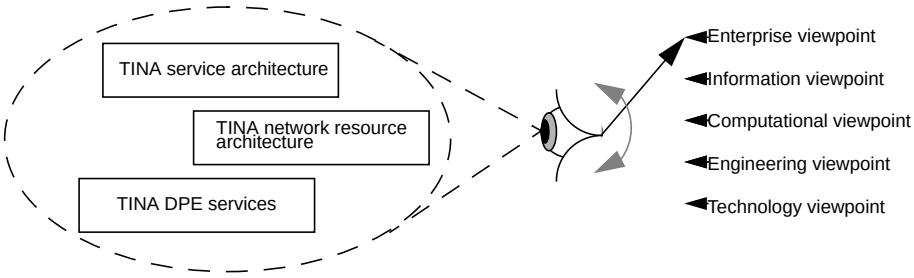

Figure 0-1. ODP view points

The DPE architecture, except the DPE services, describes only properties that are visible in the ODP engineering and technology viewpoints. This indicates that the DPE architecture, except the DPE services, can not be described in the same way as the applications (implementations of the service architecture, network resource architecture and DPE services).

The ODP viewpoints are used to describe TINA, but a practical approach has been taken when it comes to actually utilize the different viewpoints, in some cases a particular viewpoint has been proven to be useful, in some cases not.

In the enterprise viewpoint, the business requirements upon a TINA system are captured. The enterprise viewpoint describes/specifies the various aspects of collaboration between stakeholders in a TINA system, that is; collaboration between entities in a TINA systems that are owned by different stakeholders. The relationships between the stakeholders (and the roles) are modeled in this viewpoint. The language used in TINA to describe the enterprise viewpoint is natural language (English) and figures with an informal notation.

The information viewpoint is concerned with the information that need to be stored and processed in the system. It gives a view of the information without concerns of the design of the functions that actually manage/handle this information. The language used in TINA to describe the information viewpoint is the graphical notation OMT and the textual notation quasi-GDMO (a variant of GDMO).

The computational view point is concerned with the functions needed in a system. It describes the system in an object-oriented fashion - as a set of interacting objects. The objects encapsulates the sub-functions of the TINA system without taking into account the actual distribution/deployment of objects on various computing nodes. The objects are defined as computational objects. For each of the computational objects the external interfaces is specified and its internal behavior. The interfaces are of two types; they can be a set of operations or a set of streams. The language used in TINA to describe the computational view point is TINA ODL which is a superset of OMG IDL.

The engineering viewpoint is concerned with the actual distribution/deployment of the computational objects in a distributed processing environment. The different nodes that the environment consists of becomes visible in the engineering viewpoint. The computational objects are transformed to so called engineering computational objects (eCO). To support the management/handling of the eCOs, concepts such as capsule (grouping of objects that utilize same memory space and processing resources, within a node) and cluster (subgrouping of objects within a cluster for management/migration/installation reasons). In addition to the eCO, which are the transformed computational objects of the applications, the capsule and the cluster etc. are also modelled as objects -these are defined as engineering objects (eO). To support the communication (transport of data) between the computing nodes the channel models are defined, one channel model for operations and one channel model for streams. The channel models are also supported by a set of engineering objects. The language used in TINA is not yet defined as a formal notation, informal ways to describe the engineering viewpoint is used, figures and plain English.

The technology view point is concerned with the “details” of the components which the distributed processing environment is constructed, such as implementation languages, protocol stacks used for transport, operation systems and physical equipment. Currently, it is not in the scope of TINA-C to prescribe TINA in the technology viewpoint. No formal language/ notations are used for this purpose. To some extent examples and informal descriptions concerning the technology viewpoint is presented.

A more profound explanations of the modelling concepts can be found in RM-ODP documentation, TINA modelling concepts documentation and TINA DPE documents.

Appendix B: Reference point concepts in RM-ODP

TINA is using several concepts defined in Reference Model of Open Distributed Processing (RM-ODP). Concepts for reference point are described in RM-ODP[14], [15] and [17]. The concepts are reused to some extent in TINA.

In the various RM-ODP viewpoints reference points can be defined. E.g. in the computational view point reference point can be defined and in the engineering viewpoint reference points can be defined, the reference points in the different view points are related but they are in described as different reference points.

All interfaces in the RM-ODP are defined as reference points, the subset of these reference point to which conformance requirement apply is chosen as conformance points.

RM-ODP addresses the subject of reference points as a feasible support for conformance testing according to standards. These reference points pertains mainly within the computational and engineering viewpoints, as they are realized by object interfaces. However, all viewpoints are reflected in a reference point, e.g in the enterprise viewpoint a specification should enumerate reference points for a certain stakeholder.

Furthermore, RM-ODP specifies four types of reference points:

1. Programmatic reference point; a programmatic interface allowing (logical) access to a function. This reference point type corresponds to intra-domain reference point defined in TINA.
2. Perceptual reference point; a point between the system and the outside world, e.g. the human-computer interface. It is not in the scope of TINA to define user interfaces etc.
3. Interworking reference point; a point where communication between two (or more) systems can be established. This reference point type corresponds to inter-domain reference points defined in TINA.
4. Interchange reference point; a testable point for a specific interface bridging a system and an external physical storage medium. This is a special type of reference point which is not addressed in TINA.

A particular reference point can become any of the listed types of reference point depending on the conformance requirements that apply[1].

The reference points are depicted in Figure 0-2.

1. The 4 types of ref. points should rather be called conformance points *[editor's note]*

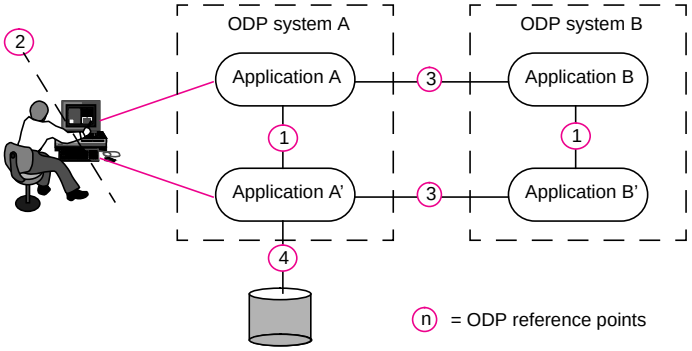

Figure 0-2. RM-ODP reference point types.

Points which define conformance for an ODP system are called ‘conformance points’. Reference points are candidates for being defined as conformance points (in RM-ODP).

Appendix C: Choices considered for ConS-RP

Chapter 3 determined the usage part of the connectivity service reference point (ConS-RP) as the interfaces between the Communication Session Manager (CSM) and the Connection Coordinator (CC). In fact, that choice is the result of an analysis of the possible candidates for this reference point. This analysis is presented in this Appendix.

The connectivity service reference point could be defined at the following locations, as depicted in Figure 1. The access components are not represented for simplicity.

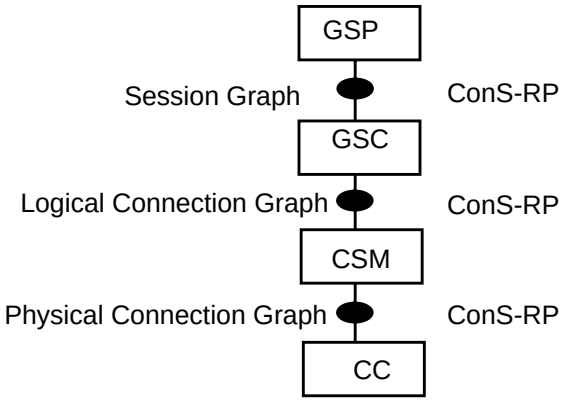

Figure 1. Possible locations of the usage part of ConS-RP

Session Graph as the inter-domain reference point:

Figure 2 shows a scenario in which the domain boundary of service providers and connectivity service providers is between the service specific objects and the generic session objects of the service session. In the scenario, a simple, common service usage is explained, from the access to the service use.

Scenario 1: A service session is initiated by the consumer. The consumer has access to his retailer that also provides the service logic. This scenario involves: access to the retailer, service specific objects instantiation in the retailer domain, access to the connectivity service provider and instantiation of the generic session objects(1...17).

1. Consumer access to the retailer to initiate a service session.

2. The UA requests service session instantiation to the service factory.

3. Instantiation of the service specific objects in the retailer domain. As this phase is always accompanied by the instantiation of the generic session objects (traditionally in the same domain), the latter must be instantiated in their domain, i.e., the connectivity service provider domain. This involves an additional access phase which makes the scenario heavier.

4. Access to the connectivity service provider domain to instantiate generic session objects.

5. 6. 7. Instantiation of the generic session objects.

8. result of the instantiation, object references of the USC, GSC are passed back to the GSP.

9. 10. Object reference of the USC and USP are passed to the UAP.

11. The UAP passes the object reference of the USC to the GSEP'95.

12. The consumer requests a service specific operation.

13. The USP must check with the USC the user authorization for performing the operation. If the generic session objects were in the same domain, it is likely that the two objects would be implemented in the same nucleus, hence no need of remote binding operations.

14. Authorization confirmed (for example).

15. If the authorization is agreed, the USP forwards the request to the GSP that has the centralized control. Again, the GSP must access the corresponding generic session object (GSC) to check if other parties have to confirm the operation.

15'. The GSC sends the address of the possible parties that need to confirm. Here again, the domain boundary has been crossed, and a remote binding has to be performed.

16. 17. Authorization result is forwarded to the consumer that can (or can not) proceed to the operation he wanted to perform.

Scenario 2: The consumer performs generic session related operations:

There are two possibilities: The USC is accessed directly from the GSEP (a") and forwards the request to the USC and GSC (b, c). In this case, the terminal communicates with different administrative domains via different interfaces. Problems of consistency are the result of this configuration. The other possibility is to access generic session objects via the USP (a & a'). Again, as in the previous scenario, the domain boundary must be crossed.

Scenario 3: The service logic is provided by a third-party service provider. A service session must then be instantiated. If the service specific objects only are instantiated in the third-party service provider domain, then the latter has to know about the connectivity service provider to instantiate the generic session objects. If the complete service session is instantiated in the third-party service provider domain, the GSC located in the connectivity service provider domain must have information on (know how to access) the service session in the third-party provider domain. Three parties are involved (the retailer, the connectivity provider, the third-party provider) instead of two for performing service session-related operations.

These scenarios show that:

1. Whenever a service session is instantiated, an additional access session must be performed between any service provider and the connectivity service provider. (No access session if service session objects in the same domain.)
2. Whenever a service specific operation is performed, the domain boundary is crossed at least twice (This number is proportional to the number of parties involved in the service session). (No domain boundary crossed if service session objects in the same domain. No remote binding necessary.)
3. Whenever a session specific operation is performed, either a different interface to a different domain is used, which implies problem of consistency between objects

in the terminal, in the service provider domain, and in the connectivity provider domain, or the same interface is used (through the USP), and domain boundaries must be crossed (cf 2.). (If service session objects are in the same domain, the same object (service session) can be accessed from the consumer, through different interfaces. No problem of consistency.)

4. Whenever a third-party service provider is involved, it has to know information about the connectivity service provider that is used to instantiate generic session objects, the other possibility being that the generic session objects are instantiated within the third-party service provider domain. In this case, the connectivity service will have to know how to access the third-party service provider. This is heavy in both cases.
5. As a result, the performance is deteriorated because of the number of remote accesses.
6. Accounting for service session: a negotiation for the accounting process will have to be done between the retailer and the connectivity service provider. (If service session objects are in the same domain, such a negotiation is not necessary.)

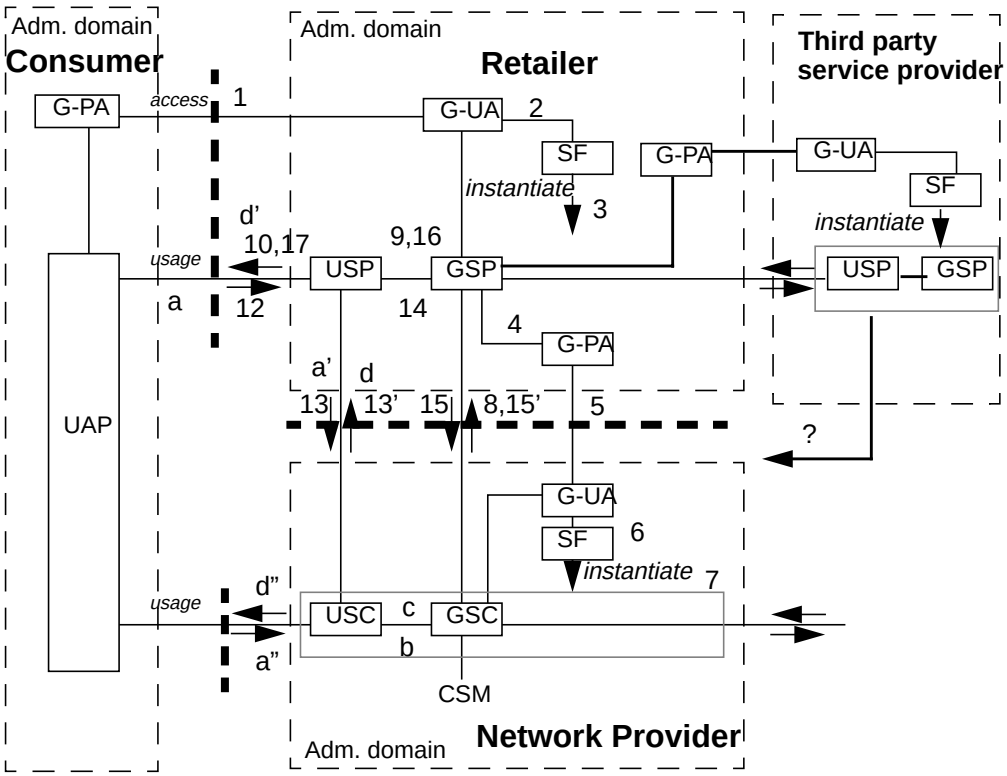

Figure 2. Session graph as the ConS inter-domain reference point

Logical Connection Graph as the inter-domain reference point:

Figure 3 Shows a scenario involving 6 administrative domains: 2 end-users, one service provider (retailer), and three connectivity service providers. The connectivity providers have the CSM function, i.e., they offer logical connection graph interface to the service providers.

When a service session is instantiated, the connection is set up. The GSC passes to the CSM service stream references (SIref) of each end user involved in the service session (two in the example). An access session occurs before the actual SI transfer to the CSM. The CSM proceeds to the CC and underlying objects in order to negotiate the connection through the different connectivity service domains (three domains in this example). The network access points of the two users are selected, then passed back to the CSM. The CSM is then in charge of establishing the nodal connection graph which is a representation of the connection between the stream interface and the network access point. In this scenario therefore, the CSM must have information on the stream interfaces that are traditionally considered as service specific entities.

This scenario shows that:

1. There is a looping of stream interface references amongst three parties (instead of two, the consumer and the service provider).
2. If the CSM were in the service provider domain, the nodal connection graph would not need an additional kTN connection (between the connectivity provider and the consumer) as the same kTN connection could be used as between the consumer and the service provider. There are thus additional DPE connections that can deteriorate performance.
3. Problem of security & confidentiality: Any connectivity provider that offers a logical connection graph interface must be given the references of end-users' stream interfaces. In the case that the retailer performs no connectivity service, it will have to use the services offered by a connectivity service provider, and provide him with the stream interfaces of his clients. The connectivity service providers are in general (current case in legacy systems) involved in the provision of higher level services (i.e., they perform retailer or third-party service provider businesses). This means that if they are given stream interface references, they would be given the possibility to contact the clients to, for instance, advertise their own service.

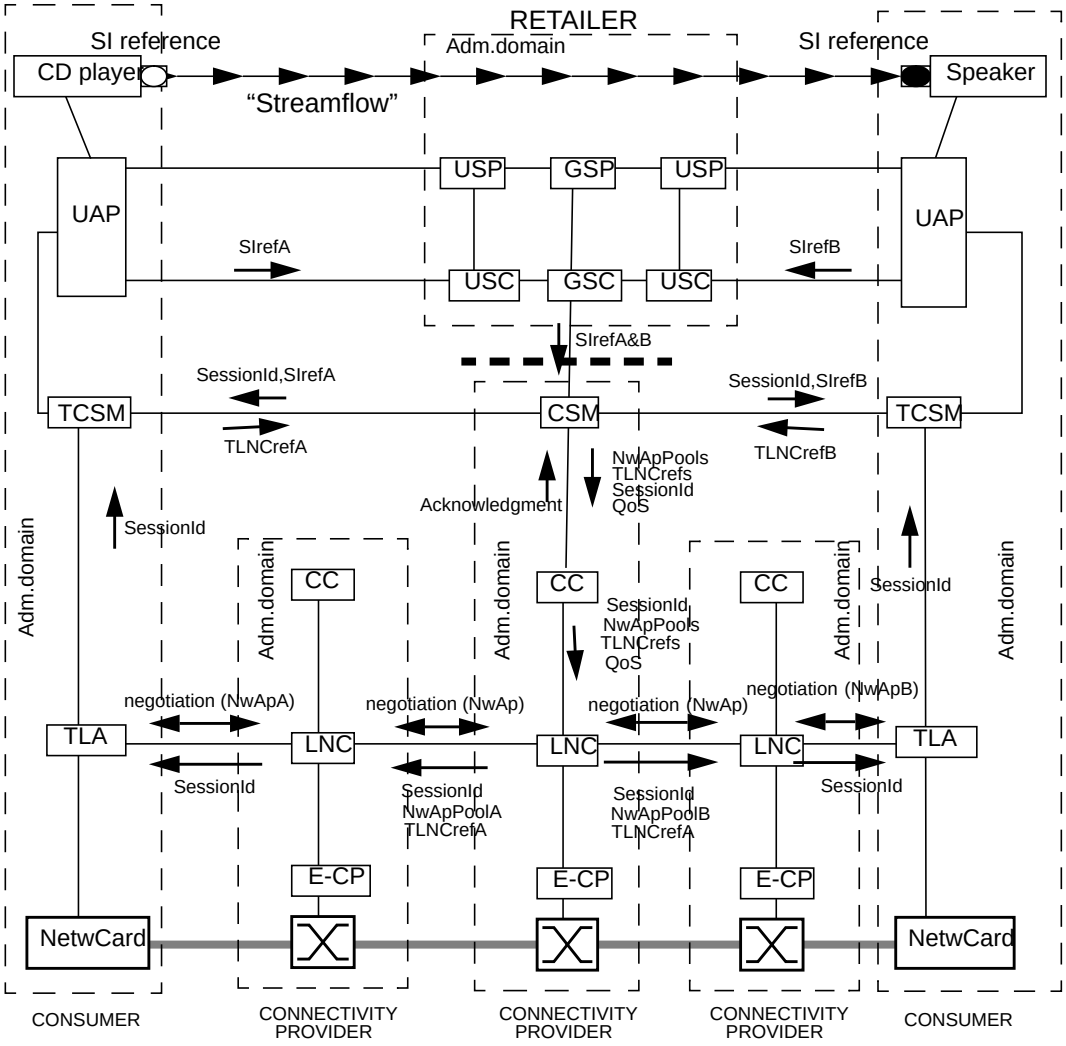

Figure 3. Logical connection graph as the ConS inter-domain reference point

Physical Connection Graph as the inter-domain reference point:

Figure 4 shows the last possibility for the location of ConS-RP, i.e., connectivity providers offer a physical connection graph to service providers. In this scenario, the service provider is in charge of handling internally stream-related operations without accessing a connectivity service provider. The drawbacks mentioned in the previous scenarios concerning performance, security, etc. are then discarded. The connectivity providers are only in charge of establishing connections amongst network resources.

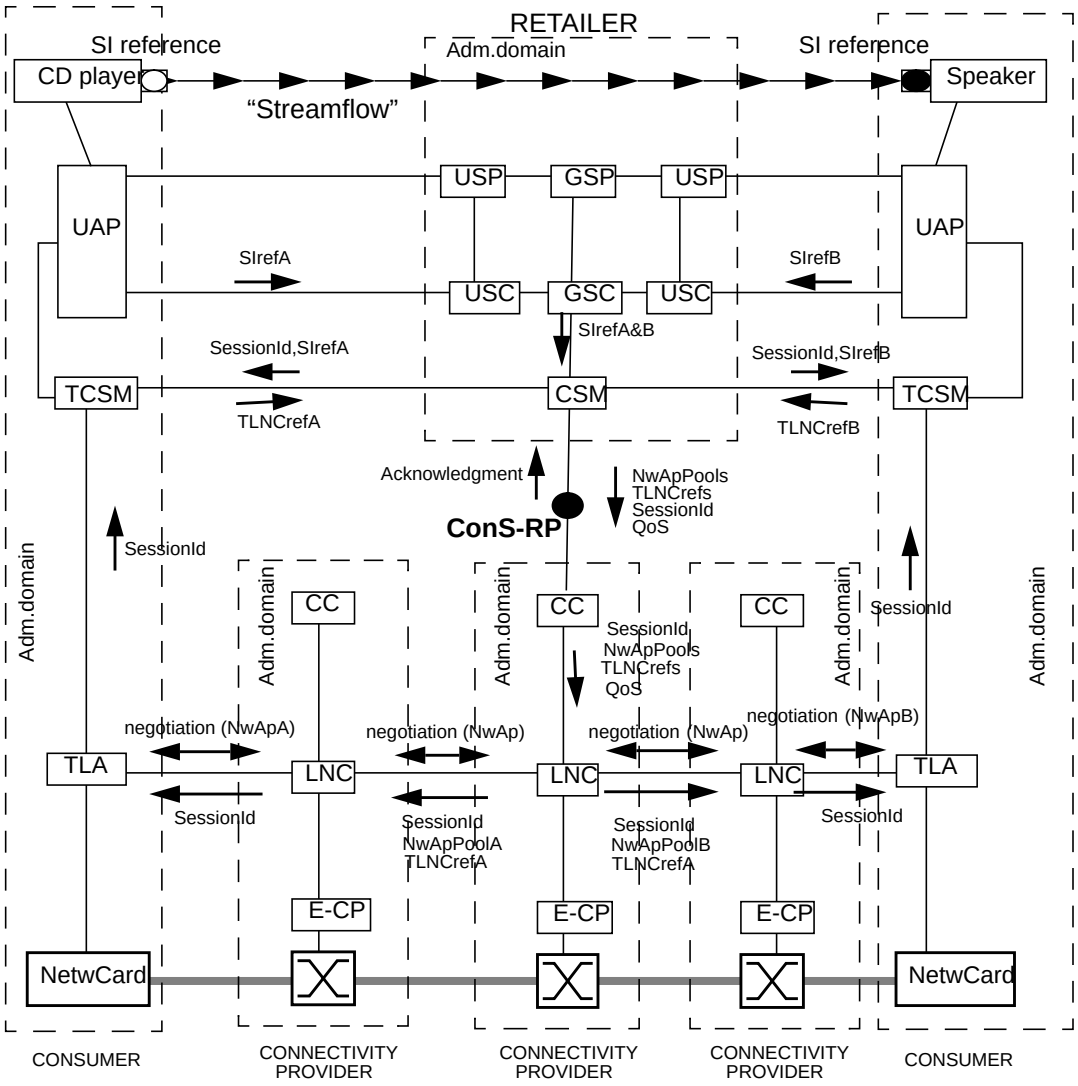

Figure 4. Physical connection graph as the ConS inter-domain reference point