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Intermediate report on industry-specific cases of value chains in cloud software business, their composition and description how value is generated for the customers and providers.

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Abbreviations

API	Application Programming Interface	An interface in a software program which allows it to interact with other programs.
BNMA	Business Network Model Agent	Software that may decide itself what action is appropriate for ensuring adherence to agreed upon collaboration behavior.
BoBo	Billing-on-Behalf-of	Telco payment and settlement services and related business infrastructure for utilizing the services.
BPaaS	Business Process as a Service	Electronic representation of a business process as a web service.
BPEL	Business Process Execution Language	Machine-executable language for specifying interactions with Web Services.
CPN	Colored Petri Net	A graphical oriented language for design, specification, simulation and verification of systems
CSF	Critical Success Factor	Business model area, which creates – if successful – value for the whole value network.
NaaS	Network as a Service	Network operator business model where network capabilities are offered as utilities through open application programming interfaces. In essence, a synonym to Open Telco.

NFC	Near Field Communication	Short-range wireless communication system.
NIST	National Institute of Standards and Technology	A non-regulatory agency promoting innovation and industrial competitiveness in the United States.
OEM	Original Equipment Manufacturer	Company that sells an end-product to the customer.
P2P	Peer to Peer	A distributed collaboration architecture that partitions tasks or workloads between peers.
RFID	Radio Frequency Identification	Radio-wave based system for identification of tagged objects.
SME	Small and Medium Enterprise	Companies whose headcount or turnover falls below certain limits.
SLA	Service Level Agreement	Part of a contract where the level of service is formally defined.
SOC	Service Oriented Computing	Task automation with internet-addressable software functionality.
STOF	Service, Technology, Organization, and Finance	Business model design and analysis framework.
WS	Web Service	Internet-addressable software functionality.
WSLA	Web Service Level Agreement	Machine-readable Service Level Agreement for Web Services.

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Chapter 1 – Business in Open Telco

1.1 Introduction

Recently, much interest has risen towards opening up the traditional walled garden model of the mobile operator business by, for example, providing third-party developers with access to some of the network assets of the operator through open Application Programming Interfaces (API). Shifting away from the walled-garden model towards a more open model would increase innovation and possibly provide an answer to the current telecommunications industry challenges of increasing competition and decreasing average revenue per user (ARPU). Understandably, the network operators must benefit from the new, more open policy for it to be realized. Regulation changes and other similar routes would take too much time; thus, profitable openness is the only force that could create quick changes.

Finally, with efforts such as Open Telco, the mobile operators can begin to take advantage of the opportunities of Open Innovation [1].

This paper is an intermediate report on industry-specific cases of value chains in *cloud software business*, their composition and description *how value is generated* for *the customers* as well as *the providers*; more specifically, the paper addresses Open Telco specific cases of value networks.

Cloud Software Program Deliverable D3.1.1 [2] defines *cloud software* as sharing the essential characteristics, service models, and deployment models with the National Institute of Standards and Technology (NIST) definition for *cloud computing* [3]. For the purposes of this document c*loud software business* is thus defined as the operation of a profitable business utilizing the cloud software concepts. Moreover, definitions for the related terms, such as *cloud*, *cloud computing*, and *cloud services* can also be found in Cloud Software Program Deliverable D3.1.1 [2].

Structure of this document is as follows: Section 1.2 describes the research framework and methodology, Section 1.3 introduces the industry-specific cases placed under critical analysis, Section 1.4 presents the analysis, and finally, Section 1.5 draws a conclusion to the findings.

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1.2 Study Framework and Methodology

This Chapter presents an overview of the theoretical framework and the research methodology applied in this study. The framework used for the analyses of Open Telco in general and the value networks of the industry cases described in Section 1.3 is the Service, Technology, Organization, and Finance (STOF) model developed by Bouwman et al. [4]. The research method of this study is collective case study [5].

1.2.1 STOF Model and Method

This section gives a brief introduction to and a description of the STOF model and method which were developed especially for the analysis and development of business models of mobile services. The STOF model is a conceptual business model framework consisting of Service, Technology, Organization, and Finance domains, which provides a holistic view on business models. Figure 1 illustrates the different business-model domains in the STOF model [4].

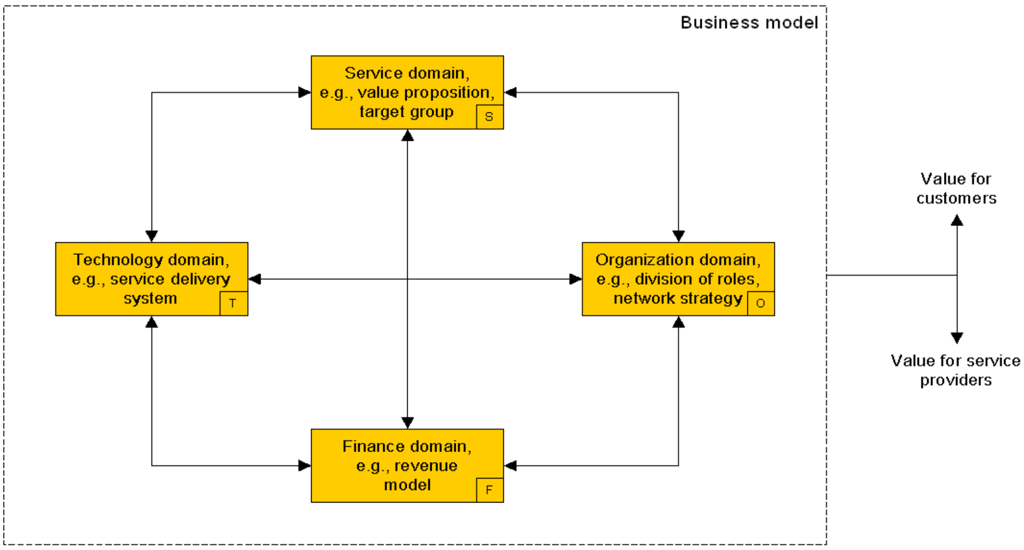

Figure 1. STOF Business-Model Domains

Service domain of the STOF model concentrates on customer value and the value proposition of the service, describing how value is generated for the target user-group of the service. *Technology domain* of the STOF model concentrates on the technologies required to deliver the service. The functional and non-functional requirements created by the service domain of the business model are considered in the technology domain. *Organization domain* of the STOF model concentrates on the value network, the roles and value activities of the different actors within the network, and describing the organizational relationships between the actors. *Finance domain* of the STOF model concentrates on the revenue model of the business model; that is, how investments, costs, risks, and revenues are realized for the actors involved in the value network of the business model.

For this study, in addition to the STOF *model*, the STOF *method* was applied in the form of its first two steps. The STOF method consist of a quick scan of the business scenario and evaluation of the business scenario with the related Critical Success Factors (CSF), described in [4] and [6]; thus, the end result is an intermediate business model proposal, developed from each of the analyzed usage scenarios. Figure 2 illustrates the outline of the STOF method [6].

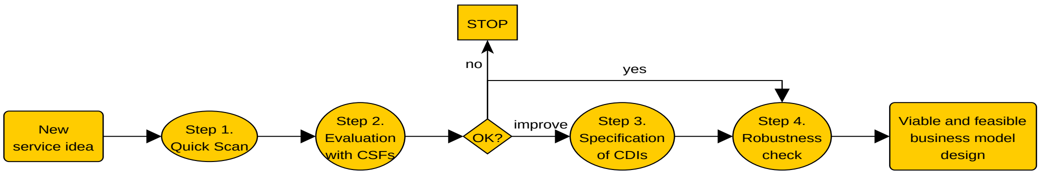

Figure 2. STOF Method Outline

Guidelines on applying the STOF method steps one and two, presented in [6] were utilized in conducting the analysis.

1.3 Study Cases

This section provides an introduction to the selected study cases – the general Open Telco framework and two Open Telco specific usage scenarios – which are placed under critical analysis in this study. Descriptions of these cases are presented below.

1.3.1 Open Telco Framework

As the first case, we cover the Open Telco business environment through a high-level analysis. The STOF model is applied in the analysis; however, we concentrate on the organization and financial domains of the ecosystem as the service domain is covered in more detail by the specific business-case analyses and the general technology-domain issues are covered in depth in Cloud Software Program Deliverable D1.2.1 [7]. Moreover, by the general organization and finance domain analyses we aim to emphasize the importance of cooperative arrangements in the organizational and financial domains between actors in Open Telco business environment.

1.3.2 Open Telco Specific Usage Scenarios

As the other two study cases, we picked a Open Telco usage scenario – Event Experience – developed during spring 2010 under the Cloud Software Program [8][9][10][11], and Open Telco service demo – Kassi Ridesharing.

1.3.2.1 Event Experience

Event Experience case is an Open Telco specific service which couples mobile event-admittance tickets to socially engaging and event-experience enhancing complementary services as well as to additional supplementary services. In Cloud Software Project Open Telco Scenario descriptions [9], the Event Experience case is described as a usage scenario; the description is cited below:

> *"Matti and Mikko have succeeded to buy mobile tickets to Green Day's concert in Kaisaniemi park. They are heading to the concert well in advance as rush is expected. The mobile ticket included a bus ticket as bonus benefit and also a route guidance. That is convenient, they think – this helps people to leave their cars at home and use public transportation. Now their phones alert both at the same time. The concert organizer is guiding Matti and Mikko to use gate B as gate A is crowded, and as they are still far enough to change their route. They got in and found their seats in no time. Now it is time to read the latest comments by other visitors on the event's blog and see if any of their friends are located at the concert area. Matti and Mikko are also invited to vote for the encore song of the concert."*

The Event Experience case includes elements from mobile-service application areas, such as mobile commerce, information, and social networking. The case takes advantage of several telco capabilities, such as messaging, payment, and positioning. The case is placed under critical analysis in Section 1.4.2.

1.3.2.2 Kassi Ridesharing

Kassi Ridesharing is a service which provides a car-pooling offer and request system aimed to decrease the user effort of sharing car rides with other users in a local community of trusted peers.

The system identifies two types of users in the ridesharing context:

a. Users who are planning to drive a route and would be willing to share the ride with another user in order to help them and/or to share travel costs.

b. Users who do not have a car and/or are environmentally conscious and would like to be able to find a car-pooling opportunity, that is, find someone driving the same route they would need to travel and willing to share the ride.

To further decrease the end-user effort of using the service, users can be automatically positioned based on mobile network-based positioning. The end-user position is used to set the location from which the user would like to begin his/her ridesharing-route offer or request. Moreover, the system offers an SMS compensation system to ease the transfer of gas-cost compensations between the end users.

The service is built on top of the OtaSizzle Kassi item and favour exchange and borrowing service, currently in beta in the Aalto University campus in the Helsinki metropolitan area [12]. Kassi Ridesharing takes advantage of messaging, charging, and positioning capabilities offered through Open Telco APIs. The case is placed under critical analysis in Section 1.4.3.

1.4 Analysis

In this section, we apply the STOF model to critically analyze the general Open Telco business environment and the industry-specific study cases introduced in Section 1.3. The results of the general organization and finance domain analyses in Open Telco are utilized in the case-specific analyses; thus for the study cases, the focus of the analysis is on the service and technology components.

1.4.1 Open Telco Framework

This section presents the general level analysis of the Open Telco business environment. The analysis concentrates on the organization and finance domains of the STOF model as the technology domain is covered in earlier research [7] and the service domain is covered by the specific study cases, presented in Sections 1.4.2 and 1.4.3.

1.4.1.1 Service domain

Open APIs have been identified as one of the key elements in the Web 2.0 paradigm [13], driving service creation and innovation, as well as attracting developers and users to the market. Open API standards have already been available and widely in use for many years on the Internet and are a core component for many Internet-related businesses.

Open Telco as a framework for a mobile network Open API connects the operators and external application developers as well as the Internet and the mobile network capabilities together [14]. This enables external development of mashup services that take advantage of network assets, such as micro-payment capability or location information. Mashups are applications that combine data or functionality from several external sources into one so-called “mashup service” or “mashup interface” [15][16].

Open Telco as a hybrid system thus increases innovation in the domain of the mobile-operator business. High volumes enable reasonable pricing for the location information and standardized Open APIs enable low costs and innovative application development. These also make possible the Long Tail of niche services using the mobile operator network assets, that is, *“selling less of more”* [17].

Through Open Telco, external developers could easily access the network assets they require to develop and deploy a telco-mashup application to national mobile-network users. It is then the end users who – through natural selection – determine which applications and services are needed. This process is the core idea behind the mashup philosophy [16] and has been proven functional on the Internet-application market [15].

More specific service domain analyses are performed under the study case analyses which can be found in Sections 1.4.2.1 and 1.4.3.1.

1.4.1.2 Technology domain

General level analysis for Open Telco in the technology domain of the STOF model will not be performed in this paper; instead, we focus on service-specific technology requirements, functional, and user-device requirements set by the service domains of each specific service-case. The case-specific technology domain analyses can be found in Sections 1.4.2.2 and 1.4.3.2.

1.4.1.3 Organization domain

The organizational model of Open Telco is a so-called “hybrid”, or “open-garden” model, of a value network. The hybrid model is classified between the traditional walled-garden model of the operator business and the open-system model that is prominent on Internet services. In this model, the operators provide the connectivity and billing for the mobile services, but relinquish the control over what actually are the provided services [4]. The hybrid model introduces a balance between openness and control that results in an optimal solution for the value network, where flexibility and open participation are present; at the same time, the value network is still organized to avoid unnecessary complexity for the end users and application developers, to ensure fair revenue share for all the participating players, and to enable business volume growth [15][18].

The GSMA has been leading the open network interface standardization efforts with their OneAPI specification [19]. The commercial pilot of OneAPI, currently active in Canada [20], provides a valuable foundation for the value network of Open Telco. The value network in the OneAPI Canadian pilot is based on a broker model, in which APIs for common network capabilities are provided in a multi-operator environment by a cross-network simplification platform run by the GSMA. The cross-network platform is provided by Aepona, a Network as a Service (NaaS) service-delivery-platform-solution developer and OneAPI reference-platform provider [21][22].

In the value network of the OneAPI Canadian pilot, the GSMA acts as the network capability broker and as a single-contract point for network operators and external developers; the GSMA is in contract with the three large domestic network-operators Bell, Rogers, and Telus [20], as well as with the external developers. Figure 3 illustrates the value network in the OneAPI pilot.

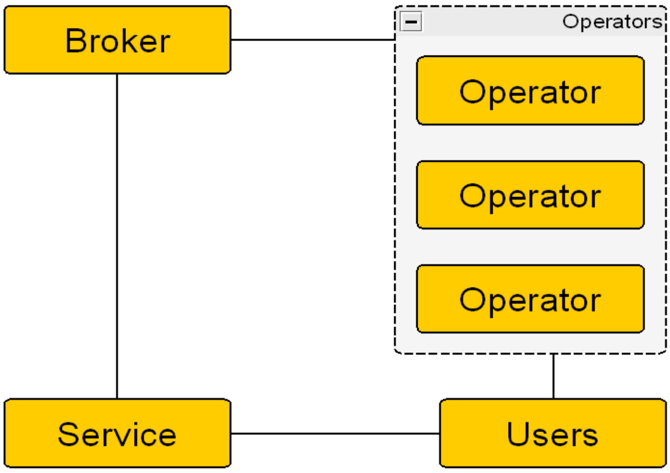

Figure 3. OneAPI Pilot Value Network

In this model, the services use the aggregated common network capabilities provided through the broker. The broker also abstracts the common capabilities and acts as the contract point between the developers and the operators. Users can then subscribe to the services and operators bill the users on behalf of the service providers.

The value network offers the benefits of simplification of integration through the abstraction of common cross-network telco capabilities, simplification of the value network through a single contract point, and maximization of network externalities through the multi-operator environment; however, we identify several issues with the model:

- Effective facilitation of competition in the operator to broker and broker to developer thresholds are absent; moreover, anti-trust laws may prevent a broker which has an effective monopoly of the operator capability brokering market. If competition is reached by introduction of several brokers, the system loses the benefit of maximal network externalities.
- Rigidity of the pricing model does not efficiently accommodate novel and diverse business models for the external services providers, especially in relation to the pricing of the payment capabilities.

Several value-network models were discussed among the Open Telco team in order to find the best fit for the Open Telco business environment. Earlier research was extensively utilized in identifying and developing the most suitable value network model for Open Telco [14][15][23][24].

We present the best option for the value network as a so-called *virtual-broker model*. This model enables the two-sided hybrid business models, as well as a single point of contract between end users, developers, and other actors participating in the value network, as well as enables a simultaneously cooperative and competitive business environment where cooperation maximizes network externalities and competition assures effectiveness of the environment.

In the virtual-broker model for open network assets, the operators act in cooperation in forming a so-called *virtual broker*. Operators, in essence, act as a *single access point* to the common network capabilities of a cross-network environment; technically the capability brokering is offered through a single broker platform – the virtual broker platform. Moreover, the operators provide a *single contract point* for developers, service providers, and other actors to engage in business with one another and enable access to aggregated network subscribers. A key concept in the virtual-broker model is *coopetition* – simultaneous operator cooperation and competition in order to cooperatively create a larger overall market and then compete for the share of that market [25]. The operators invest in and build an infrastructure enabling access to common network capabilities through standardized APIs, which allows the virtual broker to facilitate a cross-operator business ecosystem that enables external developers to take advantage of the open network capabilities across networks. The virtual broker is thus an organization jointly owned by the operators, similar to Numpac [26].

To ensure efficient competition, transparency in the infrastructure, and fair share of revenues between operators in providing network capabilities to external service providers, the operators should:

- Implement transfer pricing for the transfer of capabilities to customers of other operators *or* implement open pricing of their services and capabilities; that is, price the brokered services for *their own customers* and surrender the transfer pricing models, for example, present in roaming services.

- Be able to offer – in addition to the common capabilities – their unique capabilities through the platform.

Figure 4 illustrates an example of the virtual-broker model value network of Open Telco; the figure illustrates the most complex case where the user, service, and advertiser operators are all different. Cases where the users, service, and advertisers – or some other third parties – share the same operator are also possible; moreover, the shared-operator case would be the most lucrative for the operator.

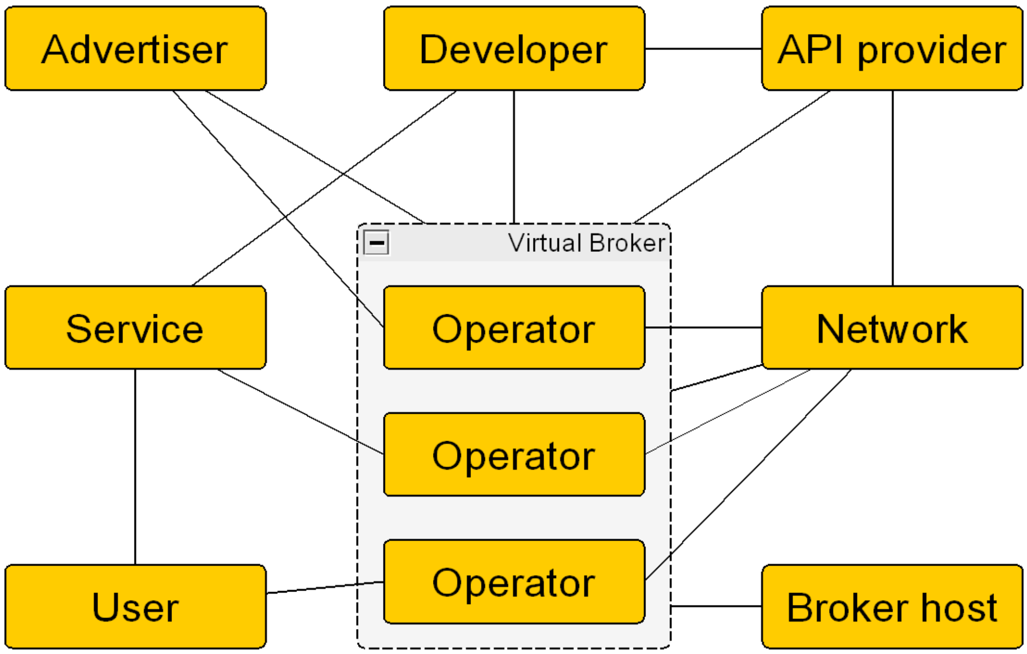

Figure 4. Open Telco Value Network

The virtual-broker model enables operator competition through several different competitive strategies, such as capability pricing, differentiation, and segmentation. The model facilitates competition also in the operator to external-developer threshold as the operators compete over customers of all kind. Cooperation, on the other hand, is required in marketing the broker platform to external developers in order to achieve critical mass for the system. Moreover, cooperation between the operators is crucial to facilitate capability and, most importantly, payment and settlement transfers within the value network – a concept which Aepona calls billing-on-behalf-of (BoBo) [23]. For example, the infrastructure must enable operators to charge their customers for the use of the services provided by external service providers, who are customers of a different operator, and transfer the revenues to the appropriate actors in the value network. For the payment and settlement transfer service, the operator can charge a payment transfer fee from their own customers. These kind of *capability transfer fees* may also come into question for other capabilities than payment; however, end users will most likely not accept costs from the ability to transfer, for example, positioning capabilities to a service in a network of another operator, rather, they will switch over to the operators who have the most appealing services. This will further increase competition between the operators in regard to capability pricing, capability transfer fee pricing, and in the acquirement of developer and end-user customers.

The key purposes of the virtual broker is thus network simplification in order to maximize the benefit of network externalities, utilization of cooperation in providing standard open network interfaces, and facilitation of competition between operators in the Open Innovation environment. Moreover, in addition to acting as a common capability aggregator, the broker may act as a service portal, also providing market presence for the service providers and service discovery for end users. In OneAPI Canadian pilot, however, the role of the broker is merely that of value network simplification [27]. In addition, the virtual-broker organization should provide customer support for the developers and service providers in utilizing the network capabilities. The operators who form the virtual broker in cooperation are responsible for providing the required network capabilities and the capacity to fulfill the task. An external broker-host may also be used to place the broker platform in a computing cloud.

Developers and service providers will benefit from network externalities through access to aggregated network users, gain a single integration point to mobile opportunities, and benefit from lightweight integration through standard APIs; the key value activity for the service providers and developers is thus developing and providing innovative services. Through the virtual broker, advertisers and the other actors in the value network, through which they can access more consumers, gain more efficiently targeted advertising, and benefit from more efficient distribution of advertisement budgets. At the same time, these third parties enable novel business models, for example, through advertisement-based revenue models. In addition, external API providers may also take advantage of the broker by opening their own APIs through the platform; this would again yield in new possibilities for novel mashup applications. At the other end, the end users benefit from the system through more plentiful, new, innovative applications and services and the value gained through using these services.

To summarize, the key benefits of the virtual broker model are listed below:

- Simplification of value network and integration of technologies
- Maximal network externalities
- Facilitation of *coopetitive* environment for Open Innovation in telco mashup-services

1.4.1.4 Finance domain

For the finance domain analysis of Open Telco, we will analyze different network capability pricing and revenue models in Open Telco, illustrate an example of the revenue flows in Open Telco, and present a techno-economic model for the broker model of Open Telco value network.

There are several network capability pricing and revenue models in the NaaS business model [27], which are discussed in detail below. In the OneAPI Canadian pilot the capability pricing model is based on transaction-based pricing in which the prices for the external developers are aggregated by the broker: $0.035 for messaging, $0.045 for positioning, and 30 percent revenue share for payment capabilities.

The most critical design issue in the network capability pricing model is the accommodation of novel and diverse business models for the external service providers – the model must be flexible to allow external service providers to run profitable business through a variety of business models.

In the end-customer subscription and pay-per-use based models the end-customers and users pay for the network capabilities; however, as Internet-age customers are accustomed to free-for-user models, it is unlikely that end-user subscription based model will be feasible save for some premium services, for example, targeted for business customers.

In the developer paid models, the capabilities are paid for by the application and service developers and service providers on pay-per-use or wholesale and bulk purchasing models. Wholesale and bulk purchasing models are common in current SMS and data capability brokering services, which makes them suitable as initial capability pricing models in Open Telco.

In the revenue sharing model, the broker and the operator get compensated for the provided network capabilities through sharing the revenues generated by an external service with the service developer. Currently, this kind of revenue sharing model is present in the OneAPI Canadian pilot system for the Payment capability: revenue sharing is based on a strict 70-30 percent share between the developer and the operator [27]. This model will be feasible for the external service provider only if the marginal cost for providing the service is low – as in the case of software applications. However, previous experience does prove the feasibility of the revenue sharing model: AppStore, Amazon, and Yahoo! collect 10 % commission [14]; however, these systems also act as a presence provider and service/product discovery engines for the aggregated services and products. This suggests that the payment capability “commission” in brokering telco payment capabilities – if providing presence, service portal, and service discovery engines are not part of the broker platform, as in the case of the GSMA OneAPI Canadian pilot [27] – should be lower than 10 percent. PayPal payment transaction handling APIs can be seen as comparable capabilities; using Paypal, the fee for payment transactions is 3.4 percent plus 0.35 € in case of personal transfers. For commercial use by using Paypal APIs to handle the payment transactions, the fees are determined by certain criteria, such as transaction volume. This would suggest a suitable range of 0-10 percent for the telco payment capabilities. The pricing model may also be based on definition of a range for the revenue share percent; however, determining the revenue share percent from the range, for example, on a per-service basis, detracts from the benefit of simplicity in the model.

To be able to provide required low pricing of payment capabilities, credit risk issues created by service consumption preceding payment of service must be solved.

Third network capability pricing model is a sponsored model in which the capabilities are free for the customer as well as the developer. Costs are supported through sponsorships, such as advertising. Advertisement based revenue model have been successful on the Internet business markets, which suggests that advertisement-based revenue models should not be omitted in the Open Telco environment.

In case of the payment capabilities, payment service laws may become a insuperable obstacle and in practice prevent operators from providing payment and settlement transfer capabilities or services for external service providers [28][29][30].

Figure 5 illustrates the revenue flows in Open Telco. Revenues to and from the virtual broker are shared and divided among the participating operators, for example, based on their market share of total mobile subscriptions; moreover, fees are transferred between operators to direct them to the relevant actors. Other revenue streams include service fees from the users the operator who transfers them to and shares them with the service provider; advertisement fees from the advertiser to the operator who again shares the fees with the service provider utilizing advertisement-based business model; capability fees and revenue sharing between the service, external API provider and the operator; and development fee from the service to the developers.

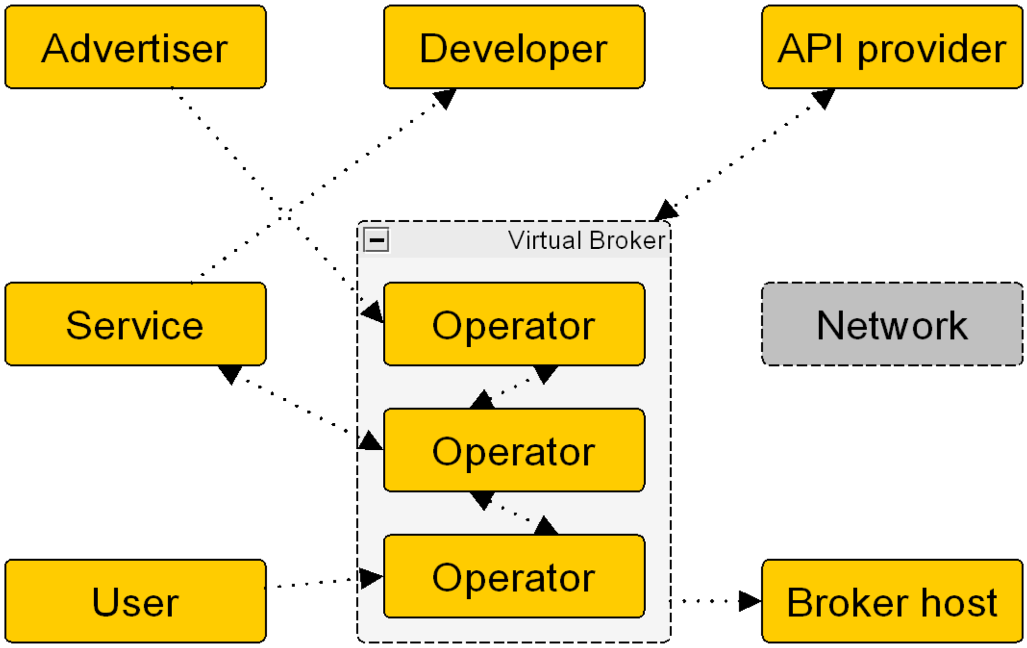

Figure 5. Revenue Flows in Open Telco

In conclusion, for the Open Telco model to be successful, the revenue model should: efficiently accommodate a diverse set of business models for the external service providers by supporting all of the described capability pricing models; overcome regulatory obstacles concerning payment services; and the operators must set reasonable pricing levels for the provided capabilities to allow feasible business models for the external service providers and to gain critical end-developer mass in order to maximize network externalities in the whole Open Telco environment.

To analyze the feasibility of the Open Telco business environment, a techno-economic model for Open Telco was built from the virtual-broker point of view; that is, the model depicts a situation in which the Finnish mobile operators join in a collaborative investment to form a national, multi-operator scale Network as a Service (NaaS) platform and to manage and follow through on the related integration work. A variety of academic and industry sources were utilized to achieve best possible form and inputs for the model; for example, discussions with industry experts were arranged – most importantly, a discussion with Aepona vice president of marketing Michael Crossey. The model for the Open Telco business ecosystem is provided in Appendix A.

According to the model, for the Finnish virtual-broker market case – assuming (1) five-year project period, (2) all major national operator join in the infrastructure and investments in the year 2010, and (3) a total number of services in the ecosystem at the end of the period as 20 000 – the five-year-break-even for the project would be achieved with a market penetration of 2.7 percent; that is, 2.7 percent of mobile subscribers use some of the 20 000 services that take advantage of Open Telco. A 5.0 percent market penetration, with the same amount of services, would yield in a payback period of 3.3 years and an internal rate of return of 27.6 percent, total turnover at the end of this period accounting to € 10.4 million. Figure 6 illustrates the profit accumulation in Open Telco according to our techno-economic model for 20 000 services with 5.0 percent market penetration and Figure 7 depicts the average revenue per user.

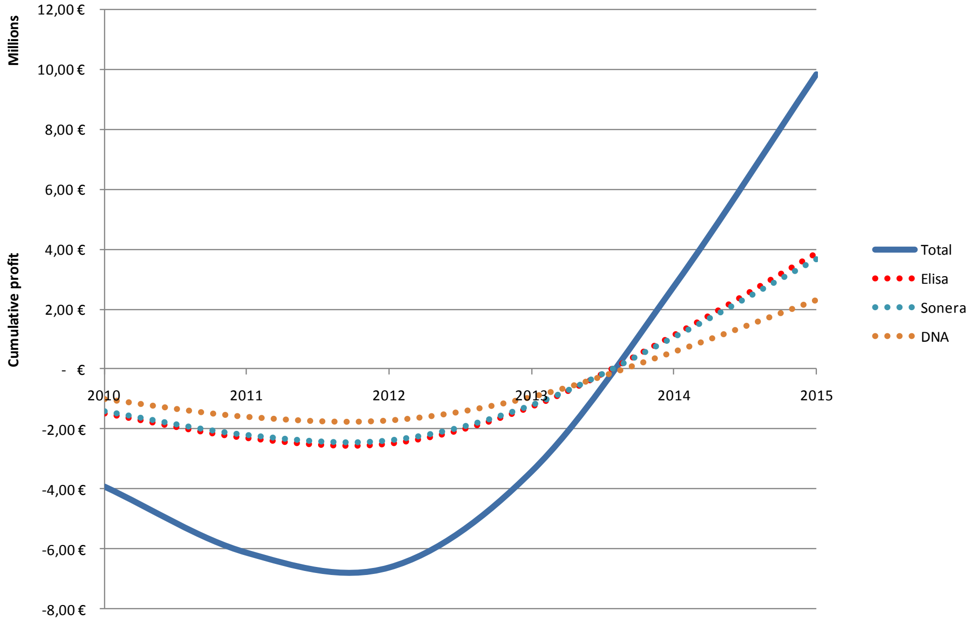

Figure 6. Cumulative profit in Open Telco in Finland

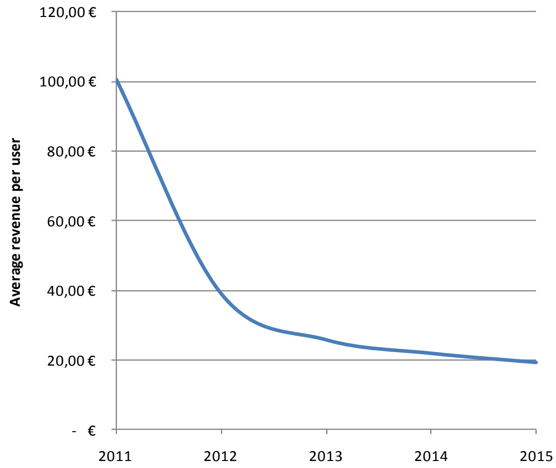

Figure 7. Average Revenue per User in Open Telco

Figure 8 illustrates the Long Tail of mobile services; that is, the market size of Open Innovation in comparison to operator (mobile voice, SMS, and MMS) and partner services (mobile data and other telecom data services) markets in Finland in 2009 [31]. Market size for Open Innovation is assumed to have reached 20 000 services and a 5.0 percent user penetration level.

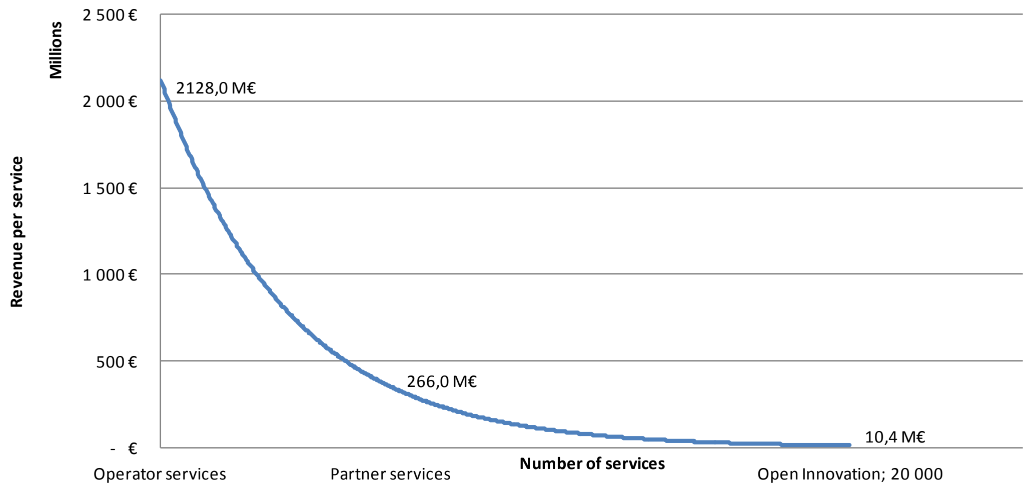

Figure 8. Long Tail of Mobile Services in Finland

The most significant input data assumptions utilized in the model are listed below:

- Inputs for mobile user market size and annual growth in Finland according to OECD Communications Outlook 2009 [32]; market size of mobile users was set at 7.7 million users, with annual growth of 7.2 percent.
- Inputs for the number of services and annual growth in the number of services were estimated based on the size of Apple AppStore ecosystem [33] and the growth of cloud software business [2]; size of the Open Telco ecosystem was estimated at 20 000 services, that is, roughly 10 percent of the AppStore ecosystem. The annual growth in the number of services was estimated at 30 percent.
- NaaS platfor investment costs of € 2 million were estimated based on the discussion with a NaaS platform provider, AePona.
- Integration to operator infrastructure was estimated at 100 000 € per capability interface.
- Estimate for the discount rate of the project was based on the weighted-average cost of capital for TeliaSonera, calculated based on their annual report for 2009 [34].
- Usage model for user groups was based on innovation-diffusion theory [35].
- Estimation for the pricing models for Open Telco APIs was based on OneAPI Canadian pilot [27] and price-level research of the Apple AppStore [36]; a bulk pricing model was created for SMS and location APIs and a revenue share model for the payment API, with 5 percent share of revenue for the operator.
- Cost structure estimation was based on an estimation for the required personnel for the virtual-broker organization, with an average annual personnel cost of 120 000 €.

1.4.2 Event Experience

This section presents the STOF analysis of the Event Experience business case.

1.4.2.1 Service Domain

We begin the service domain analysis by analyzing the value proposition of the service. Second, we examine alternate services and previous user-experiences with comparable services after which we analyze the potential market segment for the service. Finally, we address pricing issues and examine the user effort related to the service.

The **value proposition** of Event Experience is to reduce the effort and enhance the experience related to an event by offering complementary as well as supplementary services to event attendees. The reduced effort and enhanced experience are achieved through service integration, which can increase the user value of the service bundle to more than the sum of its parts [4]. The service bundle includes end-user services such as:

Complementary services:

- Information service on the event in which the users receive relevant information about the event, such as the event program, schedule, and seating chart.
- Proactive crowding avoidance at the venue, for example, to avoid crowding some entrances.
- Separate or expedited entrance for Event Experience holders at the venue.
- An event specific blog and media feed through which the users can receive and send messages to other attendees; moreover, the service component could also be utilized to provide live media streams from the event.
- Polling and voting system, for example, for voting on the encore or rating the previous song at concerts.
- Friend-presence service for checking if a friend is attending the event.

Supplementary services:

- Public transportation ticket to the venue.
- Navigation service or route instructions to the venue.
- Event-store that offers, for example, video recording of the event, song downloads, event highlights media, or other event-related merchandise available for purchase and download or delivery through the event-store system.

In addition, the Event Experience includes an organizer-service which offers the event organizers an easy way to interact with their audience as well as the benefits of mobile ticketing. Features and benefits for the event organizer include:

- Decreased distribution and processing costs.
- Increased sales through the Internet.
- Ticket validation to prevent ticket misuse, for example, in the form of copied tickets.
- Effortless reach of audience through organizer web-client; for example, the event organizer can send SMS messages, issue SMS polls, moderate the event blog, and issue crowding alerts.

In the Event Experience service, the customer and the end user are – in most cases – the same; target customers and end users for the ticket service are regular event attendees and target customers and end users for the organizer service are the event organizers. Thus, for the sake of simplicity, event-attending customers are referred to as *the user* and the event-organizing customers as *the organizer*. The specific use-context for the users is hedonic and primarily social or cultural, for example, a concert or a sports event; for the organizers, the use context is utilitarian.

The service can be described as an integrated or *bundled* service. Service bundling can be used to create price discrimination, to increase sales, to reduce costs, to promote customer lock-in, and to create entry barriers [4][37][38]. Bundling services, however, have several critical business-model design issues that are reviewed and discussed below [4]:

1. Bundle focus will influence the whole target market-segment or target user-group of the service. As the service description clearly indicates, the focus group of the service is regular event attendees. This implies the bundle focus is already quite narrowly defined; however, there is still an option to further narrow the target group from *all the attendees of an event* to an even narrower niche, such as VIP attendees; thus enabling price discrimination through versioning.

2. Bundling strategy, that is, whether the service is offered only as separate components (unbundled service), only as a bundle (pure bundling), or both separately and as a bundle (mixed bundling). In case of the Event Experience, pure bundling appears as the most suitable choice as the value proposition is achieved through service integration. This is supported by [39], which concludes that perceived value of a bundled supplementary service may be higher than that of a separate service; moreover, users have been shown to prefer service bundles that enhance the core experience of the service, which in this case is the event experience [39][40]. Mixed-bundling strategy, on the other hand, could enable service tailoring by allowing the end user to pick out the services relevant for him.

3. Bundle composition, that is, whether the bundled services are enhancing or supplementing the core experience of the service. In [40], following conclusion was made:

- Enhancing service bundles are more valued by users than supplementary service bundles.
- Likelihood of purchasing the service is increased by a bundle price discount; that is, the price for purchasing the service bundle should be lower than the price of purchasing the service components separately.
- Larger size of the bundle, that is, the number of services in the service bundle, decreases the likelihood of purchase. User dislike for irrelevant services was also mentioned during Open Telco scenario workshops [10].

For the Event Experience, the bundle composition should be considered carefully. The user should feel that he is getting the service bundle at a discount even though the bundled services were not available separately. Moreover, the number of services that will be included in the bundle should be limited and the composition focus should be kept on *event-experience enhancing* services. However, supplementary services should not be completely omitted since bundling supplementary services *with* enhanced services may be more profitable than offering the services separately [39]. For bundle composition, the key factor in realizing service-value-to-purchase connection is *bundle compatibility*, that is, the extent to which the bundled services fit together [41].

4. For *Branding* of the service bundle, there is a choice between developing a new brand for the service and selecting to use an existing brand. In a service bundle with several actors or companies contributing to the service production there may also be several brands from which to choose. Branding the service under a well-liked brand can enhance the users' positive evaluation of the whole service bundle [42]. In the case of the Event Experience, such a well-liked brand could be that of an event promoter, ticket issuer, or service-enabling operator. In [43], a guideline is given for branding mobile applications**:**

> *"Provide a positive direct experience* [that is, the experience related to directly using the application] *by creating an application that is first useful and then usable."*

However, the study also emphasizes the need to minimize usability problems while maximizing usefulness.

To summarize the value proposition of the Event Experience: the value for the user comes from integrated, experience enhancing, socially engaging, and in part unique service bundle for event attendees, providing *integrated event experience before, during, and after the event*. The final quality of the value proposition will depend on the degree of integration, and compatibility of the bundled services. Integration to existing social networking services is crucial, especially in context of the friend-presence service component, in order to take advantage of existing online social communities.

The prioritization of the service components for the Event Experience business scenario should be selected to reflect these design issues. An example of feature prioritization is given in Table 1. A *do-not-disturb* feature is added to enable the user to opt-out from receiving non-critical messages through the service system. A beta version of the Event Experience should be released when the *core service* has been implemented, that is, service components #1 through #4. Further study of relevance of service components in terms of bundle composition and user experience can – and most likely will – change the feature prioritization; moreover, new features can be added based on user feedback for the service. Different feature prioritizations and definitions of new features would provide possible future paths for the Event Experience service; modularizing the service components would in turn enable tailoring the service to the need of the event organizer and its customers on a case-by-case basis.

Table 1. Event Experience Service Component Prioritization

Feature prioritization	Service component
#1	Event ticket (proof of purchase)
#2	Event information
#3	Event blog
#4	Friend presence
#5	Public transportation
#6	Polling and voting
#7	Event store
#8	Expedited entrance
#9	Crowding avoidance
#10	Navigation and route instructions
#0	Do-not-disturb feature

There exist some **alternate services** and **previous experiences** from mobile-ticketing solutions for providing admittance tickets; for example, providing mobile tickets as SMS or MMS (Multimedia Messaging Service) messages. For example, in Finland, Steam Communications [44] provides electronic-ticketing solutions for mobile and e-mail delivery; however, the service focused only on the actual ticketing and admittance service, aiming to:

- Decrease distribution and processing costs.
- Increase sales through the Internet.
- Enable ticket validation to prevent ticket misuse, for example, in the form of copied tickets.

The system is realized by machine readable matrix barcodes, that is, 2D barcodes and numeric codes. A case example, utilizing the Steam Communication ticketing system, is Tiketti ticket office [45]. Tiketti provides electronic tickets via e-mail, SMS, and MMS at the same price and lower service fees than regular tickets.

Twitter [46] could be considered as an alternate service to the event blog and media feed service component, which offers similar benefits for connecting event-specific comments to an event through tagging. However, Twitter does not directly enable posting media, such as pictures, video, and audio, to the blog feed and it is up to the users to tag the messages to some specific event, while in Event Experience tagging is done automatically.

Another comparable case, in terms of the event-blogging service, is the experiment of the Finnish national public service broadcasting company, Yleisradio, displaying Twitter *tweets* on television screens during Eurovision Song Contest 2010 via Teksti-TV teletext system [47]. Feedback for the experiment was largely positive [48], which would imply that similar services could be successful in the Event Experience context as well. The feedback also requested integration of voting element to the service, which would imply that the voting and polling service in Event Experience is a compatible part of the service bundle. Estonia based company Mobi Solutions has also developed an SMS-based mobile voting system called SMS-voting for arranging polls during events [49].

The event information service could also be utilized in issuing alerts or warnings in case of hazardous situations relating to or otherwise affecting the event or the areas in the immediate vicinity of the event venue; for example, the service might provide help in preventing tragedies such as the stampede that occurred during a music festival in Duisburg, Germany in July 2010 [50].

Research on mobile service bundling has shown that users would be more likely in adopting utilitarian services [41], which would imply that the utilitarian elements – such as the complementary public transportation ticket – of the Event Experience service bundle would be well received.

It should be noted that similar services taking advantage of service integration to the degree of Event Experience are not presently available. Thus, the main benefit of Event Experience over the alternate services is *service integration* itself, which Bouwman et al. identify as one of the critical business model design issues in bundled mobile services [4]. Moreover, Open Telco scenario workshop [10] and Open Telco scenario focus group workshop [11], both conducted by VTT, indicated the overall idea of integrated services as the main benefit of the service. In addition, there are some unique benefits presently not available in other services, such as a system to interact with the event organizer during the event through the voting and polling system. Moreover, the main benefits of the existing electronic-ticketing solutions for the organizer are also present in the Event Experience. Table 2 presents a comparison of features and benefits between the *core service* of Event Experience to alternate solutions and services.

Table 2. Mobile Ticket Core Service – Comparison to Alternate Services

Feature / Benefit	Event Experience	Tiketti case	Twitter	SMS-voting	Facebook
Mobile ticket distribution	X	X			
Mobile ticket purchase	X	X[1]			
Ticket validation	X	X			
Context-specific messaging	X		X[2]		X
Sharing context-specific media	X		X[2]		X
Polling and voting	X			X	
Audience - organizer interaction	X		X[3]	X	X

In summary, as many of the service components present in Event Experience are available as separate services through separate service providers the value of service integration should be emphasized. Moreover, this implies that there currently are no *directly* competitive services to Event Experience.

For the **market segment** of Event Experience we can assume that only a portion of users attending an event would buy the Event Experience if they can choose between a regular ticket and Event Experience. The value proposition of the service is not such as to attract

[1] Mobile purchase is available through mobile Internet and electronic banking.
[2] User specifies the context manually through tagging.
[3] In context of the Yleisradio *tweets-to-teletext* experiment.

users from outside this group, except perhaps for some mobile-service innovators and early adopters.

To estimate the size of the potential market in Finland, statistics on attendance in Finnish festivals were studied. The Finland Festivals statistics shows total ticket sales for the year 2009 as 667 213 tickets while the median ticket sale was calculated as 3 845 tickets. It should also be noted that even though the year 2009 was a time of depression, festival attendance and ticket sale did not significantly decrease[4] from the previous year [51].

As cited earlier in this section, the likelihood of purchasing the service is increased by a bundle price discount, that is, the price for purchasing the service bundle is lower than if the services purchased separately. Moreover, **pricing** is identified as one of the critical success factors for mobile-service bundles [4]. It is unlikely that users will pay much more for a mobile-ticketing service bundle than what they would for a regular ticket, especially since there are existing mobile-ticket services offering the tickets at a lower price than regular, printed tickets [45]. It is also unlikely that the service provider would be able to charge the user for receiving messages through the service, especially in Finland, where mobile subscribers are accustomed to paying only for sent messages. Moreover, mobile service bundling research indicates that the bundle price should be lower than the combined prices of the separate service components [40]. This would imply that the *core service* should be priced close to traditional, printed tickets and the service should rely more on other revenue sources, such as location based and context-aware advertising and commissions from public transportation tickets and commissions on sales through the event-store system. Price discrimination could also provide a solution to pricing, for example, through versioning. High production-cost service components – such as expedited entrance or navigation components – could be made available only in more expensive ticket versions by versioning the service through exclusion of service components.

As with the existing mobile-ticket solutions, the Event Experience reduces the **effort** of buying tickets as the ticket can be purchased online and there is no effort related to claiming the actual ticket; rather, it is sent to the user's mobile handset. User can purchase a ticket at a ticketing service desk or online – either on desktop or on the handset – and the service is registered to the user's mobile subscription. Moreover, telco billing and charging-capabilities can reduce the effort of purchase, since the transaction can be charged directly to the mobile subscription whereas the current charging systems provided by ticketing offices usually require manual per purchase payments, for example, via online banking. With the existing Steam Communications solution, users are able to have multiple tickets on one device as each ticket is a separate SMS or MMS message with a unique matrix code. Regular printed tickets are also often purchased in sets. The Event Experience system should thus also support purchasing several tickets in one transaction. The effort of using different service components in Mobile ticket should be minimized by integrating the user interface for all of the components in a single, for example, browser-based application.

[4] Statistics show a decrease of 1.1 % for attendance and 4.3 % for ticket sales [51].

1.4.2.2 Technology Domain

We begin the technology domain analysis by analyzing the high-level technical requirements of the service and then continue on to the end-user device requirements. After the high-level analyses, we will assess other technology-domain requirements imposed on the service.

Since the main value proposition of the service is that of service integration, a separate **service application** is required. As identified in [52], usability becomes a critical issue in location-based applications in Open Telco and should thus be kept in mind throughout the implementation design. For example, utilizing standard GSM and 3G user-interface technologies, such as SMS and MMS, or common platforms to different handsets, such as the HTML browser platform, could benefit usability.

The high-level technical requirements imposed by the service components are listed and discussed below:

- *Ticket purchase* functionality should leverage existing ticket-purchase systems of ticketing offices in order to minimize investment requirements. The systems should, however, be extendable to offer payment by utilizing the telco network charging-system. This would require adding functionality to the existing system for specifying the purchasing user's mobile subscription – or subscriptions in case the user wants to purchase multiple tickets – at the time of purchase. The purchase should be confirmed, for example, by SMS with the user of the specified subscription. Radio Frequency Identification (RFID) or more specifically Near Field Communication (NFC) also has great potential in decreasing the purchasing effort; for example, an NFC tag on an event poster could facilitate direct access to purchasing a ticket.
- *Proof of purchase* functionality is required for the event ticket and other service components requiring proof of purchase, such as a public transportation ticket. Proof of purchase can be implemented either on user-device or on ticket-issuer server. On-device implementations include:
  - Matrix barcodes (MMS), such as in the existing solutions.
  - Numeric codes (SMS), such as in the existing solutions.
  - NFC, which could provide further benefits for mobile ticketing over the existing SMS and MMS-based solutions, for example, in the form of reduced end-user and ticket-verification effort. STOF analysis for NFC-based mobile ticketing for public transportation has been performed in [53]. For instance, NFC could make the ticket verification process at the event venue more efficient; however, NFC based implementation would drastically limit the possible end-user handset base though according to Tietoviikko.fi NFC chips will be included in all new Nokia handsets released in 2011 [54].
- *Message-sending* and *message-receiving* interfaces for sending and receiving, for example, polling requests and event-blog messages. For example, a SMS and MMS based interface would be a natural solution for messaging; however, as mobile data and Internet use is growing faster than desktop Internet did [55], the

browser platform could de facto become the platform of choice for end-user interfaces.

- *Event blog and media feed* requires an efficient messaging and media delivery system; especially in context of live media streaming.
- *Event-store* system, similar to an online store is required. The user should be able to download and order event-related media and merchandise through the system with minimal effort; for example, billing and delivery information should be available through the telco APIs.
- *Navigation* functionality would in practice require a Global Positioning System (GPS)-enabled handset [52], a feature that had just over 10 percent penetration in Finland in the year 2009 [56]. *Route-instruction* functionality differs in that it is up to the user to keep track of his current position on the map.
- The *friend-presence* service component can be implemented with different granularities of accuracy. At minimum, the system should be able to tell if a specific user, or *friend,* is attending the event; that is, the friend has purchased the Event Experience service for the same event or is positioned to the vicinity of the event venue. Accurately positioning the users *within* the event venue and in a crowd would require a novel positioning system capable of positioning users accurately both outdoors and indoors. Friendship in this context can be specified by the user, who invokes the *friend-presence* service with an input phone-number, or by some external social network, such as Facebook.
- *Do not disturb* functionality allows the user controls his/her visibility to some of the service-component functionalities at any given moment. The user can thus choose not to be disturbed by the event blog, friend presence, or polling and voting services. The user should also be able to select which services he wants to enable and which to disable; moreover, how users are disturbed is also crucial. In some events it might be very difficult to get the user's attention due to surrounding noise, while in other events, for example, in theaters, no noise from the audience is allowed.
- An *organizer* service is also required for managing the user service; for example, crowding alerts and polling and voting features require an organizer service interface, which can be easily accessed during the event.

As stated previously, the implementation places requirements for the end-user **devices**. A SMS/MMS implementation would significantly limit the usability and usefulness of the service as integration of different service components might be difficult. On the other hand, a web/browser-based implementation would significantly limit the possible handset base as the penetration of HTML capable browsers in mobile handsets in Finland was less than 40 percent at the end of the year 2009 [56]. Implementing the service application on the web/browser platform could thus significantly limit the target user-base; however, 3G and smart-phone penetration growth is likely to change the situation [55].

In summary, web/browser-based implementation will likely prove the most successful quality of service delivery is critical [4]. However, a SMS/MMS implementation could also be valuable for the core service-components of the bundle, including proof-of-purchase and message sending and receiving functionalities.

Other requirements and issues in the technology domain of Event Experience include system scalability, security, privacy, and user-profile management.

System scalability becomes an issue in case of larger events and event-specific setup of additional base-stations may be required, as noted in Open Telco usage scenario workshops [10][11]. An extreme case example of the system scalability issue is Twitter during the soccer World Cup 2010, when the system experienced service outages due to high traffic [57]. *Security* issues come into question with the access to the end-user application and the service components, especially in the case the application is implemented on the web/browser platform. Users must be authenticated before allowing access. In addition, security and *privacy* must be considered with the *friend-presence* feature as well; the system must prevent misuse of the service component and assure the security in the access to the positions of end-users. In addition, *user-profile management* becomes an issue if the some kind of event-attendance profile is included in the service. For customer retention point of view, a user-profile management system would be beneficial.

Figure 9 illustrates an example of the high-level technological architecture of the Event Experience service application.

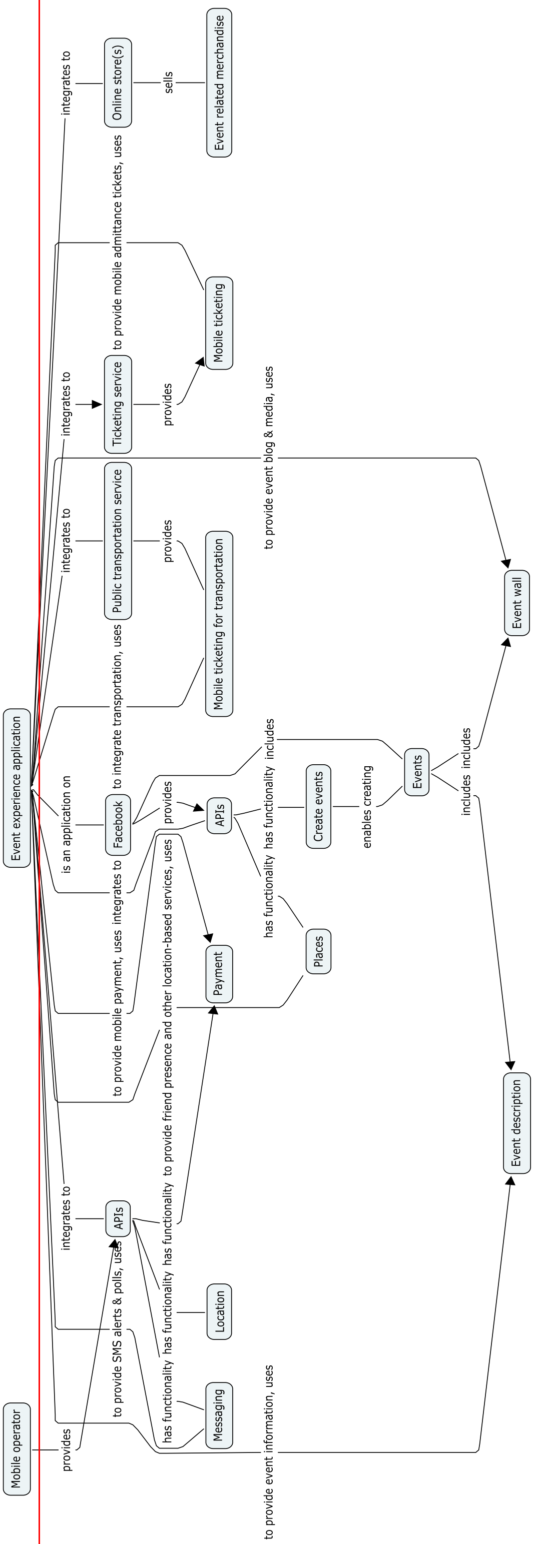

Figure 9. Architectural Description of Event Experience Application

1.4.2.3 Organization Domain

We begin the organization domain analysis by presenting an example of a value network required in providing the Event Experience service after which we discuss the roles and value activities of each actor participating in the value network. Finally, we discuss possible evolution path for the business model of the service provider.

Figure 10 illustrates an example of the **value network** in the Event Experience business case. The value network is based on the general Open Telco virtual-broker model value network which was covered in Section 1.4.1.3.

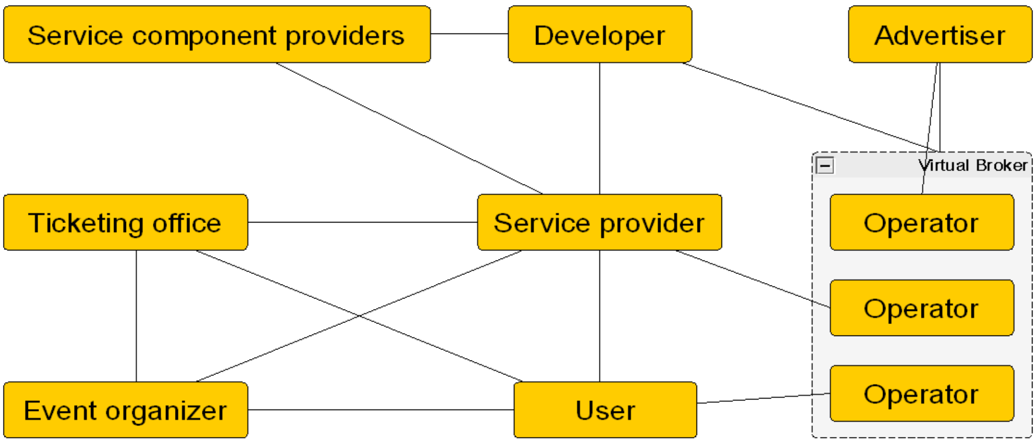

Figure 10. Event Experience Value Network

Most central **role** in the value network is naturally dedicated for the service provider who is in charge of managing the Event Experience service as a whole. If the Event Experience is to be branded with a completely new brand, the service provider would most likely become the brand owner and thus would also be responsible for providing market presence, ticket-sale system, and customer support for the service. The service provider manages the service component integration and is responsible for operation of the service as a whole. Different service components may and in some cases must be implemented – by the developer – by learning from or possibly even leveraging existing external systems; for example, in case of public transportation tickets, cooperation with local public transportation companies is required. The service may also benefit from using external providers for other components as well; for example, integrating to social networking platforms for the event blog, such as Facebook or Twitter, and cooperation with existing online stores for the event store is possible. The external service component providers may also include hosting or other cloud computing services, which allow the service application to run on cloud hosted infrastructure.

The role of the operators and the virtual broker in this case is providing the required user information, messaging, positioning, and payment capabilities. The operators also provide accessibility to the end customers, advertisers, and other possible partners through the virtual broker; for example, context-aware advertising should be utilized to ensure the relevance of the ads for the end users and more effective reach of target audience for the advertisers. Application developer provides the end user and other applications required in the Event Experience.

Roles of the ticketing office and the event organizer are also critical: existing systems for ticket sale and distribution operated by ticketing offices could be leveraged in Event Experience. Ticketing office could be most suitable brand owner and presence provider for the service; selling the ticket through existing online ticket store. Previous partnership between ticketing offices and event organizer would also support presenting a new type of ticket for the event organizer – who at the other end would be responsible for ticket validation at the venue, and operating parts of the expedited entrance, crowding avoidance, and polling and voting features. Benefits for the event organizer from adopting the Event Experience would have to be significant in order to cover for the added labor and other costs. A suitable pilot partner, comparable to a ticketing office, could be Aaltoevents [58].

The organizational model allows several **business model development paths** for the service provider. Through the two-sided business model for the service provider, revenues are received from users as well as organizers. In addition, the model allows free-for-user or free-for-organizer service models, whichever suits the situation the best. Through re-definition of the actors, roles, and value activities, the service model can be applied to a more generic mobile event-organization and ticketing services. For example, the ticketing office actor is in no way mandatory for the value network, the service provider could also directly act as the ticketing-service provider, for example, for events, conferences, or other gatherings. In addition, the concept of ticketing may also be abstracted from event tickets to cover other kinds of use cases as well where an organizer-to-user interaction channel is valuable.

1.4.2.4 Finance Domain

For the finance domain analysis of the Event Experience case, we will assess the required investments and risks as well as analyze the cost and revenue sources.

The most important **investment** in this case is the application development and service-component integration work. Integration of ticketing, social networking, location-based services, and online stores to one application is no small task and presents considerable **risks**. The risk of building such a large system could be minimized by implementing the components separately, for example, in the feature prioritization order. Building critical end-user mass by a socially engaging, context-aware mobile ticket service could be later capitalized on by including the other components.

Costs sources for the Event Experience include the telco capability costs, service operation, and marketing. Most important of the telco capabilities are the billing and charging capabilities; without affordable telco payment capabilities, the Event Experience will most likely fail, for example, 70-30 revenue share pricing of the capability is unacceptable from the Event Experience provider point of view, since a ticketing solution provider will not have a 30 percent margin in the ticket price as most of the ticket revenue goes to the event organizer. Moreover, ticketing offices and online stores already have their existing billing and charging capabilities in place, which are usually implemented using credit card or electronic-banking based methods of payment; operator billing and charging capabilities offer the advantage of decreased end-user effort but suffer from the disadvantage of increased credit risk and working capital for the ticketing office. Feasibility of the location based and context-aware features will depend on the pricing of the positioning capabilities. It is unclear whether the location-based functionalities add enough value for the end users to be willing to pay extra for them. The costs would thus have to be covered by other means, for example, through advertising revenues. Operation costs are also significant in the Event Experience. Labor is required in handling the voting and polling results, triggering crowding alerts, and handling the event store orders and deliveries.

Revenue flows in the Event Experience case are illustrated in Figure 11.

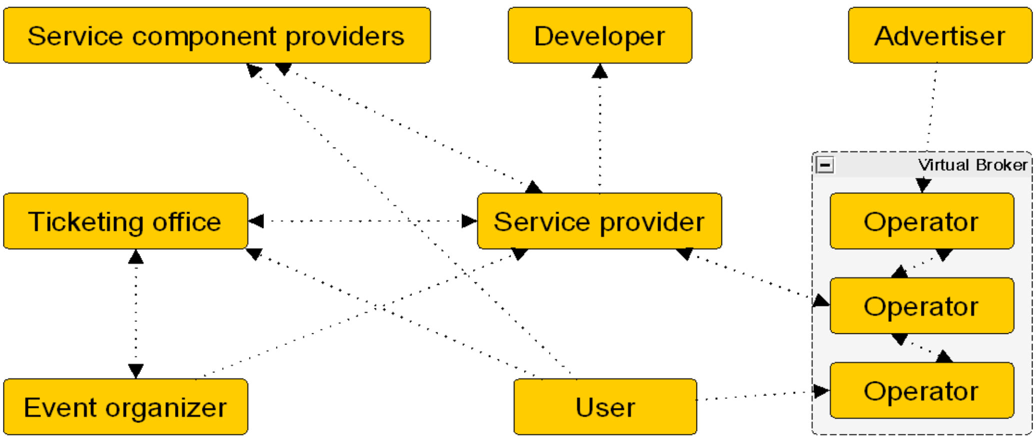

Figure 11. Revenue Flows in Event Experience

Most important revenue streams for the service provider are end users and advertisers. The two-way arrows in the figure illustrate revenue sharing between the actors: service provider and some external service component provider share the end user originated revenues, such as merchandise or public transportation ticket revenues; service provider, ticketing office, and event organizer share revenues from, for example, ticket sales and live video streaming sales; service provider; the operator share revenues from advertisers as well as based on the capability pricing; and the event organizer pays a service fee for the service provider for the organizer service. In addition, the service provider compensates the developer for the system development and the end-users may choose to pay directly to the ticketing office or external service component providers, for example, by credit card.

1.4.3 Kassi Ridesharing

This section presents the STOF analysis of Kassi Ridesharing service.

1.4.3.1 Service Domain

We begin the service domain analysis by analyzing the value proposition of the service after which we examine similar, existing services and previous experiences with the existing services. Finally, we address the pricing model of the service.

The **value proposition** of the service is to decrease the effort of ridesharing between the end users in a semi-static environment, where the users are a part of the same community – Kassi. Earlier research has identified [59] several barriers for adoption of *dynamic* ridesharing – that is, systems facilitating ad-hoc ridesharing matches close to the desired departure time – which, to some degree, also apply in the Kassi Ridesharing context. These barriers are discussed below:

1. Driver attitudes inhibit the adoption of carpooling due to convenience, flexibility, privacy, and freedom associated with driving alone. Safety is often also raised as an issue in the context of sharing rides with strangers. In this respect, Kassi Ridesharing aims to address the convenience and flexibility issues by providing mobile, easy-to-use interfaces for requesting and offering rides, for example, by allowing users to offer and request rides from a location and time of their desire, which are matched automatically by the system. Users' contact information between the driver and the rider are automatically shared. Moreover, the service decreases the effort of setting up requests and offers by providing automatic positioning of the user, which can be utilized as the starting point of a ride request or offer. In addition, safety issues can be taken into consideration by developing the Kassi trust and reputation system further with ridesharing-specific issues in mind [60]. The most critical issue in the driver attitude respect is that the drivers do not perceive enough substantial benefits from offering and providing rides to others; thus, significant *incentives* for the users are required.

2. Incentives for ridesharing of the most common forms are *time* and *cost savings.* From the rider perspective, time savings, for example, in comparison to public transportation, can be achieved through efficient design of the system. From the driver perspective, however, cost saving might be the only incentive. Kassi Ridesharing tries to respond to the driver cost savings issue by offering an SMS compensation system to decrease the effort of compensating the driver. Effortless transfer of payments is seen as a key value-creating service feature in the dynamic ridesharing context. Another growing motivation for ridesharing is environmental awareness; people want to reduce their carbon footprint and ridesharing would make using a car instead of public transportation more acceptable.

3. Substitution. In some cases, other transportation methods may provide greater value than ridesharing; for example, in case of Kassi Ridesharing in the Aalto University campus area, relatively short distances might enable cycling to provide more value to users than ridesharing; moreover, effective public transportation might be seen as more convenient than requesting rides through the system. Earlier research suggests identifying niche target groups where benefits of the ridesharing service could be feasibly utilized [59].

4. Critical mass is seen as the most critical inhibitor for *dynamic* ridesharing services. Kassi Ridesharing differs from the dynamic ridesharing services in that it is targeted for:

- Drivers and riders who share the same departure and destination locations and
- Lower ad-hoc nature; that is, Kassi Ridesharing does not primarily attempt to serve dynamic, *right-here-and-right-now* ridesharing needs.

5. Legal and regulatory issues might become a barrier for the SMS compensation features in Kassi Ridesharing. Paying the driver for the ride might be considered as a contract between driver and the rider, which would induce tax liabilities on the driver. Moreover, in Finland, there currently exist some regulatory obstacles in transferring payment transaction between users through mobile charging capabilities [30].

The context of use of the Kassi Ridesharing service can vary; the users may be seeking rides to get around locally on a day-to-day basis or seeking for a ride to some more distant destination. The initial specification is targeted for non-recurring routes but the system can be extended to support repeating routes. Target group of the service can thus vary as well; generally, Kassi is aimed for a local group of trusted peers to ease item and favor exchange. Kassi Ridesharing could be adopted by a subset of this group: environmentally conscious people with a need or want to travel by car to some destination.

Branding of the service is based on the overall Kassi brand.

Table 3 summarizes the service features.

Table 3. Kassi Ridesharing Service Features

	Service feature
#1	Browse routes
#2	Offer route
#3	Request route
#4	Match offer to request
#5	SMS compensation

To further benefit from the positioning capabilities and enhance the mobility of the service, the system could be developed to enable dynamic ridesharing [59].

Estimate for the potential **market size** for ridesharing can be achieved through the following example: the service is in production in an urban area of one million people with 500 000 cars in total. Average driver travels 20 000 kilometers yearly. The service has one percent market penetration and 20 percent shared rides per subscriber. If the average passenger fee is set at € 0.25 per kilometer and the service fee at 5 percent of the passenger fee, the total turnover sums up to 5 M€, with the turnover for the service provider being 250 000 €.

There are some **existing services** in the ridesharing request-offer-matching service market in Finland [61][62][63][64]. In addition, TeliaSonera Innovation World Challenge runner-up service involved ridesharing. These services primarily function on an advertisement-funded business model; however, Kyydit.net offers an SMS interface for the service which is priced at 0.65 € per message [63]. The Kassi Ridesharing service, however, is free of charge for the end user; the **pricing** model of the service should be aimed to attract users and promote customer retention by offering free basic service rather than trying to collect service fees from posted offers and requests; only the novel, value-adding features, not available from other ride-matching service providers, such as SMS compensations and position-based ride matching, should include service fees for the end user. The revenue models of the service are discussed in detail in Section 1.4.3.4.

1.4.3.2 Technology Domain

We begin the technology domain analysis by analyzing the high-level technical requirements of the service and then continue on to the end-user device requirements. After the high-level analyses, we will assess other technology-domain requirements imposed on the service and finally specify the functional requirements for the service

The high-level technical requirements imposed by the functional requirements of the service application are listed and discussed below:

- *Messaging capabilities* are required from the Open Telco APIs. The system uses an SMS-based interface in addition to the main Kassi desktop/web interface. The current operator messaging capability interfaces implement the message-service connection by the use of SMS keywords [65]. This significantly limits the ability of the external service provider from using keywords in its own system; increased end-user effort from having to remember several keywords – one to identify the service and another for the function within the service – detracts from the user-experience and ease of use of the service.
- *Positioning capabilities* with adequate accuracy are required; cell-id granularity should be sufficient for this purpose [52].
- *Payment capabilities* are crucial to the business model of the service; the revenue model of the service requires ability to transfer money between end users by SMS invoked payment transactions. This is not possible with the current operator APIs [65].
- *Positioning-based ride matching* would require a more advanced algorithm for matching requests and offers. Users should be able to specify how much they are willing to deviate from their original route.

End-user **device requirements** do not significantly limit the potential user scope since the system is based on SMS-based interface; in addition, the system can be used on the main Kassi desktop/web interface.

Other requirements include security and privacy. *Security* issues involve mainly the handling on payment transactions; however, in this context we assume that the telco capabilities implement most of the required authentication and authorization functions for the payment transactions. *Privacy* issues come into question with sharing of the users' location and contact information. Location privacy is covered by allowing the user to set location manually; moreover, the location is not shared continuously in the service, rather, the user invokes the positioning functionality when he wants to set the starting position for a ride offer or request. In addition, Kassi implements a user-reputation system which allows users to evaluate the trustworthiness of other users before sharing rides with them [60].

Functional specification of the Kassi Ridesharing service can be found in the Open Telco demo – Kassi Ridesharing Service Demo Specification document [66] or online at: http://github.com/sizzlelab/kassi/tree/kassi2/features/ridesharing/

1.4.3.3 Organization Domain

We begin the organization domain analysis by presenting the value network for the Kassi Ridesharing service. Again, the value network is based on the assumption of an existing virtual-broker model for Open Telco. Figure 12 illustrates the value network of Kassi Ridesharing service.

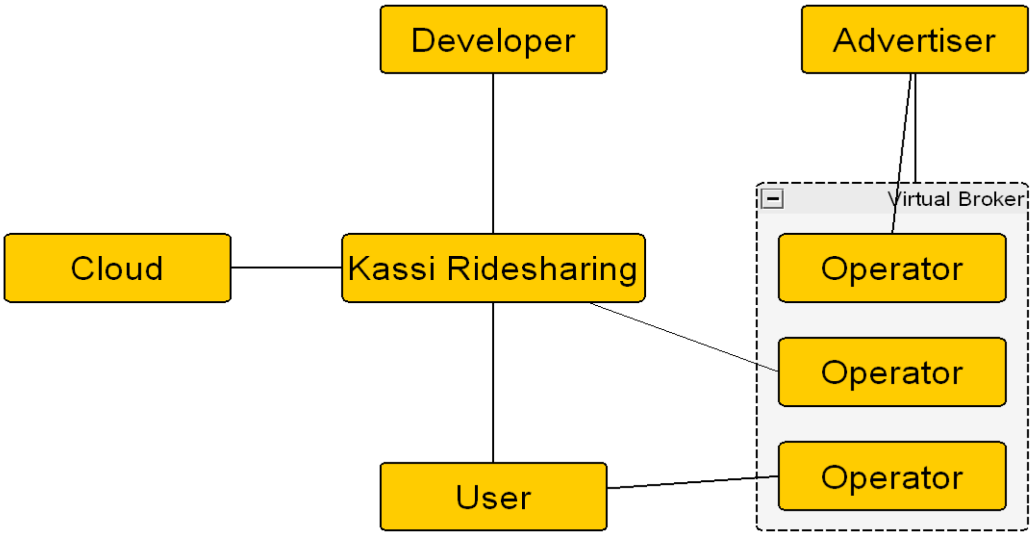

Figure 12. Kassi Ridesharing Value Network

Value activities and roles of the different actors in the value network are thus the following: Kassi Ridesharing acts as the service provider with the role of providing the end-user applications and interfaces – mobile and desktop – for the end users using the system as well as managing the end-user profiles. The system and the end-user applications are developed by the developer, a role which in this case is in practice a part of the Kassi Ridesharing service provider. Operators again have the role of providing messaging, positioning, and most importantly billing and charging capabilities for the service. The virtual-broker infrastructure and advertisers enable advertisement-based revenue models by enabling the service provider to include advertisements in its service. Moreover, combining advertisements and positioning capabilities enables location based and context-aware advertising. The *cloud* is an optional actor with the role of providing cloud computing resources, for example, hosting and other infrastructure resources for the service provider.

1.4.3.4 Finance Domain

We begin the finance model analysis by describing the **revenue model** behind the Kassi Ridesharing service. As previous research indicates, revenue models for context-aware mobile services should be based on multiple revenue models [67]. Thus, the revenue model in Kassi Ridesharing service is based on multiple revenue sources: service fees from end users for using SMS compensation feature and revenue sharing with operator for generation of mobile-originated SMS and voice-call traffic.

SMS compensation feature enables the users to easily transfer gas-money compensation for the driving user. The service feature utilizes telco payment application programming interfaces to transfer money between end users and the end user specifies the amount of money to be transferred. The compensation system credits the receiving user for the full amount. Revenue for the service is received from billing the sender, for example, a five percent service fee on top of the user-specified amount.

The service also generates both mobile terminated and mobile originated SMS messaging traffic as well as mobile originated voice-call traffic. For the generation of mobile-originated traffic, the service expects *in the least* to be able to cover the cost of mobile-terminated messaging generated by the system. The system could also take advantage of location-based advertising as a revenue source.

Figure 13 illustrates the revenue model of Kassi Ridesharing. The service provider and the operators share the service fees from end users, advertisement fees from advertisers, and traffic fees from mobile originated traffic. In addition, the service provider compensates the developers for developing the system.

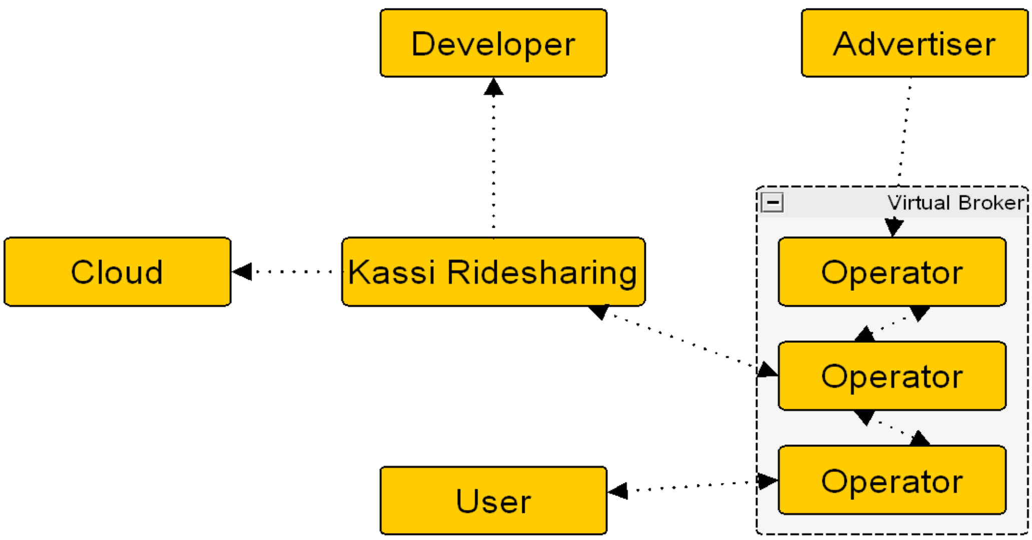

Figure 13. Revenue Flows in Kassi Ridesharing

Next, we consider the **investment** and exploitation **costs** for the service. Given that a virtual-broker environment of Open Telco is in place, the only investment to make is the actual Kassi Ridesharing application and system development investment by the service provider and developers. For the cost of utilizing telco payment APIs in the *SMS compensation* feature a strict 70-30 percent revenue share model is unfair towards the service provider and the end users. In practice, the model forces the service provider to add 43 percent to the SMS compensation amount in order to cover the 30 percent margin for the operator; from this point of view, the telco payment capability with 70-30 revenue share pricing model is not an option. As an example of an acceptable model we present a model in which 30 percent of *profit* made from the payment transaction is shared with the operator; for example, in the case of a 10 € transaction – assuming a five percent service fee – the service provider would receive 0.35 € and the operator 0.15 €, while 10 € is transferred between subscribers. Credit risk can be pushed all the way down to the payment-receiving user, who would receive the compensation only after successful billing of the payment-making user.

1.5 Conclusion

In this study, we analysed value networks and value generation in Open Telco and in two Open Telco specific usage scenarios. For the overall value network of Open Telco, we presented a new value network model – the virtual broker. The model facilitates the benefits of Open Innovation for the mobile network operators as well as promotes competition between the operators. Below, we summarize the most critical design issues of the virtual-broker model and the benefits they bring forth:

- *Coopetition*; cooperation in investments and marketing is required in building the NaaS infrastructure and a market for it. Critical mass of external developers and services is crucial for the facilitation of Open Innovation and maximal network externalities. Competition, on the other hand, ensures efficiency of the system, promotes sustainable pricing for the NaaS capabilities, as well as prevents issues concerning anti-trust laws.
- *Capability pricing models and levels*; to support the Open Innovation among the external developers, all of the pricing models for NaaS capabilities, described in Section 1.4.1.4, should be supported. Support of a variety of pricing models will enable novel business models for the external service providers, which in turn will enhance the facilitation of Open Innovation. Moreover, the pricing of the capabilities should be set on reasonable levels, or NaaS capabilities will never be adopted in the external developer communities; as presented above, competition between the operators will promote reasonable pricing of NaaS capabilities.
- *Payment capabilities*; providing telco billing and charging capabilities to external service providers will likely be one of the most lucrative business opportunities for the mobile operators. However, there are some barriers for opening telecom payment capabilities: regulatory obstacles might prevent the operators from providing these capabilities and, as seen in the finance domain analyses of Event Experience and Kassi Ridesharing in Sections 1.4.2.4 and 1.4.3.4, current payment capability pricing model of 70-30 revenue share is infeasible. In order to enable more reasonable pricing, issues brought forth by service consumption before payment must be solved.

Next steps with the Open Telco specific usage scenarios, Event Experience and Kassi Ridesharing, are presented below:

- Software Factory program at University of Helsinki [68] will begin a 7 week implementation cycle for a prototype version of the Event Experience in the beginning of September 2010.
- Kassi Ridesharing service-demo will be implemented as a part of OtaSizzle Kassi service during the autumn of 2010.

It should be noted that currently neither of these services can be fully implemented to business level with the absence of telco billing and charging capabilities; however, it is possible to utilize other charging methods than telco charging.

Chapter 2 – Semi-automating coopetition

2.1 Semi-automating coopetition

Addressing the need for semi-automating coopetition and for building a NaaS infrastructure, we must outline how the mentioned cases can be conceptualized for future work. Accordingly, the structure of this Section is as follows. First, we conceptually summarize in Sectionthe two business cases described in previous section. Sectionexplains on a height level a cloud infrastructure for the broker depicted in earlier figures of the business cases. Section explains an essential component that is part of, namely a service HUB. Finally, Sectionconcludes this Chapter and addresses open issues.

2.1.1 Conceptual collaboration positioning

Observing business collaborations in the business cases of this document, reveals characteristic features. An original equipment manufacturer (OEM) organizes the creation of value in an inhouse business process that is decomposable into different perspectives, e.g., control flow of tasks, information flow, personnel management, allocation of production resources, and so on.

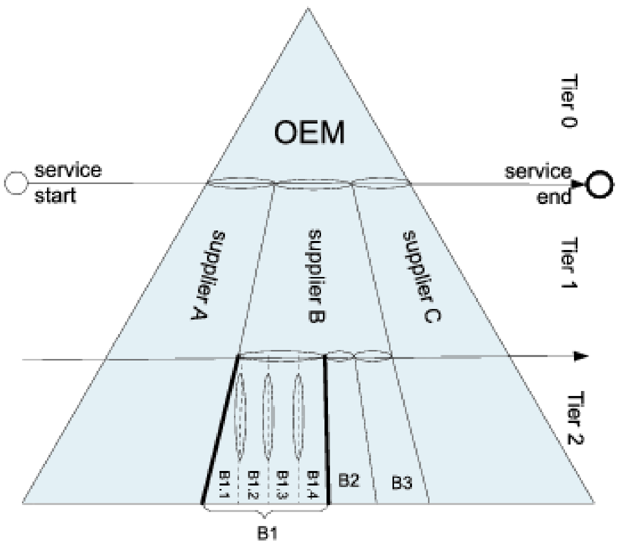

Figure 14: A conceptual business-collaboration model.

Figure 14 depicts conceptually a complex service of an OEM with optional tangible elements, of which several need to be acquired from suppliers. The reasons for acquiring parts externally are manifold, e.g., the OEM cannot produce with the same quality, or an equally low price per piece, the production capacity is not available, required special know-how is lacking, and so on.

The horizontal ellipses in Figure 14 denote the client/server integration of outsourced inhouse-process parts to lower-level clients who provide services to the vertically adjacent higher tier of a supply chain [63]. The outsourced business processes receive refinements by the respective suppliers. The refinements remain opaque to the service consumer and the supplier only has awareness of the OEM's outsourced respective process but the remaining inhouse process remains opaque.

Vertical ellipses in Figure 14, depict a peer-to-peer (P2P) collaboration within a cluster of small and medium sized enterprises (SME). If several SMEs form a composed service in a P2P way [64], they become a supplier for a higher-level service consumer.

2.1.2 Cloud infrastructure

To support the semi-automation of the business-collaboration conceptually described in Figure 14, .we need to develop a system infrastructure for the broker depicted in earlier figures. A high-level architecture of such a NaaS infrastructure we present in Figure 15.

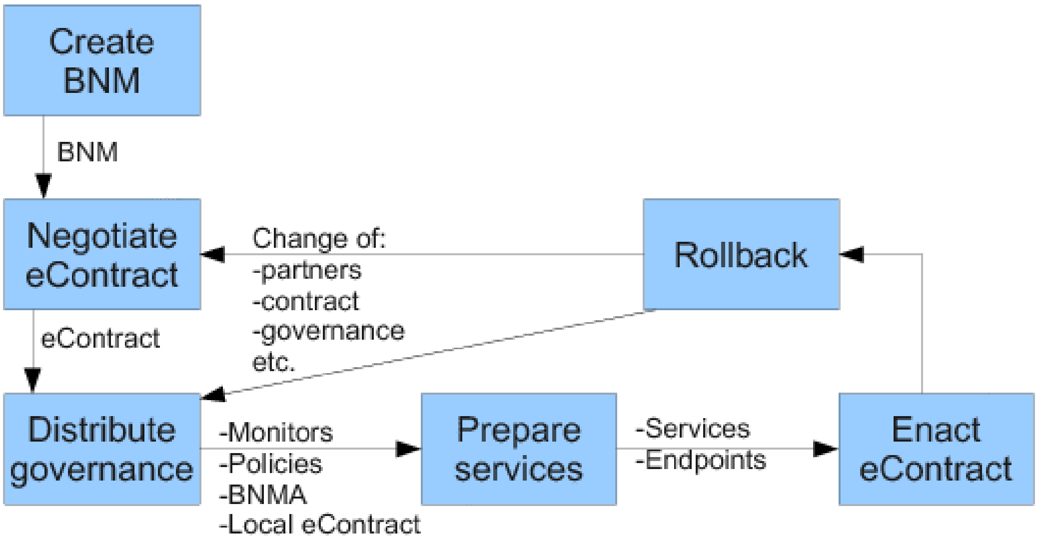

Figure 15: High-level figure of cloud infrastructure.

The proposed NaaS infrastructure supports the lifecycle of an eCommunity from inception to termination. Note that the high-level depiction of Figure 15 sums up a far more detailed model that we designed using CPN tools[5] for designing Colored Petri-Nets. A CPN is a graphical oriented language for design, specification, simulation and verification of systems. It is in particular well-suited for systems that consist of a number of processes which communicate and synchronise. Typical examples of application areas are communication protocols, distributed systems, automated production systems, or work flow analysis.

The eCommunity-lifecycle [64] starts with the creation of a business-network model (BNM) that contains service offers which are first validated with service types, and additionally roles are assigned to the services. These roles must later be filled by concrete collaborating partners in the eContract negotiation. Here, the partners that slip into roles, must vote on agreeing or rejecting an eContract proposal that is based on a

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5 http://wiki.daimi.au.dk/cpntools/cpntools.wiki

picked BNM. Rejection terminates the eCommunity while having all partners agree, results in a consensual eContract passed on to the next component. A third option during the negotiation phase is the proposal of a contract alternative.

In the component for distributing control governance, the agreed upon eContract is locally distributed to all partners who form an eCommunity. Next, all distributions have local policies, monitors and BNM agents (BNMA) assigned with facts deduced from the contract. The policies guide the monitored behaviour of partners during enactment.

Once the governance structure is set up, concrete services must be assigned for technically realizing the behaviour demanded in the local copies of the contracts. After the services are picked, communication endpoints must be created so that the services of the partners are able to communicate with each other. The final step of the preparation is a liveness check of the channel-connected services.

During enactment, the tasks of the services are carried out by an engine that propels the eCommunity business collaboration technically. Several alternative situations may occur during the enactment, namely, a total enactment termination, partner replacement, or policy violation that must be managed.

The rollback component concretely manages the alternative enactment situations. For termination, the entire distributed governance structure for an eContract is removed and the eCommunity is brought into a final ending state from where reuse is not possible. Partner replacement may either be disruptive in a sense that the governance infrastructure must be removed and a contract negotiation started from scratch. We assume a memory unit is available to notify the remaining partners to engage again in the formation of eCommunity. Non-disruptive partner replacement means the governance infrastructure remains entirely intact and a new eCommunity-partner slips into the existing local setup to replace an old partner. A policy violation may be treated with a reconciliation, ignoring it, replacing the partner, or replacing the policy. Finally, a local contract change means the removal of the entire local governance infrastructure and the respective partner has the chance to perform either a partial or entirely different local governance-infrastructure re-configuration within the framework of the overall eContract.

2.1.3 A collaboration HUB

At several stages of an eCommunity lifecycle, there is need for a collaboration HUB that facilitates the creation of a BNM, the negotiation of an eContract, and the preparation of concrete services to technically enact the business collaboration.

For the collaboration HUB architecture in the sequel, we deduce requirements from the pyramid depicted in Figure 14 that conceptualizes business collaboration.

1. A HUB must allow laymen who have no or little SOC knowledge to engage in service discovery and matching.

2. Since the HUB is part of an anonymized service ecosystem, users must be able to check the trust- worthiness and reputation of service offers and re- quests.

3. The HUB must support resolving ambiguities in the human-and machine readable service representations.

4. The HUB must support feasible service matching.

5. The user interaction with the Hub must be logged for extracting business intelligence.

2.1.3.1 A HUB architecture

We specify a conceptual system architecture for the BpaaS-Hub (Business Process as a Service). Conceptual architectures (also known as logical architectures) facilitate the understanding of the interactions between components and the functionalities provided by the system. For the BPaaS- Hub architecture, we follow design principles, styles and patterns [65, 66]. Architectural styles comprise a description of component types and their topology, a description of the pat tern of data and control interaction among the components, and an informal description of the benefits and drawbacks of using a particular style. The conceptual architecture depicted in Figure 16 utilizes the principles of separation of concern, it follows a layer style, employs a pipes-and-filters pattern and pattern-based components for abstracting data repositories.

Separation of Concerns: For breaking the system complexity down to manageable parts, we introduce separations of concerns with the characterizing questions who, with, what and how. In Figure 16, columns show these separations: WHO: refers to the business entities a user searches for. They may be services in specific domains, organizations, or persons related to service categories. WITH: refers to establishing on the fly the ontological infrastructure needed to resolve ambiguity issues in service descriptions. WHAT: refers to the need for pulling in additional service-related in-formation from the Web cloud for a trust-enhancing mashups. HOW: refers to the application infrastructure necessary for the services to be matched and en- acted. Additionally we propose social mining techniques for analyzing the logged user interaction with the Hub and extracting business intelligence that way.

Layer Style: A layer style separates vertically the BPaaS-Hub architecture, characterized by communication exchanges only permitted to the adjacent higher or lower layer. The advantage of this architecture is a limitation of communication exchanges between layers that facilitate a decoupling and replacement with alternative components. In Figure 16, the top layer called Views, depicts all user-interface components. The middle layer termed Controllers, shows components with application logics while the lowest layer termed Models, contains all system intrinsic or third-party extrinsic information sources from the Web cloud for trust-building mashups. The ontology libraries in Figure 16 group members of language categories. Other categorization options may delimit according to geographic regions, industrial domains, product families, market segments, and so on. Note that individual ontology libraries can be members of several category sets. For every concern- separating column, a dedicated database logs the user interaction with the BPaaS-Hub.

Pipes and Filters Pattern: The components of the controller layer instantiate a pipes-and filters pattern enforced by a service bus. In a fully automated scenario, an ontology-supported Goal decomposition delivers input for what business entities are sought after. The automated goal decomposition may support a human user of the BPaaS-Hub in a semi-automated scenario or may be entirely circumvented by a user. A service search results both in human-readable text and optional machine-readable WS-* specifications that belong to the SOA stack. All types of service representations potentially contain ambiguities. Hence, an analysis of search results may take place that culminates in a dynamically linked library of ontology libraries for resolving ambiguities in the service representations. In Figure 16, following a pipes-and-filters pattern, a mashup engine performs automated searches for trust and reputation establishment in user-selected information pools of the Web cloud. The results of that search may be numerous, erroneous and processing them as a user is cognitively stressful. Hence, a consolidation must take place in which result classification takes place into refuse versus the remainder that is ranked according to ontological relevance and/or aggregated where possible. The logged user interaction with the BPaaS-Hub may be mined for generating business intelligence. Additionally, a component in the BPaaS-Hub stands for matching of services in stages as described in Section 2.2. Finally, the enactment of machine-readable WS-* service representations commences.

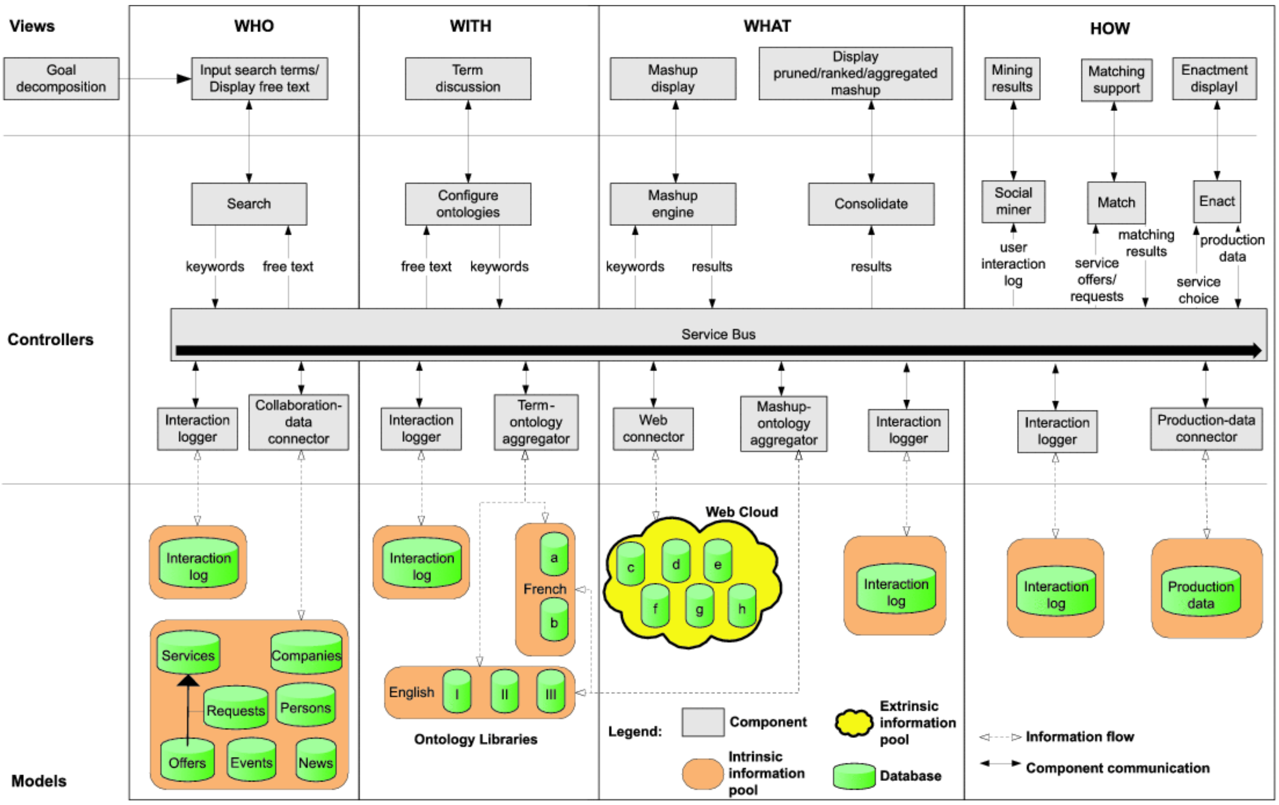

Figure 16: Architecture of a Service HUB

Abstract Data Repository: On the controller layer of Figure 16, the collaboration data connector, term ontology aggregator, interaction logger and mashup ontology aggregator are components of the architectural style abstract data repository [67]. This architectural style, on the one hand, keeps the producers and consumers of shared ontologies from having knowledge of each other's existence and the details of their implementations. On the other hand, this architecture style also keeps details of shared data-repository implementation a secret from the producers and consumers. This secret is embodied in abstract interfaces to the data repositories that further reduce the coupling between data producers and consumers.

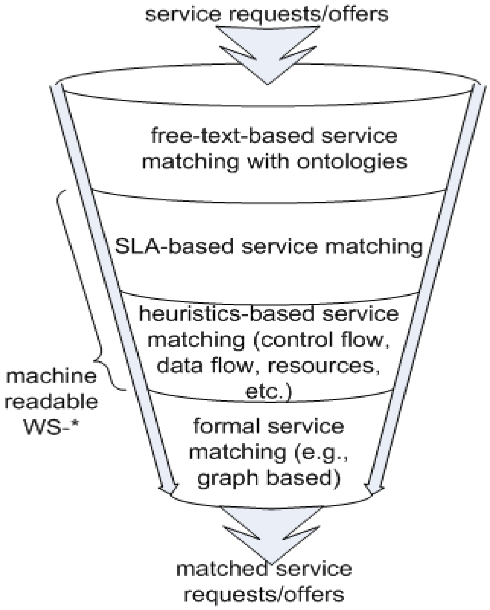

Figure 17: Increased complexity levels for service matching

2.1.3.2 **Service matching**

Assuming a SOC-automation of the collaboration pyramid in Figure 17 with BpaaS, matching service requests and service offers becomes a challenge with only employing computationally expensive high-quality formal methods. For example, computationally expensive are Petri net-based [68] approaches that support service-based business process collaborations [69, 70, 71, 72, 73, 74] because of the state-space-explosion problem, although these methods are high quality.

For the BPaaS-Hub we consider a stepwise matching approach as depicted in Figure 17. On the one hand, the amount of services decreases with every lower matching step while, on the other hand, the matching methods are increasingly computationally expensive but of higher quality towards the lower levels. The top level is a matching of service offers and requests based on extracted and ontologically clarified keywords contained in the service descriptions. A matching of left over services requires on the next level machine-readable service-level agreements (SLA) with, e.g., WS-Agreement [75] or WSLA[6]. As an example for this matching type, in [76], matching templates and instantiations comprises computing the adherence of the latter to templates. The next service-matching level involves BPEL specifications and uses heuristics. For example in [77] tree representations of the BPEL processes are the basis for applying matching heuristics. Finally, the left over subset of services is small enough to use high-quality methods that are computationally expensive. For example in [78], a Petri-net based matching of processes also comprises the soundness verification of the resulting service composition.

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6 http://www.research.ibm.com/wsla/

2.1.3.3 Evaluation

The evaluation compares the requirements postulated in Sectionwith the BPaaS-Hub architecture and gives applications from the ongoing implementation.

For satisfying Requirement 1, the Hub architecture comprises a *View* layer with several graphical user-interface components. In the CF project, we implement a user friendly business-service registry termed Collab[7] that links stored service data of service offers and requests with service-responsible persons and service-issuing organizations. Collab stores service-experience ratings from users for reputation assessments. For keyword extraction, Collab sends the free-text description to the Likey [79] application.

For Requirement 2, a mashup component is part of the BPaaS-Hub architecture. We consider the PULS [80] application for populating the mashup component. Currently, PULS surveils, prunes, ontologically ranks, and aggregates large amounts of online news for surveilling the spread of emerging diseases. However, ongoing PULS extensions cater for an in-depth exploration of domain-specific patterns for business domains such as acquisition, takeover and buyout, investment, nomination, new product release, innovation, marketing, ownership/stake; divestment/reduction of stake.

For Requirement 3, the BPaaS-Hub architecture includes components for creating ontology libraries. We use the TermFactory[8] application for allowing terminologists to define extracted keywords that enter ontology libraries for respective Hub-application contexts.

The matching component in the Hub architecture satisfies Requirement 4 and would incorporate matching levels as described in Section. Currently we implement an application for realizing the matching heuristics in [77]. In a first version, the BPEL representations of one service offer and one service request enter the matching application and converted process trees are compared for their similarity.

For Requirement 5, the Hub architecture includes logging components for several stages of user interaction and a social mining component for the extraction of business intelligence. As an example for populating the mining component, the ProM framework[9] could allow the extraction of processes from logs in a BPaaS-Hub to explore what interaction steps lead to popular service matches. ActiveBPEL[10] is an open -source option for populating the *Enact* component.

2.1.4 Discussion and Open Issues

In this Chapter, we explore the characteristics of business collaboration and present a framework for automating the matching of service offers and service requests. For service matching, we describe a stepwise decrease of matchable services with methods that are increasingly more computationally expensive but of higher quality.

7 http://db.cs.helsinki.fi/~tkt_coll/collab/

8 http://www.helsinki.fi/lcarlson/CF/doc/TFManual.html

9 http://prom.win.tue.nl/tools/prom/

10 http://sourceforge.net/projects/activebpel/

Based on extracted requirements for service matching in the setting of business-to-business collaboration, we present a Hub architecture for brokering business processes as services. The Hub permits business managers to explore with free text service offers and requests, their issuing organizations and service-managing persons. Ontology engines resolve ambiguity issues in the text and to establish trust and explore the reputation of services and their affiliated organizations and persons, Hub users employ mashups comprising news feeds, blogs, wikis, and so on. Finally, we explain with applications the populating of the Hub architecture.

For future work, we pursue the integration of identified applications for implementing the Hub architecture and plan to conduct case studies with industry using the Hub for discovery and matching of service offers and requests. Furthermore, we explore Hub extensions for integrating a service-tendering procedure that allows users to place negotiable bids.

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Appendices

Appendix A. Open Telco Techno-economic Model

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