

The Telecom Industry and Context Awareness

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Abstract

The expenditure telecom operators made to prepare themselves for the 3G (and beyond) environment are far from being re-earned and recent research has showed that mobile customers are not willing to spend more money on mobile communication. The Telecom Industry needs to search for new sources of revenue. Opportunities can be found in the area of Context Awareness. As location based services are taking off, Telecom Operators need to understand quickly the possible roles they can play in context aware services before other players in the industry do. Based on a research on context aware services this paper proposes some new business roles interesting for telco's.

Introduction

Telecom operators face a dynamic marketplace. Liberalization of the market, the internet technology and the digitalization of content has increased the amount of players in the field looking for a way to make revenue [1, Li and Whalley]. Business is becoming disruptive and the traditional value chains become value networks [1, Li and Whalley]. The organization of mobile services consists of a network of different actors performing different roles.

In [2, Chaari et al] it states that context awareness is “the capability of perceiving the user situation in it's many aspects and of adapting as a consequence the system behaviour, whereas adaptation of a service or different presentations of a document, in order to suit the needs of the user, of the environment, of the equipment etc”. During the years different attempts have been made to prototype and develop context aware applications or services. Despite the available technology and experience it is hard to find a successful implemented context aware service in the market [3, Carlsson]. A reason to explain this could be that there is not a clear understanding of the business roles involved to create a successful business model. In

contrast to current mobile services, context aware services may need a different kind of organization and new business roles.

Our research has been performed in the context awareness group of the Research and Trends department of Telecom Italia. This paper presents the outcome of our research for exploring new business roles for telecom operators in a context aware environment.

The Approach

Our research started with a scenario scouting. We decided to select scenarios in the area of E-Tourism (early adapters market), Advertisement (role of advertiser, payment models, privacy issues) and Workforce Management (business market).

Within these scenarios we developed some service concepts. A selection of the most promising service concepts was made and used for further analysis. Within each scenario we selected one service concept to identify the necessary roles. With the use of these roles we created some business scenarios to imaging the roles a telecom operator could play.

The Results

Roles can be played by different actors. An actor can perform one or more roles. A role is justified by the functionality that is needed within the service architecture. After analyzing the three service concepts for the roles involved we created a general model containing basic roles needed to set up a context aware service (see figure 1). This model has been presented at the ICMB 2006 at Copenhagen [11]. With the use of this model we imagined the roles that could be performed by the telecom operator. In today's mobile services, telecom operators provide contracts with their users about the connectivity to and traffic on their network. Billing these users for the use of their network is done by the operators self. Besides providing network access and billing their users they

also offer a set of mobile services. Therefore they also play the role of *service provider*. In some cases the

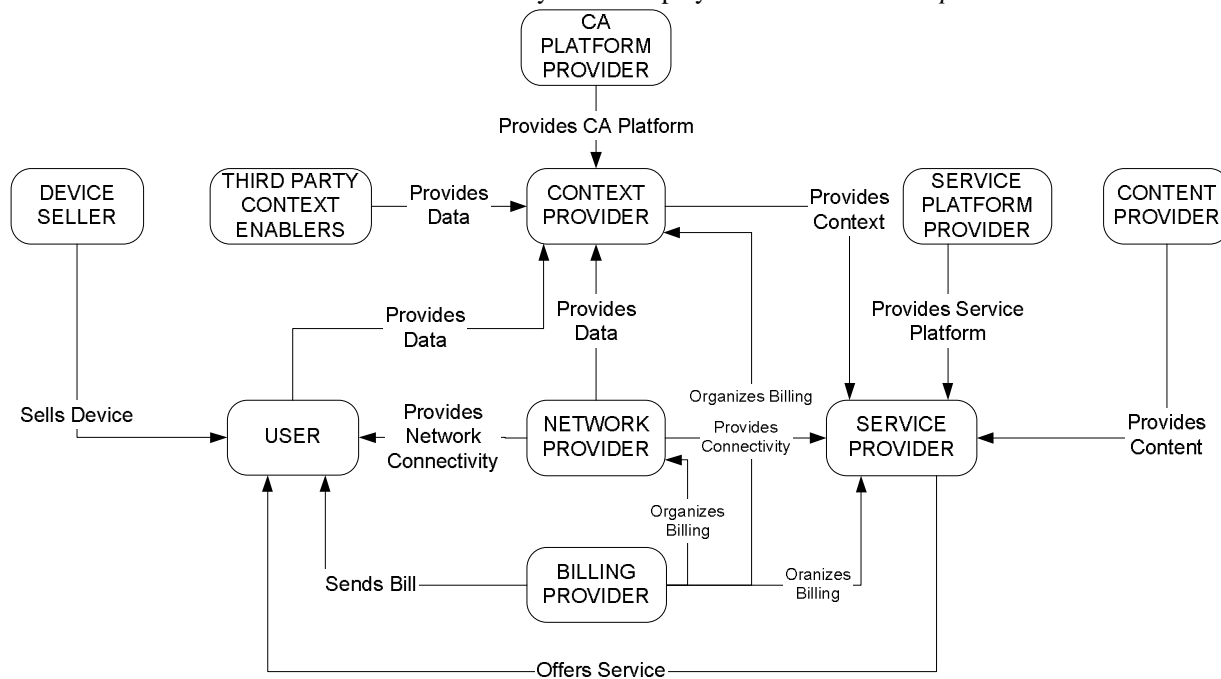


fig. 1: The organization of a context aware service

telecom operator offers own created content like ring tones or screensavers. Many big telecom operators also own a chain in retail to sell their contracts included with a device to their customers. Therefore also the role of *device seller* and *content provider* can be played by the telecom operator.

Context aware services ask for a more complex organization. To explain this we need to know more in general about context aware systems.

Context Aware Systems

The fundamental steps in context aware systems are “*Context Capturing*”, “*Context Interpreting and Modelling*” and “*Service Integration*” (see fig. 2).

The technology behind context awareness is not consolidated. Different enabling technologies can be used in each step to build context aware applications.

Context Capturing:

Context capturing concerns physical and virtual sensors, and the raw data they generate. In Context awareness architectures a context provider represents a context capturing systems that collects data from a wide range of sources (devices, networks, user profiles, etc).

Context Interpreting and Modelling:

The low level representations initially captured may not be meaningful to the application, while high level

representations are easier to interpret and to use (e.g., an address is more significant than GPS coordinates). In context aware architectures, the context interpreter module makes the context interpretation and the context modelling makes the context representation.

Service Integration:

A context aware application has to consume a part of the context. In a service oriented architecture it must subscribe to the “context broker” that carries the pertinent data to each service in the application. While subscribing, the service tells the broker which part of the context is relevant. After this, the broker can provide a context view for each service. This view can be dynamically evolved during execution, requiring some intelligence in the brokering process. Services may pull context values each time they require it, or the context broker may push context to the subscribers every time it is updated.

A reference model for Context Aware Systems was developed in IST-2004_511607 Mobilife [<http://www.ist-mobilife.org>].

Looking at figure 1, step 1 “*Capturing Context*” is presented by the three arrows labelled with “*provides data*” to the *context provider*. Schilit et al [4, Schilit et al] divides context into *user context* (like user profile, preferences, location, mood, current activity etc.), *computing context* (like device capabilities, type of network connection, amount of broadband) and

physical context (like indoor or outdoor, temperature, weather information, loudness, brightness).

In our model the *context provider* receives context information from three sources, namely the *user*,

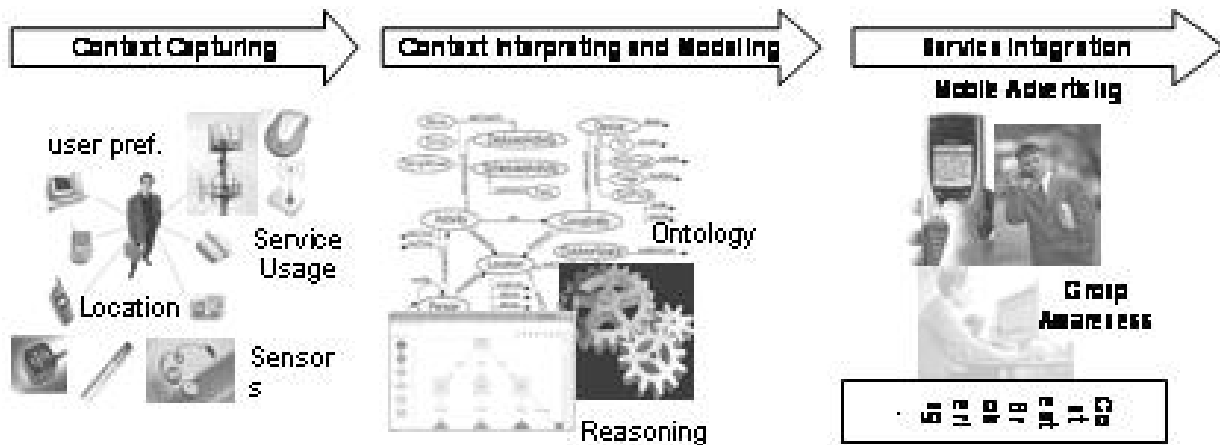


fig 2: The fundamental steps of context aware systems

network operator and in general the 3th party context enablers. Without giving a finite list of context items, table 1 shows the roles that provide context information, the type of context they provide (based on Schilit’s categorization) and some example context items.

Role	Type of Context	Context Items
User	User Context	user profile, preferences, interests, mood, current activity, agenda
Network Operator	Computing Context	connectivity information, type of device, device capabilities, available broadband
	User Context	location information
Third Party Context Enabler	Physical Context	Weather conditions, traffic conditions, illumination

table 1: Context items

This table shows that the *network provider* besides providing connection also could provide useful context information to the *context provider*. Like the *user* and the *3th party context enabler*, the *network operator* provides raw context that can be collected by the *context provider*. We call this role *context enabler*. A *context enabler* provides raw context information that can be used for the creation of context.

Step 2 “Context Interpreting and Modelling” is presented by the role of context provider. This context provider brokes raw context information from the context enablers, reasons and models on this in order to create new information, and provides this context to the service provider. In order to create context the context provider needs a platform, performing functionalities like context brokering, reasoning and modelling. Context brokering asks for collecting the information and storing the information on a location from which the reasoning and modelling part of the platform can access it. The mobile network of the telecom operator can be used to transfer all the information needed to create the context to a central location. Therefore the telecom operator has the unique opportunity to collect the raw context information and to play the role of context provider.

Step 3 “Service Integration” happens in the role of service provider. The service provider needs a service platform and access to the mobile network to execute its services. The integration of the context happens on the service platform. With the use of the context, the service provider can offer services that behave and adjust themselves to the context of the users. Telecom operators offer a different set of services to their users. The use of context aware technology could personalize and adjust these services in a better way to the context of these users. With the use of the model in figure 1 we can (theoretically) propose 3 different roles a telecom operator can play in a context aware environment. To see if there really is a potential market for context aware mobile services we need to understand the latest dynamics of the marketplace in which telecom operators put their services.

Marketplace Dynamics

To understand if there is a potential market for context aware services we performed an analysis of the marketplace for mobile services collecting state of the art information about this environment. For this we used the description of the telecom industry provided by Fransman [5, Fransman]. Fransman describes the telecom industry as a six layered industry, consisting of equipment and software, network, connectivity, navigation and middleware, application incl. content, and the consumer. In each of these layers we identified some trends that could have an influence on the adoption of context aware services. The next part summarizes the trends and developments we have found in each of these six layers.

Equipment and Software:

Mobile handsets are becoming more complex devices that can do more than just phoning and messaging. The popularity of digital cameras, digital video cameras, portable digital assistants and portable MP3 players make handset manufacturers, like for example Nokia produces handset inspired by more than just mobile communication. These devices are hybrid devices, containing all the different functionalities in a single device [http://www.nokia.com], giving the user a wide range of new functionalities. The embedded devices in today's handset let the user create a lot of digital content like photos, videos, voice recordings, personal agendas etc. Also the software on the device is changing. Nowadays mobile handsets allow the installation of a third party operating system like Symbian OS. We believe this will become a commodity within some years. Another interesting trend is the evolution of GPS on handhelds. IDC performed an analysis of the penetration of GPS-enabled handhelds into the Asia and Pacific market [7, IDC]. Instead of buying the expensive car-in navigation, consumers in Korea and Taiwan were buying simple add-on GPS packages that turned their handhelds in GPS-enabled ones. This two-piece solution, which connects the GPS receiver with the device by Bluetooth or cable, resulted in an increase of sales for the handhelds. IDC foresees the potential for GPS to increase device sales and the increase of ARPU for mobile phone vendors and operators.

Network:

Telecom operators have finished the upgrade to a 3G network, enabling higher bandwidth and an always on connection for their users. In 2004 the UMA Forum was established by leading telecom vendors and operators. UMA stands for Unlicensed Mobile Access and is a technology that connects regular unlicensed wireless networks to GSM networks [http://www.umatechnology.org]. Some telecom operators, presented in the Fixed Mobile Convergence

Alliance [http://www.thefmca.com], are merging their fixed and mobile network.

Connectivity:

The popularity of unlicensed wireless networks creates opportunities for new connectivity providers. The FON community [http://www.fon.com], for example, offers free access to all the hotspots of their members if you share your hotspot within the community. Also Google is offering public WIFI-services [6] in Mountain View and is testing in San Francisco.

Navigation and Middleware:

Internet browsers specialized for mobile devices and internet technologies, like AJAX, become available for mobile devices. Another development is about a mobile search engine founded by a group of telecom operators. Also experiments on mobile payments are taking off. A Dutch financial bank is promoting its payment services. These payments are made with the use of a mobile phone.

Application and Software:

The European project Mobilife [http://www.ist-mobilife.org] investigates, from a user point of view, the need for new mobile services. In their document "The Initial MarketPlace Dynamics" [9] they give four drivers for new applications and services in the changing marketplace. At first there is still the need for *personal communication needs and desires*. Communication among individuals is by large one of the major driver in the usage of mobile personal devices. Voice and messaging are still the most prominent services but fig. 3 shows an increase of the average revenue per user (ARPU) on data traffic in the last years.

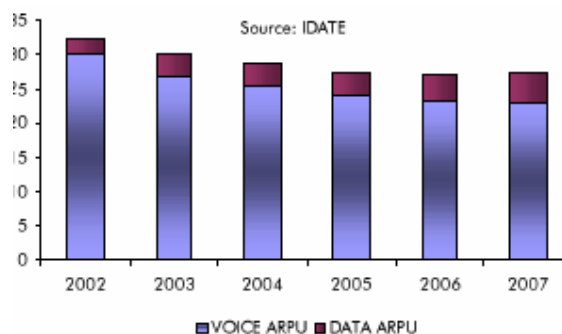


fig. 3: Worldwide ARPU evolution in US dollars per month

The second driver is *self produced content*. As explained before, mobile handsets nowadays are equipped with a lot of embedded devices and third party software. The success of camera phones shows that applications and services may need to support the production and distribution of own made content. At this moment we can find a set of services in the market based on *self created content*. In Korea and Japan the service called "OhMyNews"

[<http://www.ohmynews.com>] has proved to be a big success. It allows its customers to send self created news items to the website, which publishes them. With their camera equipped mobile phone, people can act as local reporters. Another driver is *sharing practices*. Media digitalization and portability have spread on mobile and wireless environments the sharing culture and practices pushed by P2P models on the fixed internet. The last driver is more related to the business aspect of offering new services and applications. Like the Google service, with advertising-supported search, *marketing and advertising driven free scenarios* have proved on the fixed internet to be a big success.

Based on the research of IDC [8, IDC] on the penetration of GPS-handhelds into the Asia and Pacific market they foresee big opportunities for location based services.

Consumer:

Research has proved that consumers are interested in new mobile services but are not willing to spend more money on mobile communication [10, Immonen et al]. Their willingness to accept advertisement increases if they can receive services for free.

From this analysis we can conclude that

Business Scenarios

Business models describe how a network of organizations co-operates in creating and capturing value from new, innovative services or products [9]. After we have analyzed the new business roles needed for context aware services and after having seen some positive trends for context aware services we believe that telecom operators could profit from playing new roles and therefore support the creation of innovative business models. Assuming that there will be a market for context aware services there will be the need for context information. Based on the assumption that there is a market for context aware service we propose 3 business scenarios. In the first and simplest scenario a telecom operator could set up a configuration in which he creates a context aware service by playing all the roles in the model itself. In this scenario we could identify 2 actors, namely the *user* and the *telecom operator*. The telecom operator could generate revenue from the earnings of innovative services.

In the second scenario we assume that the role of the telecom operator is limited to *context enabler*. If the *context provider* wants to produce a total context it needs Computing context information (type of connectivity, etc) and some User context information (location). For this it could pay a fee to the telecom operator for disclosing this information (see figure 3). In our model in fig 1 this can be mapped on the roles of *network provider* and *context provider*.

In the third scenario the telecom operator plays the role of *context provider* and *network operator*. In this scenario the telecom operator provides in the need for context that can be integrated into services. Other service providers want to offer context aware services and they need to configure their services with the context of their users. Telecom operators maintain and own the mobile networks. Therefore they have a strong likelihood to play the role of *context provider*. Fig 4 shows the interaction between the telecom operator, performing the role of *context provider*, selling context to the *service provider*. We can map this interaction with our model in fig. 1 on the roles of *context provider* and *service provider*.

Revenue Models

As mentioned before, research has proved that mobile users are not willing to pay more for mobile communications. In order to come up with successful business models we have to take this into account. The service provider Google has proved that services can be offered for free and that the costs can be paid by the revenue of advertisement. An aspect that is of big importance for the success of Google Searches advertisement model is that the advertisement always is adapted to the “search query” inserted by the user. For the advertiser this results in a higher awareness of the published advertisement. Based on our analysis of advertisement based scenario we believe that advertisement in context aware services could be of high potential for advertisers. Creating the context of mobile users generates a lot of interesting information for advertisers. Research should be conducted to investigate how this information could be used in context aware advertisement. Issues about the privacy of the users are of big concern. Without dealing with the issues about privacy we propose a revenue model based on advertisement income (see fig. 4). This model is created with the use of the E3-value ontology designed by Gordijn of the Vrije Universiteit Amsterdam [<http://www.e3value.com>]. This technique is chosen because it contains tools to express the “value exchange” between different actors. The tool is based on an ontology containing objects that help to describe the exchange of value objects between actors. The value exchange can be seen as a prototype of actual trades between actors. This trade is visualized by the use of “value ports”. The total explanation of the objects involved can be read in [12, Gordijn]. Our model in figure 4 is based on the assumption that the user can get the service for free. We can map different parts of this revenue model with our model in figure 1. At first the context provider needs data, in order to create the context, from different context enablers.

Based on the assumption that an actor is only willing to offer objects to someone else, if they receive

adequate compensation [12, Gordijn] the context provider has to pay a fee to the network operator for obtaining the network data.

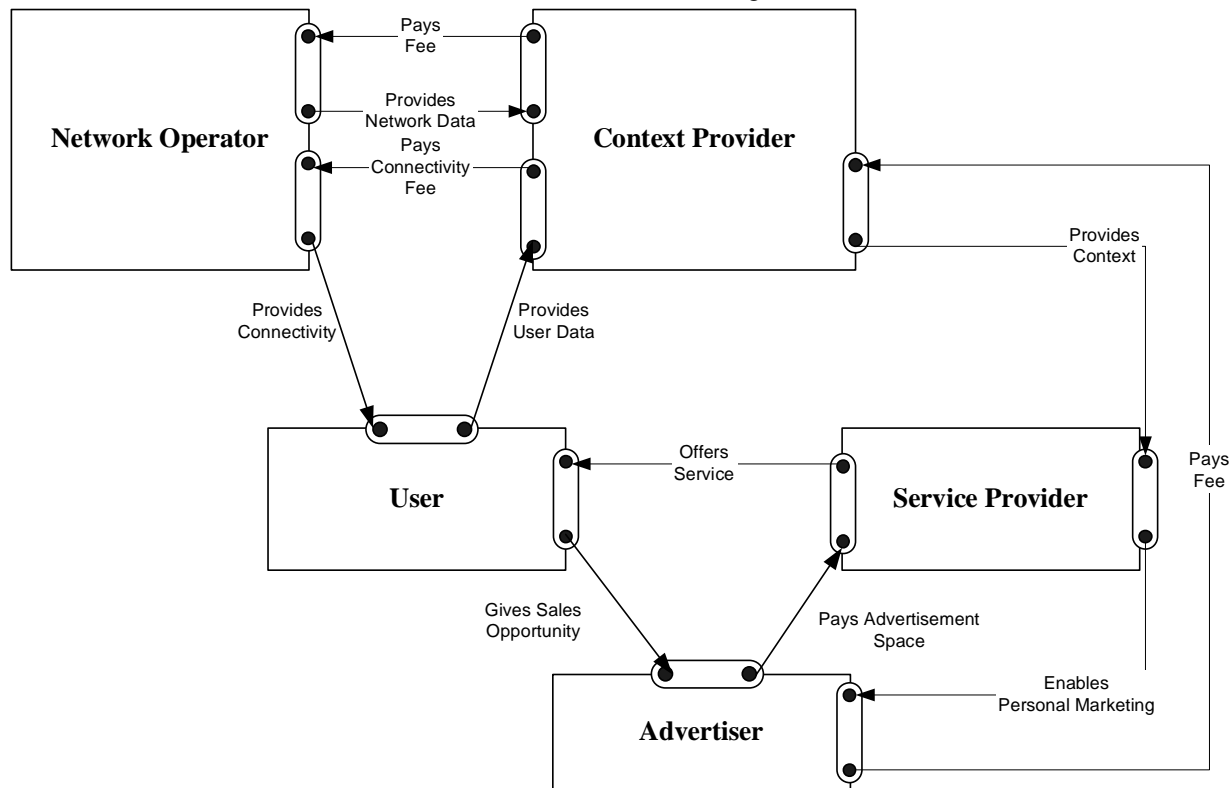


fig. 4: An Advertisement Based Revenue Model

Besides the use of network data, the *context provider* needs user data. In this model we assume that the *user* is willing to give away his user data for free in order to experience the value of the context aware service. The user data will be sent over the network owned by the *network operator* so the *user* will generate traffic which has to be billed. In this model we assume that the *user* doesn't pay for this generated traffic but the *context provider* does. He needs to broke (acquisite) the information from the *context enabler* in order to sell his context to the *service provider* and therefore he is willing to pay the generated traffic of broking user data. The model visualizes this by showing a kind of triangle value exchange. As mentioned before the user can get the service for free because he accepts advertisement. Because the *user* accepts advertisement he gives a sales opportunity (or publicity time) to the *advertiser*. The *service provider* can offer the service for free because it generates revenue by selling advertisement space. In this model the *advertiser* wants to adjust his advertisement on the context of the *user*. We can think about location based advertisement combined with user preferences, current mood and activity. Therefore the *advertiser* is willing to pay for the needed context. Another triangle based value

exchange visualizes this. The *context provider* provides the context to the *service provider*. The *advertiser* pays for this and the *service provider* enables personal marketing for the *advertiser*. Depending on the role that the telecom operator plays, he can create opportunities for new revenues. In the master thesis, which is still work in progress, we go in detail about these scenarios and models.

Conclusion

In the search for new sources of revenue for the telecom operators we investigated the area of Context Awareness. To set up context aware services we need to organize a complex web of different actors playing different roles. Within this organization of actors, the telecom operator has a unique opportunity to play the identified necessary roles.

Context Enabler:

The mobile network owned by the telecom operator is a great source for computing context information. Network data can be used for localization, available bandwidth, type of connectivity, etc. Today's devices become more complex containing more embedded devices. With the installation of an

operator's simcard, applications can be installed that periodically transmit raw context to the *context provider*.

Context Provider:

Context brokering is a functionality performed by the *context provider*. Brokering means collecting all the raw context from the different *context enablers*. Because the telecom operators have mobile networks, they easily can use their network for brokering the raw context information to a central location.

Context Aware Service Provider:

By connecting the operator's service platform to a context platform, Telecom operators can set up autonomously a configuration for supporting context aware services.

Our analysis of the marketplace dynamics has shown some trends that have a positive influence on the adoption of context aware services in the nearby future. Despite the positive trends we also identified some negative trends. Research has proved that mobile users are not willing to pay more for mobile communication. There is a certain interest for new services but there is no will to pay for them. Using advertisement to make the service (partly) free could be a solution. Although it is not clear in what way *context providers* may use personal information and how the affection of mobile users is about this, we proposed a revenue model in which the service is offered for free because the advertiser pays for user information and advertisement space. Obviously it is clear that research is needed to understand how to deal with privacy issues.

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