# Collaborative QoS-information Sharing for Mobile Service Users: A Web 2.0 Business Model proposal[1]

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**Abstract**. Mobile service providers (MoSPs) emerge, propelled by ubiquitous availability of mobile devices and wireless communication infrastructures. MoSPs' customers satisfaction and consequently their revenues, largely depend on the quality of service (QoS) offered by wireless network providers (WNPs) at a particular location and time of a mobile service usage. This chapter presents a novel business method for the MoSP's QoS-assurance process. The method incorporates a location- and time-based QoS-predictions service facilitating the improvement of the WNP's selection process. We introduce and analyze business viability of QoSIS.net, an enterprise that provides the QoS-predictions service to MoSPs or directly to its customers (i.e. in B2B or B2C settings). QoSIS.net provides highly accurate QoS-predictions based on collaborative-sharing of QoS-information by its users. We argue that this business method can improve the MoSP's QoS-assurance process and consequently may increase its revenues, while creating revenues for QoSIS.net.

**Keywords**: Wireless and mobile services**,** Quality of Service, Web 2.0, collaborative information-sharing, QoS-predictions, data mining

## Introduction

The last 15 years have been marked by the expansion, global adoption and seamless availability of the Internet with a multitude of its ubiquitous services. At the same time, a new era has undergone its preparation phase. Namely, the service users around the world, who have entered the digital era in the 1990s-early 2000s, are now entering the mobile era (Hansmann *et al.*, 2003). This era has been particularly propelled by miniaturization and personalization of communication devices, as well as the rapid expansion and adoption of mobile voice and data services and ubiquitous wireless communication infrastructures. In this era, ubiquitous mobile service providers (abbreviated through the document as *MoSPs*) bring to their customers their favorite existing Internet services and start offering, on a growing scale, a wide range of new mobile services. However, these MoSPs are fully aware that in order to gain customer acceptance, and secure own revenue, their mobile services must provide customers with a *quality of experience (QoE)* (ITU-T, 2007) comparable to the existing Internet-services (Afuah & Tucci, 2000). As part of customer QoE, a MoSP must at least assure meeting customer's (implicit or explicit) *quality of service* (*QoS*) requirements, expressed e.g. in terms

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of service performance, security level and monetary cost (ITU-T, 1993). However, to stay competitive, the MoSP should assure meeting the required customer's QoS and in a best-possible way meet his anticipated-QoE (Andersson *et al.*, 2006).

To achieve this goal, MoSPs require dependable wireless communication infrastructures supporting mobile service delivery to their customers, anytime, anywhere and anyhow. These infrastructures, and in particular their providers, i.e., *Wireless Network Providers* (*WNPs*), must be able to either match their users' (i.e. MoSPs) QoS-requirements, or provide detailed and precise information about their offered-QoS. This information would enable MoSPs to adapt their service delivery and assure meeting the required QoS-level of their mobile users (i.e. customers).

Nowadays, in almost every country, there co-exists a number of WNPs, operating different long-range wireless communication technologies. In particular, there exists at least one national *Mobile Network Operator (MNO)*, providing primarily mobile voice and data services over long-range wireless communication technologies (e.g. GSM/CDMA, GPRS/EDGE, UMTS/WCDMA/ HSDA). In co-existence with MNO's, WNPs like public WLAN providers emerge rapidly, especially in big cities. Moreover, new mobile devices support a multitude of long-range wireless technologies, as well as short-range wireless technologies (e.g. Bluetooth). Hence, communications means become ubiquitously available to mobile service users and MoSPs. This means that, at least in principle, a mobile service user and MoSP must be able to choose a WNP (and wireless technology) at any location and time, offering the QoS that meets user required- QoS thus meets his anticipated-QoE.

However, this scenario is far from reality today. The business strategy of existing WNPs, and particularly MNOs, is based on a user 'lock-in' (Buschken, 2004); the user can only choose from wireless networks (and therefore technologies) offered by 'his' WNP. Moreover, the information about QoS-offered by a WNP is based on marketing information providing numbers related to the network's theoretical performance; the real (i.e. objectively measured) QoS is unknown! Surprisingly, even mobile services provided by WNP's are based on assumptions regarding their offered-QoS. It is widely accepted practice that mobile service performance tests conduced by WNPs (and especially by MNOs) are based on 'drive-tests' (Gomez & Sanchez, 2005) and focus only on the availability of WNP's wireless communications technology at different locations. Out of these tests, the only information disclosed by WNPs to MoSPs and their customers are coverage maps. In effect, the WNPs offer their service at 'best-effort' level to MoSPs. As a result, it is not possible for a MoSP to select at a certain location and time a WNP (and technology), which offers QoS, that best assures meeting its customer's QoS-requirements. A MoSPs are constrained by above restrictions and can only provide mobile services to their customers at a 'best-effort' level.

We envision that the above restrictions on WNP selection will dissolve in the next decade of mobile service provisioning. Already we see *Mobile Virtual Network Operators (MVNOs)* appearing on the market, allowing their customers to choose a WNP from a (still small) selection of partner MNOs. With larger numbers of WNPs participating in a MVNO, a larger choice becomes available to a MoSP at any location and time. However, this does not solve entirely the problem of how the MoSP can make the selection of a WNP that best assures meeting the QoS-requirements of its mobile customer! Accurate information regarding QoS-offered by WNPs at a location and time is not available.

Because of the situation today, a MoSP that offers QoS-demanding mobile services, like mobile healthcare (MobiHealth, 2007) or mobile games (Digital Chocolate, 2008), face difficulties related to QoS-assurance to their customers and adherence to their anticipated-QoE. They are forced to provide their services at a 'best-effort' level; i.e. they can only base their customer's QoS-assurance business process (part of QoS-operational management (TMF, 2004)) on assumptions about QoS provided by WNPs. These assumptions are usually derived from WNPs' marketing (theoretical) QoS-information. However, these assumptions can be far from reality, which may significantly influence user-QoE and consequently influence MoSP's revenues.

Based on the current situation of mobile service provisioning as presented above, in this chapter we propose a novel business method (i.e. a novel method of doing business) that incorporates location- and time-based QoS-predictions into MoSP's QoS-assurance business process. Towards this end, firstly, we describe and analyze the viability of a new business enterprise: *Quality of Service Information Service Provider - QoSIS.net*, that offers an accurate QoS-predictions service to MoSPs and its customers. A QoS-prediction is a prediction of QoS-offered by a WNP (for a given technology) at the MoSP's customer location and time. For QoSIS.net, we propose a novel business method to be employed in its operational (core) business process. The method is based on 'users-collaborative-sharing' of QoS-information, acquired when different MoSPs and their customers, use different WNPs at a particular location and time. The method's novelty (as well as its major risk factor) lies in the fact that QoSIS.net can provide highly accurate QoS-predictions to MoSPs only based on a large volume of QoS-information acquired from its customers.

Secondly, we propose of a novel business method for MoSPs employing the QoSIS.net QoS-predictions service in its QoS-assurance business process. The method aims at using the QoS-predictions service to select a WNP (and technology) at a given MoSP's customer location and time. It supports meeting of the mobile user's QoS-requirements and improvement of his QoE beyond 'best-effort' level. The goal of the proposed method is to improve (e.g. in terms of efficiency and effectiveness) the MoSPs QoS-assurance process. We argue that the proposed business methods require trustful business inter-dependency between MoSPs and QoSIS.net, while it has a strong potential to bring mutual benefit to them - in terms of increase of MoSP revenues and creation of revenues to QoSIS.net.

## 2 Current trends

An issue of quality of service assurance in Internet-based-services and its relation with Internet performance has been indicated as a critical factor already in 1990s (ITU-T, 1993). QoS has been defined the as "collective effect of service performances which determine the (objective) degree of satisfaction of a user of the service". It has been recognized, that QoS-offered by Internet influences the

QoS provided by Internet-based-services to its users, and hence these users' quality of experience (QoE). QoE has been defined as "the overall acceptability of an application or service, as perceived subjectively by the end-user" (ITU-T, 2007).

The Internet-based-services providers recognized early the necessity for QoS-assurance business processes to meet their users' anticipated-QoE requirements and secure their revenues. First solutions for the QoS-assurance business processes have been proposed particularly for providers of real-time multimedia services (Hutchison *et al.*, 1997; Shepherd *et al.*, 1996). These solutions, from the technical perspective, recommended use of a rigorous and complex (!) QoS management frameworks, employing functions like QoS negotiation and resource reservation (Andersen *et al.*, 2000; Xiao & Ni, 1999). Moreover, from the business perspective, these solutions required business contracts between Internet-based-services providers and network providers, i.e. Internet-providers (Afuah & Tucci, 2000). These solutions however contradicted with the 'open' nature of Internet and its services, because in effect they limited the Internet-based-services provider customer-base to the Internet-providers' base. In this situation, Internet-based-service providers skipped the proposed technological and business solutions and learned to deal with 'best-effort' quality offered by Internet, while being able to assure the QoS to their service users. The business methods, based on which they build their QoS-assurance process, relied on estimations of QoS-offered by Internet. This approach has been feasible due to at least two facts. Firstly, QoS-offered by Internet exhibits some regularities (claffy *et al.*, 1998), hence estimations could be valid for a longer period of time (e.g. months). Secondly, if necessary, providers could easily acquire offered-QoS-estimations via dedicated QoS monitoring, and all that for free and without an degradation of quality of their provided services (Michaut & Lepage, 2005)!

With the raise of mobile era, we are somehow repeating the history regarding QoS-provisioning. It has been indicated as a critical issue already in 1999 (Chalmers & Sloman, 1999); at the time when only basic voice and data services existed. It is recognized that the most critical factor in QoS assurance is related to user's mobility; a mobile user is exposed to access WNP different access points at different locations and times, or even to use different WNPs (over different wireless technologies) along his mobility path (Dekleva *et al.*, 2007). To deal with it, and to meet users' QoS-requirements, mobile service providers (MoSPs) are advised to employ a QoS management framework as a business method in their QoS-assurance business processes. From the business perspective, this solution requires a business relationship between a MoSP and a WNP supporting a mobile service delivery; which results in a WNP-centric business models. There is a lots of research supporting solutions of this type, for example (Han & Venkatasubramanian, 2006; Soh & Kim, 2003) propose MoSPs' QoS-assurance process to employ predictions of user mobility path acquired from MNO' access points (i.e. base stations). Similarly, MNOs work on new concepts like Universal Mobile Access, Generic Access Network and IP-Multimedia System (Cuevas *et al.*, 2006), striving to provide technological as well as contractual solution for MoSP QoS-assurance process tightly coupled with MNO's business processes.

Again, such approaches contradict the 'mobile' nature of services provided by a MoSP; a business relation with a WNP would limit its customer base and service usage area to the WNP's customer-based and its coverage-area. Despite this, the WNP-centric business models seem to be dominant today as presented in literature (Calvo *et al.*, 2004; Faber *et al.*, 2003; Robles *et al.*, 2002; Tan, 2004; Tsalgatidou & Pitoura, 2001).

However, we can observe that the individual MoSPs, not following the WNP-centric business models, emerge (Tan, 2004). The MobiHealth.com (MobiHealth, 2007) is an example of these in healthcare domain, while Digital Chocolate (Digital Chocolate, 2008) – in mobile gaming domain. Providers in both domains struggle with QoS-offered by WNPs to assurance of QoS to their users (Bults *et al.*, 2005; Busse *et al.*, 2004). Moreover, in parallel, we can observe rise of new WNPs or new long-range wireless technologies (like e.g. Ultra-Mobile-Wideband) being employed by existing WNPs, and that all striving to 4G vision of plentiful WNPs and wireless technologies being available for mobile users (De Vriendt *et al.*, 2002; Dekleva et al., 2007; Ortiz, 2007; Tachikawa, 2003). Yet, whenever a new WNP appears, it is a commonly used practice that it does not provide any information about its offered-QoS; it always starts with a 'best-effort' level offers (Gomez & Sanchez, 2005).

In light of these developments, and with respect to the fact that MoSP are very likely to be highly mobile and roaming between different WNPs, new trend appears in research on mobile business, focusing on user-centric business models. The aim is to enable for a MoSP to meet user QoS-requirements and his anticipated-QoE with use of any WNP at user given location and time. Towards this direction, there exists technically-oriented research proposals for e.g. advanced signaling between involved WNPs (Bless *et al.*, 2004; ITU-T, 2006) or new user-centric approaches for WNPs and MoSPs (Manner *et al.*, 2001). There are even large EU projects dedicated to new business methods for MNOs to support MoSPs, without locking-in their customers (Sanchez *et al.*, 2008). There exists also proposal of forming smart-business networks (van Heck & Vervest, 2007) to support special MoSPs users' QoS-requirements by building 'ad-hoc' business relationships between enterprises.

Still the question remains: how a MoSP can choose a WNP best matching his user's QoS-requirements at a given location and time. Methods used in Internet-based services do not work in mobile services; the QoS estimations vary per location and they change in time, moreover, dedicated QoS-monitoring is costly in terms of money and mobile device resources, e.g. battery and network throughput, which can in turn degrade the provided mobile services.

This situation supports our proposal for a MoSP QoS-assurance business process employing a QoS-predictions predictions service of QoSIS.net (details in the next Section). To our knowledge, this kind of solution has not been proposed yet in the literature. The novelty (as well as a risk factor) of QoSIS.net is in the fact that it provides pre-existing offline community of mobile service users with a complementary online service. This is particularly an idea behind all Web 2.0 services (Hoegg *et al.*, 2006; Martignoni & Stanoevska-Slabeva, 2007; O'Reilly, 2005; Pascu *et al.*, 2005), that emerge successfully nowadays in different domains and gain users' acceptance (e.g. Facebook, YouTube, Wikipedia). Particularly, Web 2.0 is coined by O'Reilly (2005) as "the philosophy of mutually maximizing collective knowledge and added value for each *participant* by formalized and dynamic sharing and creation of user generated content" (p.1) and its 'mobile' extension means that it is implemented as a mobile service. QoSIS.net employs a Mobile Web 2.0 paradigm, and its customers are such 'participants' contributing to community with acquired QoS-information. This chapter presents feasible business models for QoSIS.net, and the existing technical solutions supporting it service delivery.

## 3 QoSIS.net: Collaborative QoS-information sharing for mobile service users

In this and the upcoming sections we exploratively (rather than exhaustively) introduce and analyze the business viability of QoSIS.net along the business model framework given by (Hoegg et al., 2006); we consider its service, potential market-segments and customers, value chain, revenues-costs model and so on.

### 3.1 Features of a Value-add Service

QoSIS.net delivers a value-add QoS-predictions service to its customers: MoSPs and their customers. QoS-prediction is a prediction (along with its accuracy estimation) on QoS-offered by a WNP and wireless communication technology at a MoSP's customer location and time. The QoS-predictions are used by a MoSP to select a WNP, to match the mobile service QoS-requirements and to facilitate an improvement of his QoE beyond 'best-effort' level. QoSIS.net offers a value-add service to MoSPs, because it is the responsibility of a MoSP how to use the information provided by QoSIS.net.

QoSIS.net provides its service based on user-collaborative QoS-information acquisition from MoSPs and their customers. QoSIS.net incorporates QoS-monitoring, -storage, -processing, -predictions engine and QoS-predictions dissemination functionality (Figure 1 (Wac, 2006) and (Pawar *et al.*, 2008)).

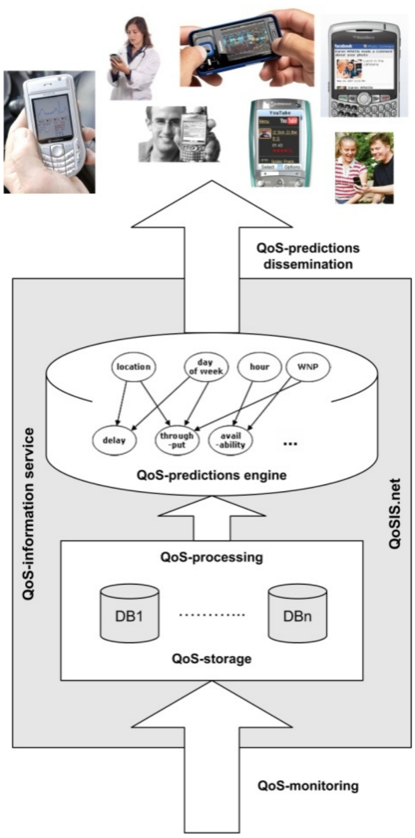


Figure 1. QoSIS.net high-level system architecture

QoS-monitoring acquires and stores QoS-information that concerns QoS observed (i.e. measured) by a MoSP and its customers when using a WNP and wireless communication technology at a particular location and time. A request for a QoS-predictions service, results in instantaneous processing of large quantities of QoS-information by prediction engine. The engine uses data mining techniques (e.g. Bayesian Networks (Heckerman, 1996)) to discover QoS-information patterns. The result is returned to the QoSIS.net customer (i.e. service user).

QoSIS.net provides its service users a private mobility-map (stored on the user's mobile device) showing all the visited locations so far combined with QoS-predictions information. The mobility-map is automatically updated, either at regular time-intervals or at the moment a prediction is requested. The information in the map allows the QoSIS.net service user to get historical QoS-predictions even if the user is out of coverage of any WNP.

One of the technological challenges for QoSIS.net is the fulfillment of customer expectations in terms of service speed, dependability, accuracy, interoperability, security, scalability and fault-tolerance ((Henricksen *et al.*, 2005), (ITU-T, 1993)). It is important to notice that QoSIS.net can use its own QoS-predictions services as value-add services in its QoS-assurance business process; i.e., to select a WNP (and technology) with use of which its prediction service is going to be delivered to its customers at a given location and time.

QoSIS.net employs a generic QoS-information model that includes (Chalmers & Sloman, 1999; ITU-T, 1993)):

a) WNP-related information – a provider name, wireless technology used (e.g. 3G/WLAN)
b) WNP performance - speed, delay/throughput, accuracy, dependability (incl. availability),
c) WNP monetary cost - e.g. per MB, per hour
d) WNP security features (e.g. authentication, confidentiality, integrity, non-repudiation)
e) MoSP services used and usage context i) mobile device used and ii) user location and time

Note that the mobile service (i.e. application)-specific user's QoE-related parameters like e.g., picture resolution, audio quality, AV rate/synchronization are outside of the scope of the QoS-information model, due to their application dependency. It is important to notice that the QoS-information does not have any notion of mobile user's identity, all information is anonymous.

### 3.2 Features of the Service Medium

After describing QoSIS.net service, the question arises what the service medium features are of importance for QoSIS.net service delivery to its customers. We emphasized that the QoSIS.net service is beneficial for mobile service users. Therefore, the features of the service medium depend on the user's context (e.g. WNPs available at a particular location) and may intentionally or accidentally disable or disturb QoSIS.net service delivery (Camponovo & Pigneur, 2003; Tsalgatidou & Pitoura, 2001). Hence, the user context can influence the QoSIS.net business processes as well as influence the QoE of QoSIS.net customers. Dealing with service medium issues needs to be taken care of in business contracts between QoSIS.net and its customers (see further sections for details). Examples of QoSIS.net service medium-related issues are:

a) user communication-autonomy, e.g. user can deliberately configures his mobile device to use one particular WNP and technology or can be unreachable due to out of WNP coverage or empty mobile device battery
b) ACID properties (atomicity, consistency, isolation, durability) of QoSIS.net's service transactions
c) vulnerability of the user's mobile device (in terms of possible device's damage or loss) and its limited storage, processing, communication and power capacity
d) WNP's wireless communication technology characteristics, e.g. asymmetrical throughput characteristics, variable delay characteristics and restrictions on volume of QoSIS.net service data exchange (may require use of lightweight protocols and QoS-information lossless compression).

### 3.3 Social Environment

There are several influences of the QoSIS.net services provision, rising from customer competition, legislation and social or ethical constraints. Firstly, competition amongst QoSIS.net customers (MoSPs) requires QoSIS.net to be a trustworthy enterprise. It should apply strong security mechanisms to prevent competitive customer information is disclosed to other QoSIS.net customers; e.g. any information regarding MoSP service usage statistics or customer base should be protected. Therefore, the business relationship between a MoSP and QoSIS.net is based on a strong trust relationship (Ratnasingam & Phan, 2003) and detailed business contracts. Similarly, WNPs' competitive market situation poses strong security requirements on QoSIS.net information. Any information regarding QoS provided by a WNP should not be altered in favor of this WNP. Moreover, in order to secure QoSIS.net revenues and its competitive advantage on the market, details of its QoS-information databases or QoS-predictions engine should not be disclosed to its customers.

An important social aspect of the provided service is related to the user-privacy consent. QoS-information acquired from QoSIS.net customers contains detailed location and time information of mobile service users. Therefore, it is required (at least in Europe) that a mobile service user is legally informed of the fact that this privacy sensitive information is acquired (Gorlach *et al.*, 2004), even if it is in anonymous form. It is the responsibility of a MoSP as the QoSIS.net customer to provide user-privacy informed-consent.

### 3.4 Generic Revenue-Costs Model

From the perspective of QoSIS.net, we can anticipate that QoSIS.net can get revenues by selling its stored QoS-information to other value-add service providers, or it can have costs related to supplying of QoS-information or external QoS-predictions engines.

Before we analyze in details possible revenues for QoSIS.net and its customers (in upcoming sections), we indicate possible (generic) costs related to QoSIS.net's service usage. Namely, from the QoSIS.net side, costs related to the setup and maintenance of QoS-information databases and enrichment of the QoS-processing service and QoS-predictions engine towards increased QoS-predictions accuracy. From the QoSIS.net's customer side (e.g. a MoSP user), these costs are related to use of customer's resources: computation, storage and communication capacity, as well as battery, especially on the mobile user's device. Moreover, due to the nature of provided service, it is required for QoSIS.net users to own a mobile device with one or multiple interfaces for a long-range wireless network to be used via different WNPs (or at least one WNP). This device must also have a GPS, or other location-determination sensor. At this point we would like to emphasize that technical realization of inter WNP (i.e. vertical) handovers is an ongoing research issue (Chen & Shu, 2005; Dekleva et al., 2007; Pawar et al., 2008) outside of the scope of this book chapter and discussed in more details elsewhere (Wac, 2008).

### 3.4 Market Description and Market Entry Strategy

QoSIS.net market contains of two market segments: a Business-to-Business (B2B) market segment containing MoSPs as its customers and a Business-to-Customer (B2C) market segment containing customers, who are mobile service end-users. In the B2B case, QoSIS.net offers a value-add service to MoSPs, which is invisible to the MoSP's customer. In the B2C case however, QoSIS.net offers its value-add service directly to a customer; i.e. a mobile customer, who is a mobile service user (of e.g. Facebook or VoIP) facilitates improvement of his own-QoE, by using QoSIS.net services. In addition, the mobile customer may also act as QoS-information provider for QoSIS.net helping it to improve its QoS-predictions service by enriching its information base.

We envision that the primary market segment is B2B (MoSPs) being for a QoSIS.net a mandatory stepping stone to become successful in the B2C market segment. Since QoSIS.net business thrives on large quantities of QoS-information for its QoS-predictions service, the question raises how to obtain this information. The B2B market entry strategy is to convince MoSPs that QoSIS.net adds an accurate location- and time-based QoS-predictions service to their infrastructure that improves the QoE of their customers. We are currently working on case study on the QoS-predictions service accuracy (Wac *et al.*, 2008b). QoSIS.net offers a value-add QoS-predictions service to its B2B customers. QoSIS.net B2B customers require information provided by the prediction service to assure meeting their customers QoS-requirements, and facilitate improvement of their customer-QoE. Consequently, MoSP's can increase own revenues. Once the QoSIS.net B2B market is substantial enough (i.e. sufficient location- and time-based QoS-information is available), the B2C market is targeted where the fundamental concept of Mobile Web 2.0 lies; i.e. services are created and used by customers.

We identify critical success factors for the QoSIS.net service. The first critical success factor is related to an initial market entry barrier. QoSIS.net must have a critical mass of customers and sufficient QoS-information to provide accurate QoS-predictions to its customers. The second critical success factor is related to creation of sustainable revenues to QoSIS.net and ensuring its competitive position in the market. It is necessary to have a critical mass of customer acquiring up-todate QoS-information, based on which QoSIS.net is able to provide a highly accurate, and therefore highly competitive, QoS-predictions service.

## 4 B2B Market-Segment

In this section, we take a mobile healthcare SP – MobiHealth.com (MobiHealth, 2007) - as an existing MoSP. In this B2B setting, QoSIS.net is a value-add 3rd Party service provider (TMF, 2004) for MobiHealth.com and the assumption is that MobiHealth.com uses the QoSIS.net location- and time-based prediction service to improve its service delivery, while the prediction service itself remains invisible to the MobiHealth customer (end-user). The case, in which QoSIS.net is a value-add business partner for MobiHealth.com, due to space limitations, we consider elsewhere (Wac, 2008).

### 4.1 MobiHealth.com: a QoSIS.net customer

MobiHealth.com provides mobile health services (m-health services) for remote monitoring of a patient's health condition. These services are based on the MobiHealth Service PlatformTM that consists of a Body Area Network (BAN), Internet-based application-server and user Portal. Patients wear a BAN configured for monitoring physiological data relevant for the patient's disease (e.g. COPD, cardiac condition). The BAN uses WNP's wireless communications technology to continuously send patients' vital signs data to the application-server. A care professional at a healthcare centre uses the Portal to obtain (from the application-server) and display vital sign data (offline or real-time). To support patient mobility, the BAN supports handovers between different WNP and different wireless communications technologies. The QoS-requirements of the m-health services depend on the patient's disease. These requirements are defined (in most cases) in *qualitative* terms by the care professionals responsible for patient treatment, and mapped by MobiHealth specialists to *quantitative* requirements of the MobiHealth system. The MobiHealth business model can follow (Dijkstra *et al.*, 2006). MobiHealth can either be a healthcare centre or in a business relation with one. Moreover, insurance companies can reimburse (at least partially) the m-health services usage costs to the patients.

Further considerations on the MobiHealth system and MobiHealth.com business model are outside of the scope of this paper and is presented elsewhere (van Halteren *et al.*, 2004; Wac *et al.*, 2008a).

### 4.2 User Scenario

Sophie is a young COPD (chronic obstructive pulmonary disease) patient and is continuously remotely monitored with a MobiHealth COPD BAN to detect exacerbations (i.e. to cause a disease or its symptoms to become more severe). She does not have to visit a care professional at the hospital frequently, feels save being remotely monitored and being less limited in her active life. Her MobiHealth

COPD BAN always uses the most suitable WNP and wireless communications technology, available at her location (and time) and this process is completely transparent to her.

### 4.3 Features of QoSIS.net service vs. Mobile Web 2.0 paradigm

QoSIS.net offers anywhere-anytime-anyhow, accurate location-based QoS-predictions service via user-collaborative QoS-information sharing. As we said, the QoS-predictions service facilitates the choice of WNP by MobiHealth.com; however, it is responsibility of MobiHealth.com to use (or not) QoS-predictions to choose a WNP.

In the given scenario, QoSIS.net service is employed in the MobiHealth QoS-assurance process to facilitating provisioning of the m-health services by MobiHealth.com to its users (which is MobiHealth.com's core business) and increasing of its revenue. QoSIS.net's QoS-predictions service, i.e. QoSIS.net operational (core) business process, is based on the principle of collaborative content-creation and sharing amongst the MobiHealth.com users. We argue that from this perspective, QoSIS.net can be seen as a specific example of *stand-alone Mobile Web 2.0 Service Provider* (Hoegg et al., 2006; O'Reilly, 2005). The content generated and shared by MobiHealth.com users is the QoS-information acquired in QoS-monitoring service. The QoS-processing service analyzes this data, and includes automatic content manipulation, update, rating, and information quality annotations or enrichment, facilitating QoS-predictions service provided back to the MobiHealth.com users. In this sense the QoSIS.net is not a typical example of Mobile Web 2.0 (like e.g. YouTube) because the QoS-information providers are not actively (i.e. by taking an initiative) 'participating' as content provider-and-consumers in the service (MobiHealth.com is a producer and consumer of the QoS-information), moreover they do not have an access to the QoS-information acquired from and disseminated to them. We argue that implementing the QoSIS.net service based on the principle of a user-collaborative content-creation and sharing service can benefit from the fact that MobiHealth.com's users are very likely to be in close geographical location/in given time, e.g. in one city, and therefore they will collect overlapping QoS-information, which in turn will increase it QoS-predictions service accuracy.

### 4.4 Potential customers

MoSPs like MobiHealth.com are potential customers of QoSIS.net. These MoSPs are particularly mobile service providers in e.g. mobile information, education, entertainment, infotainment, and education or healthcare domains. QoSIS.net can also target niche markets – small MoSP with specific user QoS-requirements being mobile in very specific location area and time e.g. mobile workers inside and outside the buildings along widespread company fields far from the city.

Services provided by these types of MoSP require frequent data exchange with their mobile users and hence frequent use of WNPs. Data exchange can be continuous or in bursts. Because the success of MoSPs mobile service is related to the QoS-offered by a used WNP, the QoS-predictions service is an important value-add service for MoSPs, which can facilitate (proactive) choice of best WNP for their user anytime-anywhere-anyhow. Therefore, the QoSIS.net's value-add to MobiHealth.com's business lies in use of the QoS-predictions by MobiHealth.com in its QoS-assurance business process (TMF, 2004). Moreover, when using QoS-predictions, MobiHealth.com saves resources involved in its services delivery e.g. money while choosing cheaper WNP, or saving on service data delays/improved throughput, or in terms of saving user's device battery life.

The biggest incentive for MoSP to use QoSIS.net would be the fact that while using QoSIS.net, MobiHealth.com improves its user's-QoE and increases its revenues while creating revenues to QoSIS.net. The QoSIS.net fulfills the MoSP need of knowledge of QoS-offered by different WNPs at mobile user location and time. Without existence of QoSIS.net MoSPs can assure QoS to its users by a) carefully designing and operating its mobile services, assuming some minimal QoS-offered by WNP b) establishing a business relationship with (a set of) WNPs, which however would limit MoSP customer base and service usage area to WNP customer base and WNP coverage-area.

### 4.5 Value chain

In a QoSIS.net's value chain, we only present parties (and their relationships) that play roles in the context of a QoSIS.net's service interaction that provide value to MobiHealth.com as QoSIS.net's customer. The possible role of WNP in value chain is omitted in this section and discussed further in this chapter.

In the value chain (Figure 2) we distinguish QoSIS.net, MobiHealth.com and its user (e.g. Sophie). QoSIS.net is a 3rd Party SP, i.e., value-add SP for MobiHealth.com. Their *business relation* is defined in terms of contract, payment and service usage relationship. Particularly, QoSIS.net is a provider of services to MobiHealth.com (i.e. MobiHealth.com is a *subscriber*). These two business enterprises have a *contract relationship* (a SLA), i.e., a formal negotiated and agreed between them contract defining the terms and conditions for the delivery of the services, detailed services' specifications (along the agreed QoS-information model) as well as the *payment* specifications (e.g. monthly, post-paid) by MobiHealth.com to QoSIS.net.

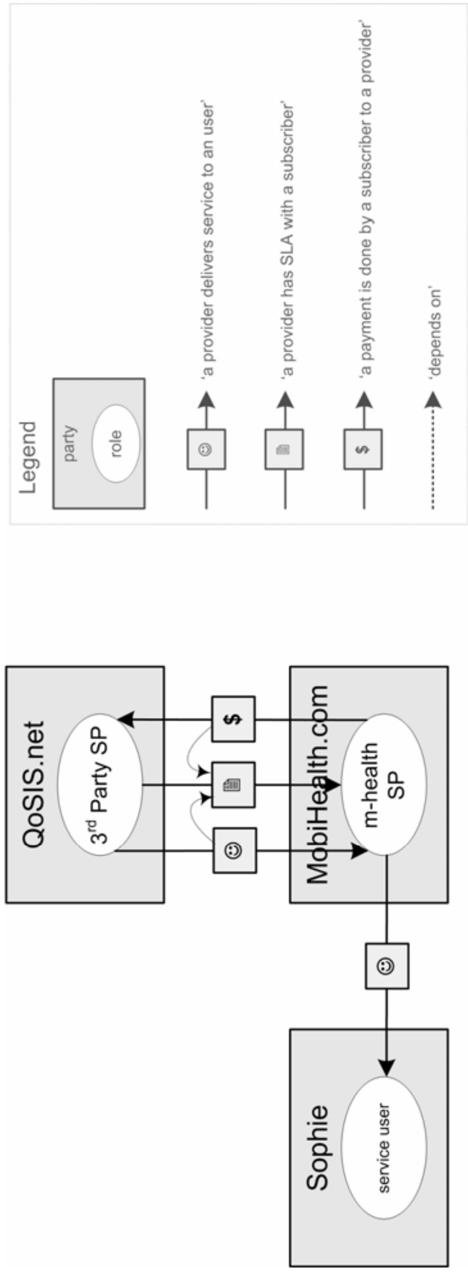


**Fig.2.** QoSIS.net as 3rd Party Service Provider

QoSIS.net's service *user* is not only MobiHealth.com, but particularly MobiHealth.com's users e.g. Sophie. QoSIS.net's services are seamlessly integrated in a MobiHealth.com's offer and transparent for Sophie. Anywhere she is, her BAN always uses (or handovers to) a WNP, which best assures meeting the

QoS-required by her m-health service. The WNP choice is made based on information provided by the QoS-predictions service and this choice is completely transparent to her. Moreover, along MobiHealth.com's services delivery, the QoS-monitoring and QoS-processing service are provided continuously, as they are based on the QoS-information about the QoS observed by MobiHealth.com using different WNPs.

### 4.6 The impact on existing value chains

The MobiHealth.com's business models will be influenced such that according to our scenario, the MobiHealth.com does not need to be in business relationship with WNP/MNO in order to be able to assure QoS to its mobile users. This will expand possible customer base of MobiHealth.com, not being limited to customer base of any given WNP/MNO (e.g. given region/country), but residing anywhere in the world, and using best WNP available there.

What is important and worth to emphasize once again is that due to the nature of service provided by QoSIS.net, a strong partnership trust (Ratnasingam & Phan, 2003) as well as technology trust (Ratnasingam *et al.*, 2002) is required between MobiHealth.com and QoSIS.net in order to assure the success of both businesses. The contracts between the enterprises need to be therefore defined in an innovative way.

### 4.7 B2B-specific revenues-costs model

We envision that QoSIS.net can charge its customers (MobiHealth.com), per transaction (i.e. per a single QoS-predictions service delivery) or it can introduce monthly (flat) subscription fee (anticipating particular QoS-predictions usage). Once QoSIS.net has a critical mass of customers, it can provide price differentiation. For example, the transaction fee can depend on a) number of WNPs available to mobile user at a given location and time (i.e. the price increases with number of WNPs, because the richer the choice, the higher probability that a MoSP can use WNP matching its user QoS-requirements, thus improving its user's-QoE), b) on the actual accuracy of QoS-predictions, where this accuracy can be checked against the QoS-information acquired along the acquired from user QoS-monitoring data or c) on the accuracy of QoS-predictions, which would be (on purpose) lower for lower accuracy predictions, and higher for higher-accuracy QoS-predictions. We argue that any pricing model proposed by QoSIS.net can be beneficial for QoSIS.net creating its revenues, as well as increasing MoSP's revenues, but it very much depends on the MoSPs application area and criticality of QoSIS.net service to MoSP's core business. We further consider different cases elsewhere (Wac, 2008).

QoSIS.net can have additional revenues by selling its QoS-information acquired in B2C scenario (described in next Section) to MobiHealth.com, and that in order to improve the accuracy of its QoS-predictions service.

### 4.8 Supporting services

From a business perspective, all QoSIS.net's services: QoS-monitoring, QoS-processing and QoS-predictions services are necessary to create a value to the QoSIS.net's service user. The QoS-information content producer and consumer is MobiHealth.com user. QoS-processing service needs to update its historical database upon each new QoS-information acquired by QoS-monitoring service. To support the QoS-monitoring service delivery, MobiHealth.com needs to obtain user-privacy informed-consent (see previous Sections) and instrument its services for acquisition of the QoS-information (along the QoS-information model agreed in contract between QoSIS.net and MobiHealth.com). Moreover, MoSP and QoSIS.net need to agree upon the QoS-monitoring service delivery: how often the data collected by a mobile MoSP's user is going to be acquired by QoSIS.net (e.g. depending on change of user location, time passed, or a WNP change). To use QoS-predictions service, MobiHealth.com needs also to instrument its services for using of the QoS-predictions in a WNP selection process.

Due to the nature of services delivered by QoSIS.net, partnership management is one of core activities of QoSIS.net, for example QoSIS.net needs to have supporting services for generating of service reports for MobiHealth.com.

### 4.9 Further evolvements of the business method in B2B scenario

QoSIS.net can have a dynamic SLA with MobiHealth.com, depending on actual QoS-requirements for m-health service delivery, or related to any other MobiHealth.com core-business-related objective. To tackle scalability requirement, QoSIS.net's can be a location-based service, i.e. can limit its scope of operation to particular city, region or country, hence limiting the scope of WNPs for which QoS-predictions can be provided; scoping can be dictated by need of limitation of QoS-information to be processed, or need for higher accuracy of QoS-predictions provided for a limited geographical-area. Furthermore, QoSIS.net can be limited in terms of WNPs and technologies, for which it acquires data. Moreover, in order to enhance the QoS-information base and improve the QoS-predictions accuracy, we envision that QoSIS.net customers - MoSPs whose users are likely to be in overlapping geographical-areas have a business relationship in which they agree to collaboratively share their QoS-information bases. This idea follows a vision of "smart-business-networks" (van Heck & Vervest, 2007), in which players initiate and maintain (short-term or long-term) business relationships for a purpose to deliver better services to their users; in our case all collaborating MoSPs could benefit from larger QoS-information base for QoS-predictions service provide to them.

## 5 B2C Market-Segment

In this scenario, QoSIS.net is an (additional) *Service Provider* (TMF, 2004) for a MoSP user (who is a QoSIS.net customer), responsible for usage of these two services accordingly to their purpose. For the purpose of this section, we take a social-networking (Mobile Web 2.0) SP – Facebook.com (Facebook, 2007) as an example of existing MoSP.

### 5.1 User Scenario

Eric is a student living in Amsterdam area. Nowadays he practices intensively his Spanish, while preparing for student-exchange stay in Madrid. He is a diligent student - following language evening-course and using lots of Internet-based-resources. He accesses them at PC, or (more often) at his new PDA - while waiting for/traveling by train or in a bus, finishing his course-homework. He particularly enjoys his Facebook.com social-networking space, where he meets his friends from Madrid! They sometimes chat online, post photos or a day-blog; all that in Spanish. He checks Facebook.com's marketplace for a students' room for his stay. Facebook.com is fun and excellent resource for learning about culture and practicing his language. He never gets bored!

To support his online activities, Eric's PDA by default used any available WNP in his location and time. He finds frustrating to loose the connection with his Facebook.com space, especially, when he is using it on the move.

To change it, recently he created his user-account on QoSIS.net website and downloaded from it a fancy application to his PDA. This application indicates him which WNP at his given location/time offers which service level for his PDA, and moreover it reconfigures his PDA such, it uses a WNP offering best service in terms of price/performance (and this process is completely transparent to him!). He likes the application's feel-and-look – it displays to him a mobility-map of his location and different colors correspond to (predicted) quality levels offered by different WNP. It is easy! - Green color is associated with very good quality, orange with good and red with bad quality. The application also indicates to him which WNP he is currently using (it's green, eventually orange). Using QoSIS.net already proved to work; he does not experience Facebook.com disconnections anymore while on the move; he enjoys even more his social-networking services in Spanish. Moreover, while planning a trip, for example for a weekend in city suburbs, he can always check with the QoSIS.net application (by putting location/time details by hand) what is the predicted quality offered by different WNP available there. Based on this knowledge he can prevent being disappointed that he cannot get 'online' there. Eric also knows that in case if there would be no WNP to be used, the QoSIS.net's application will start an audio/vibration alarm to him, and give him information about nearest location where a WNP can be used. As he lives in Amsterdam where there are plenty of available WNPs, this kind of alarm has not yet been raised to him.

To enable the QoSIS.net's application, the only thing he needed to do after downloading it on his PDA was a) to agree upon terms and conditions of service usage, b) to indicate that he is using Facebook.com as his primarily mobile service and c) to setup his WNP preferences by ranking quality criteria for a WNP choice: monetary cost (which for his students pocket is of priority!), performance and security. The service's terms and condition indicate that anywhere/anytime he is, QoSIS.net will always acquire from him data regarding the quality level offered by different WNP to his PDA, and that in anonymous form! This data is acquired assuring his privacy and it is later on used for predictions provided by QoSIS.net to him and other users. He knows that in this way he can ask for predictions for locations he never visited before, because there was always somebody using QoSIS.net who visited the place before him! From time to time, he just logs-in on the QoSIS.net website and checks his service usage statistics visualized in colorful easy-to-read maps: e.g. statistics of data he generated while visiting different locations along his busy days, as well as statistics of how often/when and where his PDA was requesting the update of mobility-maps, or what was the most frequent WNP he uses in which location and at which time. Moreover, on the QoSIS.net website he has already created his social community of family members and friends, who, following his invitation, also use QoSIS.net application. By collecting data regarding use of different WNPs in Amsterdam, his social community collectively improves accuracy of predictions provided by QoSIS.net to them. By default, Eric and all his community members can share their profile and statistics on the web; however, he knows that he can always easily adjust his privacy settings on the web and disable viewing his statistics by others - by the whole community or by particular person. Eric also knows that if he would be not satisfied with the services provided by QoSIS.net, he can at any point disable them from being used on his mobile and on the web. Using QoSIS.net, along usage of Facebook.com is also fun for him. He likes very much to share his service statistics with his community; he is proud because so far, by using his Facebook.com services on the move almost daily, he produces much more data than any other of his community members.

### 5.2 Features of QoSIS.net service vs. Mobile Web 2.0 paradigm

QoSIS.net is an example of an additional mobile service provider for Eric, a Facebook.com user. QoSIS.net provides QoS-predictions service to its users in a same way as in the B2B case. The only difference is that in B2C case, QoSIS.net, makes a choice which WNP to use at a given location and time (on behalf of a mobile user - based on his preferences). We argue that in the B2C scenario, QoSIS.net is a specific example of *stand-alone Mobile Web 2.0 Service Provider* (Hoegg et al., 2006) - QoSIS.net provides mobile service for its users based on a collaborative content-creation and sharing. The content is the QoS-information, acquired from users via QoS-monitoring service and disseminated to them via QoS-predictions service; the users are content producers and consumers. The QoSIS.net provides to its users also a web-based service, where users can see their service usage statistics (c.f. Eric), and shared them with their community. In this sense the QoSIS.net is not a typical example of Mobile Web 2.0 (like Facebook.com) because the QoS-information is not as ‘tangible’ as other multimedia data and users cannot see their contributions directly, they only see their service usage statistics visualized in maps. QoSIS.net cultivates the community culture for online and offline information exchange by means of set of formalized (IT) guidelines on its website e.g. via user’s privacy settings, chat or blog tools.

We argue that the idea of realizing of QoSIS.net operational business processes along the ‘mobile social-networking’ service that enables users to create own communities, has at least three advantages for QoSIS.net and its users. Primarily, each community member setup his/her own rules for privacy settings, i.e. whom to invite to his own community, and who can have access which statistics; non-community members can only see a user’s name. Secondly, by enabling users to invite each other to their communities, QoSIS.net can benefit from the fact that users in a community are very likely to be a group of closely related people (family or friends) in close geographical location/in given time. Therefore they collect overlapping QoS-information, which increases QoS-predictions service accuracy. Thirdly, belonging to such a community can be a trendy lifestyle choice (like for Eric) supporting his daily activities.

### 5.3 Potential customers

Mobile service users like Eric are potential customers of QoSIS.net. QoSIS.net can target small number of users living in little village of city suburbs with limited WNP choice, as well as big number of users living in city center with plentiful of available WNPs. Because their QoE while using their mobile services is related to the QoS-offered by a WNP used, they are interested in use of QoSIS.net’s value-add service in order to facilitate (proactive and automatic) choice of a WNP best for them anytime-anywhere-anyhow. The user grants responsibility to QoSIS.net on how to use QoS-predictions, i.e., when to demand new predictions (i.e. mobility-maps’ update) and when to choose another WNP.

From the users perspective, belonging to a QoSIS.net community can be a trendy lifestyle choice, for which they are willing to pay the price in terms of mobile device resources assigned for QoSIS.net execution (battery, capacity, storage etc.). The goal of community is to collectively empower it users in a WNP choice, fulfills a mobile service user’s need of knowledge of QoS-offered by different WNPs at a given location/time. However, what can be the most important objective for a mobile user driving him to use QoSIS.net, is the fact, that belonging to QoSIS.net community can also addresses his human belonging, gaining prestige, fulfilment and recognition needs (Hoegg et al., 2006). Moreover, an additional trustworthiness may arise in a user, if somebody who the user already knows is in; the user is very likely to accept invitation to QoSIS.net from his friends/family members, who is already in.

A QoSIS.net user saves resources involved in e.g. Facebook.com services delivery e.g. money while choosing WNP with cheaper tariffs, or in terms of saving mobile device’s battery life. The incentive for a mobile user to use QoSIS.net is an improvement of his QoE when using his mobile services. Without existence of QoSIS.net, Facebook.com mobile user like Eric would use any available WNP in her location and time and experience lower quality services.

### 5.4 Value chain

As in B2B scenario, we only present parties that play roles in the context of a QoSIS.net’s service interaction that provide value to Facebook.com user as

QoSIS.net's customer. Therefore, in the value chain we distinguish QoSIS.net, Facebook.com and Facebook.com's user – Eric (Figure 3). QoSIS.net is a value-add SP for Facebook.com user, and their *business relation* is defined in terms of contract and service usage relationship. Particularly, QoSIS.net is a provider of value-add services to Facebook.com user (i.e. a *subscriber*). These two parties have a *contract relationship* (a SLA), i.e., a formal contract defining the terms and conditions for the delivery of the services and detailed services' specifications. These terms and conditions need to be agreed upon the user, before the QoSIS.net application can be used by Eric, i.e., installed on his PDA. Moreover, it is important to notice that it is responsibility of Eric to make sure that by using QoSIS.net he does not violate SLA existing between his and the Facebook.com, especially with regards to the (default) WNP use or use of any mobile device resources, for which these two services would now compete.

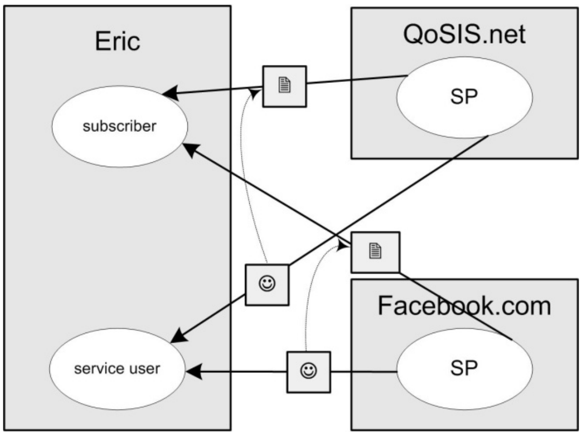


**Fig.3.** QoSIS.net as a Service Provider

QoSIS.net's service *user* is Facebook.com user – Eric. QoSIS.net's service is seamlessly and transparently delivered to him while on the move. Anywhere he is, his PDA always uses (or handovers to) a WNP, which best assures meeting the QoS-required by his social-networking service and his preferences like WNP usage monetary cost. The WNP choice is made based on information provided by the QoS-predictions service and this choice can be completely transparent to him. Moreover, along Facebook.com's services delivery, the QoS-monitoring and QoS-processing service are provided continuously, as they are based on the QoS-information about the QoS observed by Facebook.com services using different WNPs.

### 5.5 The impact on existing value chains

The Facebook.com does not need to be in business relationship with QoSIS.net, but it will profit from services provided by it - by means of increased user-QoE, which then can drive an increased Facebook.com's (or any other MoSPs') revenue.

### 5.6 B2C-specific revenues-cost model

We envision that QoSIS.net starts as a free service by mobile users for mobile users. The QoSIS.net can generate revenues from community-based (e.g. location-, or community-interests-based) advertising on its website (as it happens in case of Facebook or YouTube today). The QoSIS.net marketing costs would be little, as major advertisement would be “word-of-mouth” going from user to user, and from community to community. Additionally to maintenance costs of QoS-information base, new costs of management of community-databases are added.

### 5.7 Supporting services

As for the B2B scenario, from a business perspective, all QoSIS.net’s service: QoS-monitoring, QoS-processing and QoS-predictions are necessary to create a value to the QoSIS.net’s service user. Differently from B2B scenario, in here, to support the QoS-monitoring service delivery, QoSIS.net instruments user’s mobile device for acquisition of QoS-information (using application similar to AcbTaskMan (AcbTaskMan, 2007) or CoSphere (Peddemors, 2008)). QoSIS.net need to decide upon the QoS-monitoring service delivery; how often the data collected by a mobile user is going to be acquired by QoSIS.net, e.g. depending on change of user location, time passed or a WNP change. QoSIS.net needs also to instrument user’s mobile device for using of the QoS-predictions while choosing a WNP, and for an enforcing of this choice.

### 5.8 Further evolvements of the business method in B2C scenario

After having a critical mass of users, QoSIS.net can change its revenues model and can charge its users per a transaction (i.e. per a single QoS-predictions delivery) or it can introduce monthly subscription fee for premium-users (anticipating particular QoS-predictions usage). The transaction fee can be intentionally a) low for low-accuracy predictions or b) high for high-accuracy predictions. The accuracy in turn can be checked against the information acquired QoS-monitoring service. Transaction fee can also depend on number of WNPs, a user can choose from at a given location and time; the higher the number the higher the fee. It is also possible that user is offered e.g. two free transactions per day, and pays for any additional one.

QoSIS.net can also provide QoS-monitoring and QoS-predictions services as separate services, and reward a user of QoS-monitoring service (i.e. producing QoS-information) and charge a user for using QoS-predictions service (i.e. consuming QoS-information). This however brings to QoSIS.net a risk of not having enough contributing users; so far statistics for Web 2.0 indicate that only 1 % of service users (!) is willing to contribute and generate the content (Arthur, 2006).

Moreover, QoSIS.net can also have revenues from selling critical information like user profiles, statistical information about QoS-offered by different WNPs or most frequently used mobile services, to MoSPs and WNPs or any other interested parties. QoSIS.net can also launch an affiliation program, rewarding users who helped to acquire a new QoSIS.net customer via their website.

To tackle the scalability requirement, similarly to B2B scenario, we propose QoSIS.net to be a location-based service, i.e. limiting its scope of operation to particular city, region or country, hence limiting the scope of WNPs for which QoS-predictions can be provided. Scoping can be dictated by need of limitation of QoS-information to be processed, or need for higher accuracy of QoS-predictions provided for a limited geographical-area. Moreover, web-based communities build by QoSIS.net users can use different language or can have different representation of their data depending on privacy regulations in given country or their cultural background. In the case of different QoSIS.net' location-based instances, they can form a (short-term or a long-term) "smart-business-networks" (van Heck & Vervest, 2007) for a purpose of delivering better services to their users roaming in between locations areas belonging to different QoSIS.net; all QoSIS.net instances collaborating in the business network could benefit from larger QoS-information base for their QoS-predictions service.

The other evolvement of B2C we envision is related to the situation, where a user would like to use QoSIS.net, however, is not a frequent MoSP's service user (e.g. like Eric using his Facebook.com daily) and hence will not generate lots of 'real' mobile traffic. This kind of mobile user may be proposed using a QoSIS.net QoS-monitoring service as his mobile phone 'screen-saver'. Namely, at the moments when he would not use his mobile for a while, the QoS-monitoring service would take a role of active mobile service user - using a WNP (and imitating e.g. busty web-browsing) and acquiring QoS-monitoring information at a given location/time. In such a way, QoSIS.net would acquire QoS-information enriching its databases and such a mobile user could be paid for information generation. However, the critical issue would be related to mobile device resources usage for QoSIS.net QoS-monitoring service (battery, capacity, storage etc.).

## 6 Potential of QoSIS.net for WNPs/MNOs

The proposed B2C and B2B scenarios are different from existing WNP-centered (i.e. MNOs-centered) business models, as they aim to empower the MoSP and its mobile users to use best WNP, and not the one the one user is locked-in. The proposed B2B and B2C business scenarios have a possible impact on WNP's business models by means of unlocking the users from WNPs and disclosing publicly the information about their offered-QoS and thus increasing the competitiveness amongst WNPs. In our scenarios, the WNP is envisaged to have revenues coming from the QoS-information exchange (e.g. per MB), the WNP's role is assumed to be passive as a so-called 'bit-pipe'. It is however equally possible that a MoSP, as a QoSIS.net customer, is itself in a business relation with a WNP (or a set of WNP), who e.g. get additional revenues whenever MoSP user requests service delivery. In such settings, revenues of WNP would be increased along the improvement of MoSP's user-QoE and thus (expected) increase of mobile service use by this user.

We would like to emphasize that there exists a huge business potential for all parties in case where QoSIS.net QoS-information databases collected for a given WNP would be made available for this WNP. Namely, if WNP considers QoSIS.net as trustworthy business enterprise, it would analyze its offered-QoS (in terms of availability, speed, security level and monetary cost) at given locations and time and be willing to improve this QoS, in order to stay competitive amongst the WNPs. Moreover, once encouraged, a WNP can even provide QoSIS.net with some additional information regarding its network configuration, which would facilitate more accurate QoS-predictions service. We envision that improvements of the QoS-offered by WNP to MoSPs, as well as improvements in QoS-predictions service will improve mobile users'-QoE. This in turn will encourage MoSPs users to use even more their mobile services while on the move. This situation can be highly beneficial for all parties, as it has a potential to increase revenues to MoSPs, as well as to WNPs, and create revenues for QoSIS.net while improving a mobile service user's experience.

Regarding other possible business scenarios, it is also possible for WNP/MNO to have an active and dynamic role if: a) QoSIS.net's become a 3rd Party SP to WNP/MNO or b) WNP/MNO takes a role of QoSIS.net. In both cases QoSIS.net's service are provided i) to users of mobile services provided directly by WNP/MNO (i.e. being a MoSP) or ii) to MoSPs (and their users) that have business relationship with WNP/MNO. Due to space limitations, we do not further analyze these scenarios in this paper, however we consider them elsewhere (Wac, 2008).

## 7 Concluding Remarks and Future Trends

As we have presented in this chapter, mobile and ubiquitous service providers (MoSPs) emerge, struggling to provide their users with QoE at least comparable to one the user is familiar with from using Internet-based (fixed) services. All this happens because wireless communications' infrastructures, supporting delivery of these services, neither provide QoS guarantees, nor disclose information of their offered-QoS. To bridge the gap regarding the lack of information about QoS-offered by different WNPs in mobile users' location and time, in this chapter we propose business methods enabling firstly a creation of enterprise (QoSIS.net) providing such an information to MoSPs, and, secondly - usage of this information by MoSP in its QoS-assurance business process. We emphasize that the aims are to make MoSPs QoS-assurance process ubiquitous and competitive (i.e., efficient and effective) and to increase MoSP's user-QoE, hence to increase revenues to MoSP, while creating revenues to QoSIS.net. We currently attempt to implement the QoS-predictions service of QoSIS.net together with MobiHealth.com as a MoSP (Pawar et al., 2008; Wac et al., 2008b).

Future research opportunities within the domain of our topic relate to further evolvements of the proposed business methods for QoSIS.net and its customers. These research opportunities are related firstly to understanding the dependencies between WNP offered-QoS, the MoSP user QoS-requirements and his QoE, for MoSPs in different application domains. This can then serve, at least partially, as a basis for deriving detailed requirements posed on the QoSIS.net's QoS-predictions service by MoSPs (as customers and service users). These requirements can be expressed, for example in terms of service availability, accuracy and delay. Related to this, second research opportunity focuses on the efficient and effective market entry approach for QoSIS.net as an enterprise and its possible innovative marketing solutions; and this for overcoming its initial hurdle of attracting critical mass of users in order to be able to provide accurate QoS-predictions service and start generating revenue. Third research opportunity lies in understanding partnership-trust (Ratnasingam & Phan, 2003) required in the QoSIS.net's value chain, as well as challenges in QoSIS.net's customer management in B2B and B2C market segments. Fourthly, due to the nature of service provided by QoSIS.net, we indicate a need for research on trust in technology (Ratnasingam et al., 2002). This research investigates, on one hand, dependability features of architectural system design. On the other hand, this research investigates entries necessary in business contracts established between parties, in order that these contracts encompass business practices for possible technological scenarios endangering core business processes and revenues of involved parties. This will e.g. include research on security mechanisms employed in QoS-information exchange between parties.

Future research opportunities along the books theme relate particularly to research upon new competitive business methods that can be employed in existing management, operational (i.e. core) or supporting business processes of mobile and ubiquitous service providers as business enterprises. These business methods need necessarily aim in delighting their customer, while increasing their revenues. We propose that these business methods are based on emerging trend of short- and long-terms business inter-dependencies (i.e. "smart-business-networks") between different enterprises, bring into a value network different but complementary, expertise. This, on one hand, brings high risk, but on the other hand has a huge potential to substantially increase revenues of all of the involved parties, and that by increasing a customer experience anywhere-anytime-anyhow. Moreover we would like emphasize a risk, but also huge potential of employing of user-collaborative-content-sharing paradigm, i.e. Mobile Web 2.0, as a base for business methods employed in enterprise's core business processes. Its risk is mainly related to requirement of attracting a critical mass of contributing users, which may not always be easy. These methods would aim at creating new revenue streams from user-generated content-manipulation and enrichment. The enriched content could be then a part of enterprise service, consumed back by users. The Mobile Web 2.0-based methods however require careful research upon the content type to be generated and consumed by users. Therefore, answer for research questions like what is the pre-existing offline information possessed by users, which, if enabled to be manipulated and shared online amongst them, could empower them in some way?, as well as if this information violates in any way user's privacy?, and what is user's willingness to share this information online and with whom?, are critical for the success of the business method. Moreover, research upon design of the offered service, careful market analysis and management of the enterprise start-up phase, and so on, is necessary.

We envision that in order to fulfill the dream of novel successful services offered by mobile and ubiquitous commerce, and to increase their revenue, enterprises need to take a necessary risk and employ such novel business methods on a growing scale in their business processes.

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