CONTEXT AWARE SYSTEMS IN CONVERGED NETWORKS

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INTRODUCTION

Fixed Mobile Convergence is presently one of the crucial strategic issues in the telecommunications industry. It is about connecting the mobile phone network with the fixed line infrastructure. With the convergence between the mobile and fixed line networks, telecommunications operators can offer services to users irrespective of their location, access technology or terminal.

The development of hybrid mobile devices is bringing significant impact on the next generation of mobile services that can be rolled out by mobile operators. One of the visions for the future of telecommunication is for conventional services such as voice call to be integrated with data services like e-mail, Web and instant messaging. As all these new technologies evolve, more and more efforts will be made to integrate new devices and services. New markets for services and devices will be created in this converged environment. Services become personalised when they are tailored to the context and adapted to changing situation.

Context aware network system is designed to allow for customisation and application creation while at the same time ensuring that application operation is compatible not just with the preferences of the individual user but with the expressed preferences of the enterprise or those which own the networks. In a converged world, an extended personalisation concept is required. The aspects covered include user preferences, location, time, network, and terminal have to be integrated and the relationships between these aspects must be taken into consideration to design business models. Next-generation handsets are capable of a combination of services available on personal digital assistant (PDA), mobile phone, radio, television, and even remote control. This kind of information and communications

technology and mobile services together form one of the most promising business fields in the near future.

The voice average revenue per user (ARPU) is declining, the competition is getting fiercer, and voice over Internet protocol (VoIP) is entering the market with aggressive pricing strategies. Fixed Mobile Convergence should help in this context by providing converged services to both, consumer and small business users. For telecommunication companies it is now crucial to attempt to identify concrete applications and services for commercial offerings based on Fixed Mobile Convergence which go beyond the current hype. Market scenarios and draft initial business models for such Fixed Mobile Convergence solutions will be required and are therefore valuable for future strategy decisions

The paper examines market aspects, user requirements and usage scenarios to come up with a roadmap and suggestions on how to deal with this matter.

CURRENT AND FUTURE TRENDS

In the past, user movement has often implied interruption of service. With the advent of pocket size computers and wireless communication, services can be accessed without interruption while the entity using the services is moving (Floch, Hallsteinsen, Lie, & Myrhaug, 2001). There is a strong need for seamless access. Convergence has been taking place for years now. A study performed by the European Commission (1997) defines convergence as allowing both traditional and new communication services, whether voice data, sound or pictures to be provided over many different networks. An excellent example of convergence in the telecommunications industry is the IP Multimedia Subsystem (IMS).

Similar to other emerging industries, Fixed Mobile Convergence is characterised by a continuously changing and complex environment, which creates uncertainties at technology,

demand and strategy levels (Porter, 1980). Porter (1980) asserts that it is possible to generalise about processes that drive industry evolution, even though their speed and direction vary. According to Ollila et al. (2003), these processes are of different types and are related to:

- Market behaviour
- Industry innovation
- Cost changes
- Uncertainty reduction
- External forces, such as Government policy and structural change in adjacent industries

Each evolutionary process recognises strategic key issues for the companies within the industry and their effects are usually illustrated as either positive or negative from an industry development viewpoint. For example, uncertainty reduction is an evolutionary process that leads to an increased diffusion of successful strategies among companies and the entry of new types of companies into the industry. Both of these effects are believed to contribute to industry development with regards to the Fixed Mobile Convergence value web.

The technological uncertainties are usually caused by fast technological development and the battles for establishing standards, which are common in the beginning stages of the life cycle of a specific industry as a result of a technological innovation (Camponovo, 2002). Concerning demand, regardless of the generalised consensus about the huge potential of Fixed Mobile Convergence, there are many uncertainties about what services will be developed, whether the users are ready to pay for them and the level and time frame of their adoption (Camponovo, 2002).

While the wireless industry is often cited as an example of a rapidly changing sector, the period from 2001 – 20055 could (in some respects) be regarded as relatively stable (Brydon, Heath, & Pow, 2006). Mobile operators have made the vast majority of their service revenue from simple voice telephony and text messaging, while their value chain has remained largely undisturbed (Brydon et al., 2006). However, new services, alternative technologies and an evolving competitive landscape mean that the possibility of substantial industry change over the course of the next five to ten years cannot be discounted (Brydon et al., 2006).

The telecommunication industry has experienced several waves of changes from the introduction of wired telephony to wireless telephony and is currently heading towards fixed-mobile convergence. Users become more demanding: "user centric" and not "network centric" approach needed.

According to Hellwig (2006), many fixed operators loose their market dominance and merge units (fixed and mobile). New technologies and new actors (e.g. VoIP, Wi-Fi operators) coming into the picture are driving the adoption of Fixed Mobile Convergence. The formation of new roles in communication industry, including brokers, aggregators, alliances and cooperation have further pushed the stakeholders to take aggressive strategies to gain competitive advantage.

However, since new roles have been introduced, it is unclear how the market acceptance in the near future will be. Existing business models might not be applicable in the new business environment. The lack of terminal devices at the moment also hinders the diffusion.

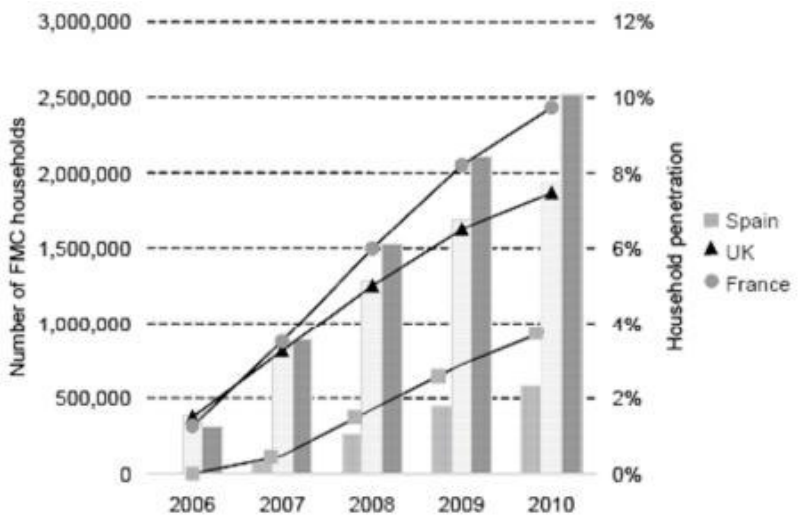

Figure 1: Number of Fixed Mobile Convergence Households in Spain, UK and France 2006 – 2010 (Hellwig, 2006)

In markets where there are high levels of fixed-mobile substitution and where broadband penetration and wireless local area network (WLAN) diffusion in the home are accelerating, it is most likely that consumers will be drawn to Fixed Mobile Convergence, provided the cost savings and added convenience of carrying one device are apparent to the consumer (McQuire, 2005). According to Yankee Group (2005), almost one-third of users make more calls within the home using their mobile than their landline. The trend is stronger among younger respondents. Figure 1 shows the number of Fixed Mobile Convergence households in Spain, UK and France from 2006 to 2010.

The increasing need for personal communication device which can connect to any type of network – mobile networks, IP networks or even public switched telephone network (PSTN) – and that supports all voice and text-based communication services drives the development of context aware systems. The primary objective of the system is to facilitate acquisition, translation and representation of context information in a structured and extensible form, in order to enable the development and enhancement of functionality of network resource, personalised according to individual's needs. The secondary goal is to facilitate rapid

development and deployment of services and applications through a defined framework which can maintain interoperability between different services and domains.

An example of a context aware system would be BT's proposed Context Aware Service Platform (CASP). In June 2004, NTT DoCoMo, BT and a number of other incumbent operators from around the world formed the Fixed Mobile Convergence Alliance (2006) with the objective of developing common technology standards and low cost devices for integrated fixed-mobile services. The CASP middleware mentioned is the interpretation and one of BT's visions for the development of converged platform. The salient features of the proposed product include:

- User-centred operability

  One important requirement for heterogeneous network environment is the ability to instantaneously optimise services for individual users without the need for them to perform any annoying operations. CASP aims to provide transparent connectivity between users with devices and surrounding communication resources. It is able to recognise users' situations and environmental information automatically.

- Ease of service provisioning

  The proposed platform and generic framework guidelines in respect to security, data integrity, non-repudiation, registration, subscription, and quality of service (QoS) for all services will be made available. It offers standard interfaces for all services which enable easier access to a less complex network, with common operation and management, maintenance and training, as well as a common environment for services development and delivery.

- Interoperability of shared services

  The proposed platform provides a common specification for services to guarantee the

interoperability between shared services in the communication networks. Specific context information with respect to specific aspects characterising a service or entity can be expressed in extensible markup language (XML)-based instance document.

- Unified identity

  In a true seamless access communication world, every user or communication object is represented by a unified identity. Session initiation protocol (SIP) address (e.g. simon.hoh@bt.com) can be used to uniquely identify user or communication object even when it moves across different networks or between different devices. By having identity management, it simplifies mobility management, security management and unified user profile management.

- Dynamic user interface (UI) on shared device

  Through the proposed platform, user can have a shared device which can connect and interact with the ubiquitous communication objects nearby. Each networked object or entity such as cameras, scanners, printers, video players and so forth, can be represented by different UI based on its own dynamic profile and thus can react intelligently to events in the communication space.

- Context enabled adaptive service

  The heterogeneity of the converged networks, in terms of network capacity and terminal capabilities, is expected to cause unpredictable changes of network condition. The traditional QoS mechanisms, which do not take the presence of mobility and seamless connectivity into consideration, are not sufficient to guarantee a stable service. Thus, the use of adaptive services being able to change their settings to adapt to the available network resources is a must. CASP enables dynamic selection of the settings used by multimedia services and applications during a multimedia session based on the context

of the surrounding environments.

In the near future, stakeholders in the industry will move towards IP based transport, call control and service creation and delivery platform functionality. They will follow and adopt developments in 3rd Generation Partnership Project (3GPP) (3GPP, 2006), European Telecommunications Standards Institute (ETSI) (TISPAN) (ETSI, 2006), Internet Engineering Task Force (IETF, 2006) Next-generation Network (NGN, 2006) to support open interfaces and avoid interconnection and cooperation incompatibilities. In addition, support IP based signalling and addressing, media negotiation, QoS and security mechanisms; support a very large variety of multimedia application, banking and mobile office applications seamlessly across different networks and adopt seamlessly to the network characteristics and device used. The players in the industry must also consider entering new positions in the value network by taking on new roles and going into cooperation with other telecommunication companies (Hellwig, 2006).

Figure 2 shows how and when future enterprise telephony services will embrace convergence.

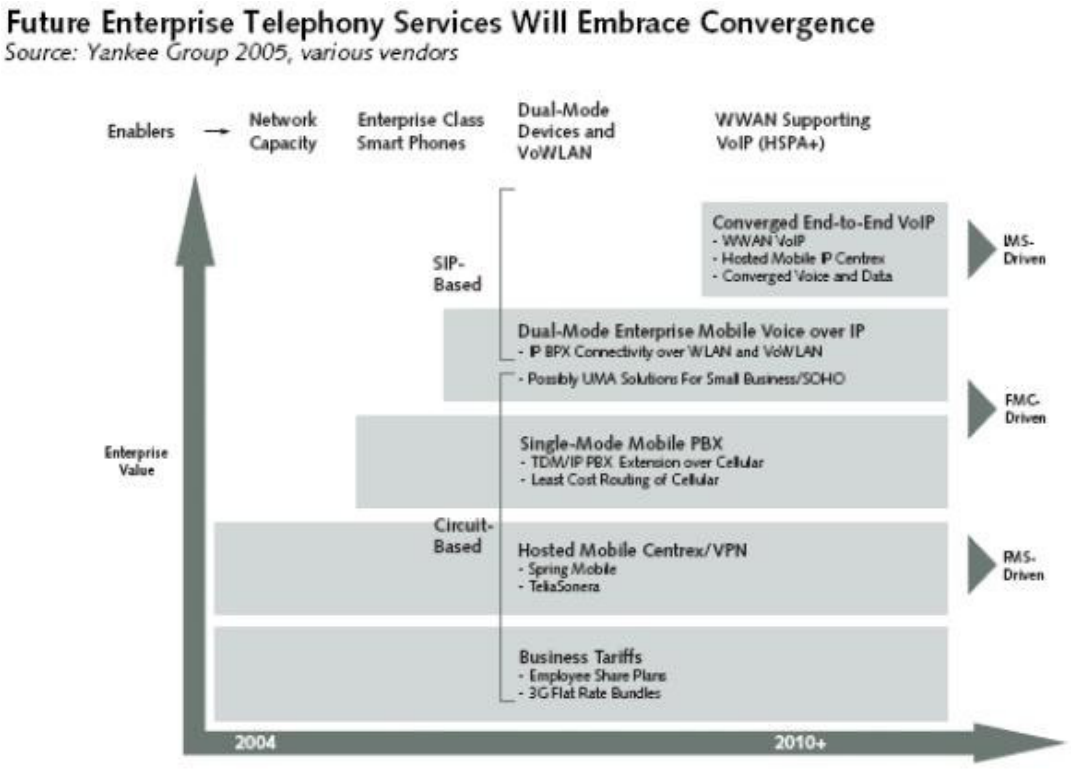

Figure 2: Future Enterprise Telephony Services Will Embrace Convergence

USAGE SCENARIOS

Cheryl is a recent university graduate whose work as a researcher means she has a busy travel schedule. She often travels to several places to attend international conferences and workshops. She uses a multi-radio mobile device and a mobile VoIP service subscription to keep in touch with her friends and family whether she is at home or on the move.

She subscribes to an Internet VoIP service to save money on calls to her family and university friends that are now spread around the globe, but since her mobile operator utilises

unlicensed mobile access (UMA, 2006) technology, she is now able to enjoy cheaper calls by using her mobile phone and connecting to her home WLAN or public hotspots. Her mobile device also enables a number of rich services which enable her to communicate with her friends via voice, video as well as text.

When she was on vacation in Hawaii recently, she was able to show the pictures she had taken with her mobile device to a colleague while he was talking to her over a VoIP call, and later sent a "wish you were here" video message to her parents.

Since all her communications are unified in a single device, Cheryl's friends and family can always reach her, either by voice, text, instant message, video call or any other means, while Cheryl can use presence to broadcast her availability to her contacts (such as "in a meeting" or "travelling"), as well as manage the incoming communication depending on the context of what she is doing.

Now, she can keep her long-distance bills lower by using VoIP, but since it is in her mobile device, she does not have to be sitting in front of her personal computer (PC) to use it. And whereas some of the PC-based services Cheryl previously used were cumbersome to set up, and she had separate providers for her telecom services, she now gets all these functionalities in a bundled offering from a single operator, and all technology takes care of itself, working invisibly to her through a user friendly interface.

CONCLUSIONS

Context aware systems, when made available to the end users, will be greatly valued by them. Consumers will be in a more interactive environment that could help them to take care of small yet related matters automatically. Any possible devices around them could be used to bridge any services offered, giving them the familiarity they preferred. Users would

always have the option to alter the service execution or switch it off anytime they like.

Meanwhile from the network perspective, knowing the situation of the network and each network node's role could enable an adaptive and intelligent network. The capabilities such as self-healing, autonomous utilisation optimisation and self-reconfiguration to adapt for changes could also be enabled with context sensitive service logic.

The CASP provides a stable and robust environment for the context aware service developers and operators. This stable environment is extremely important for them to have the accurate anticipated outcome and have the flexibility on changes. On top of the stable environment, the platform will be assisting the service execution to reduce the complexity for the service creation.

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TERMS AND THEIR DEFINITION

Extensible Markup Language (XML): A specification developed by the W3C. XML is a pared-down version of for standard generalised markup language (SGML), designed especially for Web documents. It allows designers to create their own customised tags, enabling the definition, transmission validation, and interpretation of data between applications and between organisations.

Internet Protocol Multimedia Subsystem (IMS): IMS is a standardised Next Generation Networking (NGN) architecture for telecommunication companies that want to provide mobile and fixed multimedia services. It uses a VoIP implementation based on a 3GPP

standardised implementation of session initialization protocol (SIP), and runs over the standard Internet Protocol (IP). Existing phone systems (both packet-switched and circuit-switched) are supported.

Public Switched Telephone Network (PSTN): PSTN refers to the international telephone system based on copper wires carrying analog voice data. This is in contrast to newer telephone networks based on digital technologies, such as integrated services digital network (ISDN) and fiber distributed data interface (FDDI).

Quality of Service (QoS): QoS is a networking term that specifies a guaranteed throughput level. One of the biggest advantages of asynchronous transfer mode (ATM) over competing technologies such as Frame Relay and Fast Ethernet is that it supports QoS levels. This allows ATM providers to guarantee to their customers that end-to-end latency will not exceed a specified level.

Session Initiation Protocol (SIP): An application-layer control protocol; a signalling protocol for Internet Telephony. SIP can establish sessions for features such as audio/ videoconferencing, interactive gaming, and call forwarding to be deployed over IP networks, thus enabling service providers to integrate basic IP telephony services with Web, e-mail, and chat services. In addition to user authentication, redirect and registration services, SIP server supports traditional telephony features such as personal mobility, time-of-day routing and call forwarding based on the geographical location of the person being called.

Unlicensed Mobile Access (UMA): UMA is the technology which provides access to global system for mobile communications (GSM) and general packet radio service (GPRS) mobile

services over unlicensed spectrum technologies, including Bluetooth and 802.11. By deploying UMA technology, service providers can enable subscribers to roam and handover between cellular networks and public and private unlicensed wireless networks using dual-mode mobile handsets.

Voice over Internet Protocol (VoIP): VoIP is the routing of voice conversations over the Internet or any other IP-based network. The voice data flows over a general-purpose packet-switched network, instead of traditional dedicated, circuit-switched telephony transmission lines. Voice over IP traffic might be deployed on any IP network, including those lacking a connection to the rest of the Internet, for instance on a private building-wide LAN.