Emerging Trends in the Mobile VoIP Business

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Abstract

This research paper has analyzed the mobile VoIP technology from the business point of view, focusing mostly on the consumer sector. Through the identification of relevant technologies in implementing mobile VoIP services the paper has constructed a classification of major players in the business. First, there are incumbent operators, who might leverage on the combination of cellular and emerging radio technologies in providing mobile VoIP services. Secondly, there are challenger operators emerging, who have a core strategy in mobile VoIP. If they provide standardized interfaces and service-level products without owning any radio access technologies, they are called virtual mobile VoIP operators. There are also Internet companies which might strongly leverage on the modular Internet-like evolution path. These actors might distribute proprietary light-weight clients (e.g. Skype) and approach the mobile VoIP business from the disruptive Internet perspective. It is actually possible that voice connectivity is a simple Internet application in the future, if this path gains momentum. By discussing the technological advancements of the near future and likely evolution of business approaches the paper suggests that in the end of the day it might be a two-way evolution path which emerges on the market. The first path leads to a very vertically integrated operator-driven ecosystem, in which incumbent operators can probably leverage both on their existing cellular infrastructure and on new emerging radio access technologies. Platforms and standards such as UMA and IMS probably drive this path. The alternative evolution path leads to an Internet-like model, in which the ecosystem is layered and highly modular. Bit-pipe operators take care of traffic, whereas on the higher level actors with focused strategies implement mobile VoIP services. In the case of failure of key VoIP standards it is major Internet companies with light-weight proprietary clients (e.g. Skype, Google) who prosper, or in the case of wide-scale emergence of SIP-capable WLAN handsets and establishment of open WLAN networks it is virtual mobile VoIP operators who might be better off in future of the mobile VoIP industry.

1. Introduction

Voice has been the key service of the mobile industry. It was voice for which the first analog and digital cellular networks and handsets were developed and built. Though we have seen quite an evolution towards more and more complex mobile services, voice is still there as the most important service category. According to Vesa [1], the non-voice revenue of operators throughout the world is still significantly smaller than voice revenue. No doubt, it is very important to consider the evolution of mobile voice services.

Voice has traditionally built on circuit-switched technologies. As we are now moving towards packet switched networks, in which all kinds of streams and information are easily combined into packets, we have to reconsider the justification for circuit-switched services. It is very expensive to have a separate circuit-switched network to implement voice services, as the integration of all information on a packet-switched network is much more cost-effective and scalable. In addition to the lower investment expenses we see major advantages also in further development of voice services towards e.g. video calls and instant messaging. In the fixed Internet we have already seen quite a number of voice-oriented services, in which voice is essentially coded into streams of packets. These technologies and services are often referred to as voice over IP (VoIP) [15].

In this research paper the focus is on mobile VoIP. Mobile VoIP is here defined as voice-oriented services, in which voice is transmitted over IP networks, and the service is used with a mobile handset. In this paper the foremost focus is on understanding mobile handsets as small smartphone kind of devices, which have at least cellular capability and provide an operating system capable of running add-on applications.

It is important to understand the matrix of technologies which are needed in implementing different kinds of mobile VoIP services. However, the business implications of mobile VoIP might be even more interesting. There are already quite a number of actors somehow running mobile VoIP services, not to talk about the diversity of players currently testing, planning or considering a movement to the mobile VoIP business. In this paper it is argued that the type of technology chosen has major implications on the type of approach to the mobile VoIP business, and different kinds of actors are currently emerging in a certain order because of technical solutions chosen. Through this techno-economical approach the paper then suggests a certain categorization for the business actors taking part in the game, concluding with a timeline kind of analysis of the near future of mobile VoIP.

2. Mobile VoIP technologies

Lots of research is currently pursued in analyzing and categorizing emerging mobile services [2] [3]. The focus is often in disruptive applications. Disruptive applications are generally considered as "…new services that create significant changes in a business model" [4]. Disruptive applications shake dominant business models by introducing new application innovations and at the same time perhaps making older applications obsolete. [21] It is important to understand that mobile VoIP is essentially not understood as a disruptive service in this research paper. Mobile VoIP is not that new a service from the end-customer point of view. Mobile voice connectivity has been there for years, and that is what the customer is seeing when he uses VoIP applications. Although from the technical point of view the implementation is completely different from traditional circuit-switched voice communication services, the end-customer is merely interested in the kind of value-added the new service provides. Of course in the end of day it is possible to better extend basic voice services in IP networks (integrating e.g. video, instant messaging, file sharing and security layers to the basic service), but the core value-added is voice. Therefore we should not call mobile VoIP as a disruptive application, but instead the numerous disruptive technologies around the core service generate the disruptive potential. [4]

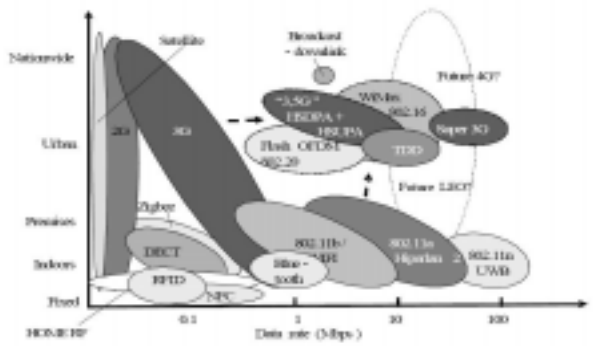

Figure 1 - Emerging radio technologies (adopted from [5])

From the incumbent cellular network operator point of view the greatest threat (i.e. disruptive potential) in the near future is centered on emerging/challenger radio technologies (see Figure 1). In Europe a lot of money and focus has been pushed on the evolution of cellular technologies (1G, 2G, 2.5G, 2.75G, 3G etc.) [5]. In the future we see a continuation of these technologies towards 3.5G, including technologies such as HSDPA and HSUPA. In the UMTS framework we also have to consider the UMTS TDD technology, being an alternative to the WCDMA interface. However, there exist many alternative radio technologies, too. WiMAX is currently considered as a wireless broadband technology for fixed locations. In the future WiMAX will be developed towards more mobile use cases, which will position it as a serious substitute to cellular technologies. FLASH-OFDM is also worth consideration. In addition, with WiFi we refer to a portfolio of standards such as 802.11g and 802.11b. In Europe we generally talk about WLAN technologies. They are already widely deployed and are therefore worth more discussion.

WiFi radio access technologies are considered currently as the most powerful threat to cellular, thanks to a wide deployment of various kinds of WiFi hotspots in public places, enterprise-driven WiFi coverage, municipal WLAN networks etc. Taking WiFi as a case example, it is good to analyze other (middle-layer) technologies which are needed in making VoIP working fluently. In cellular networks we take it for granted that e.g. hand-overs work easily. In WiFi hotspots this is not that easy, and many alternatives are currently considered in implementing seamless hand-overs from a "WiFi cell" to another. Other issues are related to possible roaming arrangements, QoS issues, cellular-to-WiFi-handovers etc. From the network management point of view one also needs various kinds of management tools for WiFi networks. It is quite another thing to get a multiple-WiFi-cell-network to work with handovers etc., than to operate a single WiFi base station mostly meant for flexible but fixed use cases (e.g. WLAN home networks). Currently many of these technologies are under standardization.

By taking a more holistic approach, there any many standards or frameworks on a higher level which basically discuss the evolution of mobile networking from a wider perspective. The concept of 4G is still a bit hasty, but the general idea in the movement towards 4G is the application of various radio access technologies which all together form the ground for IP-based networking. UMA (also known as GAN) deals with largely similar kind of issues, though it is currently being specified whereas 4G is a somewhat future concept. UMA is adopted by 3GPP, and it is considered as a major approach in bringing local and wide area networks closer to each other, solving issues such as roaming and handovers from cellular to e.g. WiFi. It is also developed in parallel with e.g. the IMS (IP multimedia subsystem) platform, which is considered very important in providing IP based services to mobile subscribers in the future. The main idea in IMS is that all the services are provided through a managed IMS platform, in which not only the network operator but also 3rd party content providers can create value to the end-customer. Mobile VoIP is definitely one of the key services thought to benefit from IMS.

Table 1 - Analysis of the concepts/technologies

Layer of interest	Network architecture, switches, mobile subsystems	Radio access technologies	Roaming, handovers, authentication, security (middle layers)	Application layer, software clients	Handset, terminal, network edge
Technologies / Concepts	•UMA •4G •Mesh networking •VoIP PBX •Middleware •Longboard •SCCAN •IMS •PMC	•GSM •CDMA •CDMA2000 •WCDMA •HSDPA •HSUPA •Bluetooth •WiMax •802.11a •802.11g •802.11b •EVDO rev A	•SIP •vPnP •GSC (IEEE 802.11e) •WPA •WPA2 •WEP	•Call management •Networking machines •Instant messaging •Video calls •GUI	•Battery life •Convergence of radio access technologies •Open software platforms •Processing power •Multimedia capabilities
Companies	•Trapeze Networks •Broadcom •Aruba •Orbitel Telecom •Cingular •Ericsson •Nokia •Nortel etc.	•Ericsson •Nokia-Siemens •Alcatel •Intel •Kamal etc.	•Kineto Wireless •BridgePort Networks •Longboard •Panonet Networks •Aruba •Motorola •WI-LAN •Cisco etc.	•Skype •Vonage •Bucosen Junction •MSN •Yahoo •Google etc.	•Nokia •Motorola •SonyEricsson •Samsung •Windows mobile terminals etc.

Many of the technologies mentioned in this chapter are some sort of standards. However, there exists quite a wide portfolio of technologies and solutions which are not standardized at all. These are referred to as "proprietary" technologies. For example Skype, the widely speculated VoIP service in the fixed Internet, is based on a proprietary technology. For a reverse engineered description of the technology, see [17]. Usually proprietary solutions are considered as a bit hostile, particularly from the open-source kind of perspective. Proprietary solutions typically do not drive e.g. interoperability issues.

The major conclusions of this research paper are related to the possible paths of mobile business evolution, the first of which is based on the dominance of huge cellular operators and standardized interfaces, and another of which can be possibly proprietary based Internet-like service evolution. The technical background is essential in understanding the suggested framework. The relevant concepts and technologies are mentioned in Table 1.

3. Emerging actors and business logic

Now as the technology issues are discussed, we can move to more business-oriented analysis. By taking a holistic look at the mobile VoIP business, we can identify following types of actors in the game (see Figure 2):

- Proprietary 3rd party VoIP service providers
- Virtual VoIP operators
- Incumbent operators

In the categorization above we focused on companies which could actually provide/manage VoIP services, i.e. provide voice connectivity over IP networks to the end-customer/enterprise. There exist a wide number of other actors in the larger value network, too. These include e.g. software/hardware manufacturers, suppliers, consulting companies and ODE type of product developer companies. Some of the distinctions that are emphasized in the categorization of this paper have already been disputed earlier. For example, in [19] the discussion centers on the battle of MNOs against ISPs (which are in this paper referred in many cases as 3rd party client providers because of their high location on the modular Internet business design). On the other hand, in [20] it is described how fixed network operators can take MVNO kind of positions in launching mobile VoIP services. Certainly the concepts have been there also earlier, and they reflect the current typology of actors playing in the mobile VoIP field. However, it might be that in the future we need to reconsider our categorizations based on the evolution of the market. Now it is too early to say what is going to happen.

Incumbent operators - now talking predominantly on incumbent cellular network operators - are currently taking a bit defensive or explorative approach. Sure, major players in the industry are considering the threat or opportunity of mobile VoIP. It is inevitable that voice communication moves to the

packet-switched domain. However, cellular operators get their most important and biggest chunk of revenue from mobile circuit-switched voice services, so it would be stupid all of a sudden to leave everything behind. On the other hand, they are also waiting as the technologies evolve. If they are to fluently extend their cellular offerings, people expect them to provide solutions which support seamless roaming and integrate well with all the other services. Incumbent operators have lots of stakes in complementing efficiently the current value offerings together with driving their brand value. Incumbent operators are currently observing the whole technology landscape, putting a lot of trial and development e.g. on the IMS platform. They are also considering how to best combine cellular voice and mobile VoIP, in which UMA player an important role. If the cellular operator also owns e.g. DSL kind of infrastructure and home connections, they might have the incentive to bundle mobile subscription with home WLAN base stations, which then switch calls at home. It also remains to be seen how the possible regulatory agents deal with these kinds of approaches in the future.

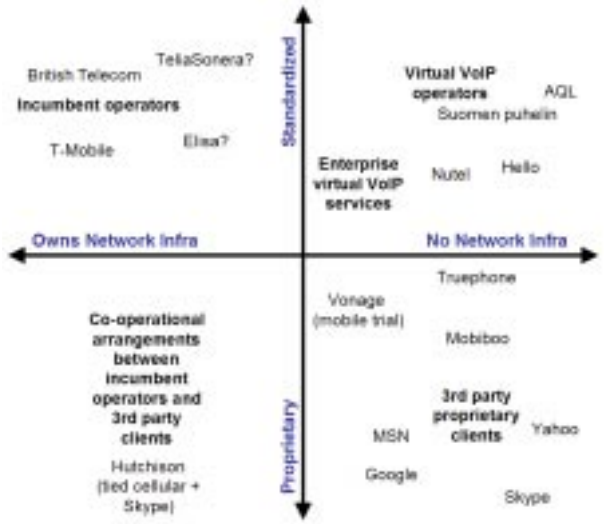

Figure 2 - Classification of actors

Virtual VoIP operators resemble the virtual operators we have already seen in the mobile cellular business, i.e. MVNOs (see e.g. [18]). Virtual operators provide a service, possibly implementing some billing and charging mechanisms, but do not own any network infrastructure. [14] In the VoIP business this kind of actors fit into the value network even better. Currently in many countries it is not the cellular network operators (who might have the possibility to block VoIP kind of traffic) who own the hotspots. On the contrary, there are many WLAN hotspots provided by a municipal actor, there are open networks in which individual households provide WLAN access points, restaurants provide a customer with an incentive to come eat and by providing inhouse WLAN coverage also to access the Internet. If this is the case and very open network access networks emerge and prosper in the future, there is a lot of potential for virtual VoIP operators. They could also partner with companies who drive Internet-like service architectures and in which there is practically no vertical integration. In this Internet model there are separate companies serving as bit-pipe kind of operators, whereas there is room for separate companies providing services, for example mobile voice connectivity through IP networks (i.e. VoIP).

There might emerge many kinds of virtual VoIP operators. Some of them might target the value-added to the enterprise sector, whereas some could focus on consumer customers. Some of them might partner actively with other companies, some might just rely on the fact that the competitive Internet model emerges in which a variety of radio access alternatives are found at least in urban areas. In any case, virtual mobile VoIP operators are likely to have extremely focused strategies on the highest OSI layer. Mobile virtual VoIP operators are likely to build their services on standardized technologies if they are to emerge from scratch and build on other domains, e.g. the base of SIP-capable WLAN handsets.

The third main group of actors in the game is not far from mobile virtual VoIP operators. We call these actors as 3rd party proprietary client providers. Their role can be understood as a bit hostile, as they do not leverage on standards that much. They take advantage of the potential Internet evolution path by only focusing on the highest layer, where they interact (and effectively own) the customer. This can also be understood as a "rupture" scenario [7], as the 3rd party proprietary client providers have quite different business models than the currently well-known incumbent and virtual operators. Their business is based on attracting as big as possible a user domain. We see this kind of actors in the instant messaging world today, as Internet giants such as Microsoft, Yahoo and Google are all trying to maximize the network externalities in their own particular user network. On the VoIP side it is Skype [13], naturally, which best fits in this category. However, the differences of instant messaging and mere VoIP services on the client level are gradually disappearing, as many of the clients already provide both functionalities, not to talk about all the other add-on services such as file sharing or video calls. Business-wise these 3rd party proprietary client providers make money by bundling other services or through advertisement revenue. By keeping clients proprietary they make sure that only they can manage their own customer domain. If there emerges only massive Internet companies who own the customers and provide the core voice communication services, major challenges are of course related to interoperability issues between these actors. Some interoperability/roaming kind of arrangements should be done without doubt, not only to other Internet companies but also older PSTN / cellular networks, which certainly remain complementary in non-urban areas for long. These 3rd party client providers do not work on massive vertical integration projects and/or they do not have to wait for standardization to freeze down, which might takes years. The only thing they are depending on is the very tightly evolved Internet mobile VoIP model, in which all the layers are distinctively separate and competitive.

4. Evolution of the mobile VoIP business in the future

Based on the discussed categorization of VoIP service actors and their respective characteristics, we can draw three SWOT maps reflecting their possibilities in the industry [16]. Maps are illustrated in Figure 3.

Currently it seems that the most light-weight implementations of mobile VoIP are emerging. We are now talking about Skype kind of proprietary solutions. Also virtual VoIP operators, which are using simply SIP-based services through emerging Nokia E-Series handsets, for example, are appearing on the market. These kind of actors emerge quicker, as they are usually quite small and have thus advantages in terms of time-to-market. Furthermore, they do not need to consider issues such as integration to cellular networks (e.g. UMA approach). On the other hand, incumbent cellular/DSL operators are still considering their best movements. They need the interoperability/handover standards, and they also reconsider their business value networks in leveraging on mobile VoIP. Most importantly, they also generate money from the circuit-switched voice, so why hurry? As virtual VoIP operators and 3rd party client providers leverage on the innovative ramp-up, incumbent operators prepare for a defensive mobile VoIP approach more carefully, remembering that they have lots more to risk.

Then, relying on the scenario modeling which tries to identify extreme industry evolution paths, a two-path map is drawn for the future evolution of the VoIP service industry (see Figure 4 for the illustration).

Currently we are moving along the time line towards an expected cross-road. All the different actors emerge, the potential technologies are explored, while the standards and other platforms at the same time evolve and are eventually frozen. Then we face the so-called tipping phase. The business logic / ecosystem will converge to either of the two possible directions.

VIRTUAL VoIP OPERATORS

Strengths	Weaknesses
- Fast ramp-up based on (open/closed) IP networks - Focus on VoIP services	- Lack of vertical integration - Small size and negotiation power
Opportunities	**Threats**
- Innovative business logic - Leveraging on the Internet model and established standards such as SIP and available hardware (e.g. Nokia E-series) - Acquisition by bigger operators?	- Emergence of a strongly operator-centric model - Bigger operators and hostile strategies - Large Internet companies and 3rd party light-weight VoIP clients

INCUMBENT OPERATORS

Strengths	Weaknesses
- Ownership of network infrastructure - Experience in the roaming etc. interoperability arrangements	- Time lag due to standardization and evolution of IMS kind of platforms - Size, slowness
Opportunities	**Threats**
- Bundling of cellular and fixed - Seamless interoperability and combination of cellular and WLAN	- Emergence of an Internet model - Challenger actors (virtual operators and 3rd party client providers)

3RD PARTY PROPRIETARY CLIENTS

Strengths	Weaknesses
- Fast ramp-up - Proprietary solution - Existing user domain in the Internet - Levers on the Internet model	- No network infra - Interoperability issues to other Internet services and PSTN/cellular networks - No vertical integration
Opportunities	**Threats**
- Integration of various other value-added services on the application layer - Innovative potential / challenger benefits	- Emergence of a vertically integrated business model - Value-destroying competition

Figure 3 - SWOT analysis of the main actors

The first path resembles the current mobile cellular business, which is much operator-driven. On this path UMA and IMS play a big role, as incumbent operators need them quite a lot if they are to successfully integrate cellular with alternative radio access technologies and to coherently support the emergence of IP-based services. This path is called a vertically oriented one as operators retain a lot of control, and Internet-type of openness and modularity is absent.

The other possible path leads towards an Internet-like scenario, in which we have strictly layered industry structure. Others provide connectivity, whereas others provide services (e.g. mobile VoIP). On this path operators as we know them today remain as mere bit-pipes, and mobile VoIP becomes a true Internet service. In fact, on this path we might see a major transformation in which voice connectivity all in all moves to a true Internet era!

On this other path we see possibly a strictly dominant category of actors, or alternatively we see both 3rd party proprietary client providers and virtual VoIP operators. The key question remains: What is the role of standards vs. proprietary solutions? It is possible that major virtual service providers emerge who leverage on the established standards implemented in e.g. newer handsets (e.g. Nokia E-Series), or then we see the rise of huge Internet companies like Google, MSN or possibly Skype, who leverage on the user domain and proprietary solutions.

It is impossible to say which is the predominant business logic in the future, the strongly modular Internet-like business ecosystem or more vertically oriented cellular-like operator-driven business ecosystem. It remains to be seen for sure, however, during the next 2-6 years.

5. Conclusion

This research paper has defined the mobile VoIP service and speculated it as a potential disruptive service, not from the service point of view but because of its close linkage to emerging alternative radio technologies which provide IP-access also through other than cellular networks. In this movement towards a holistic network access perspective we see the handset in a central role. Dual-mode handsets (e.g. Nokia E-Series) provide an interesting platform for emerging VoIP services. However, the key uncertainty of the mobile VoIP business relates to the different kinds of implementations of mobile VoIP services.

The key technologies and standards under development were discussed in this paper. Leveraging on this technical assessment the different actors were also introduced who might serve as mobile VoIP services providers. The key idea was that different actors leverage on different kinds of technologies and further on different kinds of business approaches. The tipping phase of the whole industry reveals that towards which of the two main evolution paths the mobile VoIP industry develops. The first main path was an Internet-like scenario with a strongly modular and layered structure. 3rd party proprietary client providers and mobile virtual VoIP operators might benefit from this ecosystem design. The other path leads to a more operator-driven and managed ecosystem, which is not that far from today's cellular business. Vertical bundling and levers on the existing network infrastructure might drive the dominance of this model. While it is too early to say which path is winning, there exist many important parameters in addition to business logic and technologies which certainly affect the outcomes. One of these important factors is regulation. There might also emerge mixed strategies. For example Hutchison and Skype have recently launched a trial service together [12].

While this theoretical paper has speculated on the future evolution paths of mobile VoIP, it remains very interesting to follow the scene also in practice. The development of measurement methods in order to follow the market, and analyze the emergence/adoption of mobile VoIP services, remains very important [8] [9].

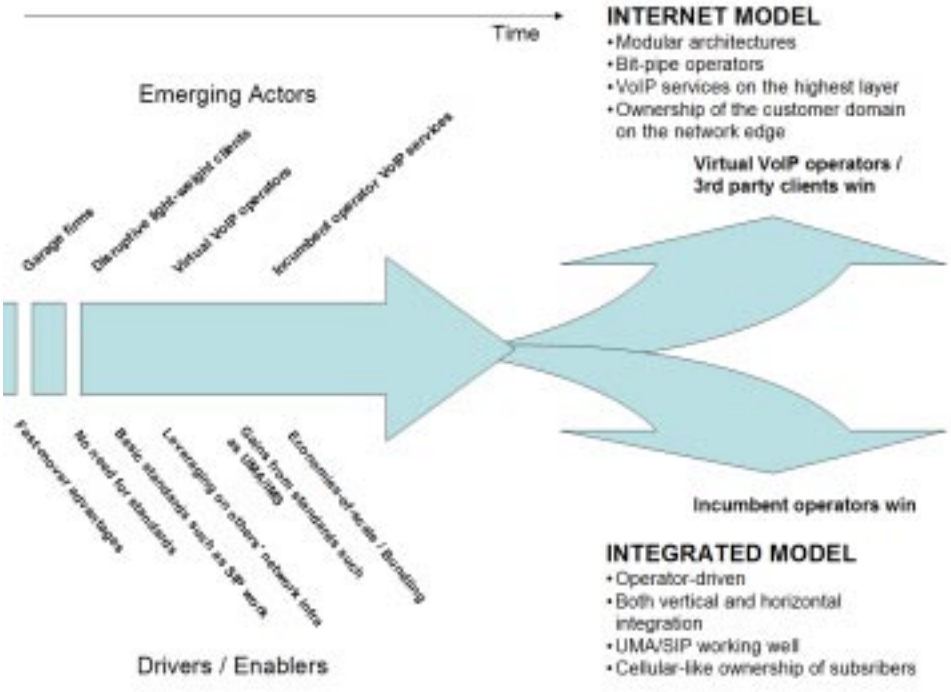

Figure 4 - The evolution path of the mobile VoIP business

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