SERVICE ADOPTION FOR PUSH OVER CELLULAR

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Abstract

Push to talk over Cellular has gained substantial interest in recent months. Traditional Push to Talk service has been available already several years but only recently new specifications and technical innovations based on Internet Protocols and utilising standard cellular packet data bearers have been introduced. This new approach not only makes Push to Talk to spread from dedicated system to become a standard service on any cellular network but in best case it provides way forward to make future IP based Multimedia services to interwork globally, regardless of the air interface standard. Standardization effort for Push over Cellular is still in its early phase but the basic characteristics and capabilities are already visible. Some key technology selections are to be made in the near future. These decisions will position the Push over Cellular either as a vanguard of a new mainstream or as another additional supplementary service of cellular networks. In any case Push over Cellular has high likelihood to impact the communications market during the next 2 to 3 years.

Key Words

Push Over Cellular, PoC, Internet Protocol, IP Multimedia, GSM, 3G, GPRS, CDMA2000, WLAN, OMA, 3GPP, IETF

1. Introduction

Push over Cellular (PoC) is a novel concept combining converging digital content formats, IP protocols and cellular packet bearers to provide proven use case, Voice Group call. The developed solution in standardization is targeted to be applicable over any wireless system technology and therefore being able to serve customers globally.

There are still many technical and political risks involved in the technology and standards development itself. But even bigger risks are involved in the way the PoC service will be provided by the Mobile Network Operators (MNO). It is possible that MNOs maintain their Walled Garden approach also in case of PoC. This however is less and less likely to succeed commercially because there will be other more open competing ways to provide comparable service.

This paper discusses the primary technology and commercial challenges in the PoC development as well as addresses issues, which may significantly impact the PoC service adoption.

2. Evolution towards Push over Cellular

Push to Talk (PTT) has its roots in military radios of the World War II. During the last 60 years PTT have probably been the most used paradigm of two-way and multiparty radio communication. Only the last 20 years have been era of dominating cellular radio technologies. PTT user paradigm is still very common in military and other professional radio systems (e.g. Terrestrial Trunked Radio, TETRA system) and it is also used broadly in private purposes such as coastal naval radio for leisure boating, deer hunting (VHF radios). Consumers would use PTT even more widely if it only were available anytime, anyplace. Traditional Push to Talk suffers limited coverage and poor privacy but on the other hand has no or very low usage charges. The golden era of Push to talk was probably some 30 years ago, when Citizen Band (CB) radios were used quite commonly by teenagers and by truck drivers. (Edquist 2003)

Similar use cases have been addressed in the past also by two variants of public cellular radio systems, namely so called GSM-R Radio system for European Railways Union (UIC) and proprietary radio system iDEN (Integrated Enhanced Digital Network) developed jointly by Motorola and their customer operator, NEXTEL.

The recent buzzword, PoC, Push (to talk) over Cellular introduces the next wave of technology serving the basic human interaction mode of group communication. The main differentiator between PoC and all the earlier technologies is that PoC is utilizing general packet packet radio and Internet Protocols (IP) versus earlier analog technologies or circuit switched digital radio

technologies. This new approach does not only bring some obvious advantages of IP, such as low operating and capital expenditure but it is also able to support various advanced services, which benefit from all-digital content formats and broad compatibility throughout all the Internet.

3. Proven use case: NEXTEL

Success story of Nextel in the USA has been quite remarkable. The roots of Nextel are in the Enhanced Specializised Mobile Radio (ESMR), which is the term for Professional Mobile Radio (PMR) in Americas. Nextel was operating a ESMR system. This provided them low cost access to mobile radio spectrum in the USA during the years when other cellular (especially the PCS) operators had to pay high auction prices for the limited amount of radio spectrum at 1700 MHz bands. Since the spectrum available for Nextel was allocated for ESMR use, they had obligation to provide also the very basic PTT service as part of their service offering. (Nextel 2004)

The additional constraint however became one of the key features of their system, called Direct Connect. This feature has enabled Nextel to differentiate from the other cellular network operators and to maintain higher ARPU and loyalty of their customers. Nextel today have some 12.3 million subscribers (7.5% market share of the continental USA cellular subscribers), out of which over 90% are using also Direct Connect. Many of the users are still professional users, such as employees of small businesses but the users of Direct Connect include a lot of ordinary people, families and teenage groups. (Donahue 2000)

Probably Nextel's background in professional radio has made them to focus on network quality and service quality in general. They rank #2 and #1, respectively in today's end user polls. This indicates that the service characteristics, including Direct Connect satisfy the customers' needs and hence can be used as valuable reference point when considering PoC service for similar end user groups. Especially in the USA, the ordinary cellular operators planning to deploy PoC will not succeed unless they can provide comparable quality of service.

Nextel has extended their offering to cover all the typical features and functions in other networks today, including variety of terminals, Application Execution Environment (J2EE) and other services ranging from ring tones to location services. This is an evidence of similarities of the user groups, which indicates that combining PTT to ordinary cellular radio and vice a versa is a viable way to go.

The main weakness of Nextel service offering is probably its limited coverage (Nationwide service has been launched recently) and still low variation of terminals because of the proprietary technology (Motorola dominating). This will keep the cost structure high and they will be vulnerable to the competition if their differentiation options are significantly reduced.

4. Standardization

The principal standardization bodies relevant for PoC include 3GPP, 3GPP2, OMA and IETF. Each one of them in principle has clear mandate but in practice the work plans are not fully inline.

The primary role of 3rd Generation Partnership Project (3GPP) is to develop technical specifications for GSM evolution to 3G, including maintenance of GSM core specification, future development of WCDMA radio specifications and for PoC most relevant work area is the Internet Multimedia Subsystem (IMS) specifications. The 3GPP develops specifications, which then will be approved by regional and national official standardization organizations, such as ETSI, ANSI, ARIB for Europe, USA and Japan, respectively, among others. The 3GPP has already completed, as part of their release 5 most of the fundamental features of IMS including the basic SIP (Session Initiation Protocol) based signaling, support of ISIM (IMS Subscriber Module) and related authentication and security protocols. The 3GPP is responsible on the architecture and service aspects, not only the protocols. In practice all relevant players for Mobile Cellular business are participating the work in 3GPP. The 3GPP2 is similar organization set up later to carry out the standardization for CDMA2000 maintenance and evolution.

Open Mobile Appliance (OMA), has been created parallel to 3GPP specifically to develop application and service enabler level specifications. Most of the OMA members are also actively participating 3GPP but especially the IT vendors are focusing their effort rather to OMA than to 3GPP. The OMA has inherited many pre-IP era application specifications, such as WAP Forum and Wireless Village, which on the other hand provide stable basis for further work but in many aspects are also a burden, since their compatibility to 3GPP IMS has not really been any goal. Additional source of friction is that the pre-IP era protocols are competing with IETF protocols, developed for similar purposes for the Internet. Co-operation between OMA and 3GPP is developing and going into better direction but still there are several complex and complicated areas to be sorted out. Related to PoC, 3GPP has been working also with Presence, Group and Instant

Messaging as well as for IMS Conferencing, which are considered as application level specifications and therefore potentially belonging to OMA mandate.

The Internet Engineering Task Force (IETF) is the predominant body to create the protocol specifications for the Internet in general. Way of working in IETF is in some aspects quite different from business driven bodies such as 3GPP and OMA. The primary focus, naturally in IETF is in the integrity of the set of protocols intended for Internet, even though in many cases IETF has not achieved single solutions but instead there are several parallel protocol specifications for the very same purpose. Related to the work in 3GPP and in OMA the most critical protocols, which are still under development in IETF include SIP and SDP but also SIMPLE, XCON, and SIPPING.

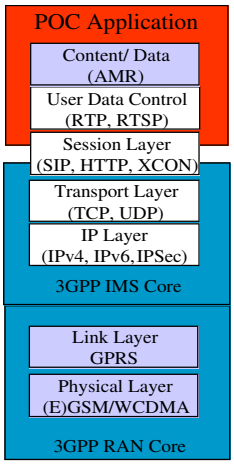

Figure 1. Layers of standardizations in case of PoC

Standardization is often considered as work for the best of the mankind and therefore the performance of the service, applications and system should be the first concern of the bodies drafting the specifications. Politics and individual ambitions should only follow.

4.1. Technology proposed for standardization

PoC standardization process is an exception to typical 3GPP and OMA standardization process. The baseline technology is a synthesis of available proprietary technologies. Nokia has already launched products with PoC feature enabled. Ericsson and Motorola are using software application developers (Sonim and Magic4, respectively) to provide similar capability and Siemens is in the process of launching their first products supporting PoC. These companies however joined their effort in mid 2003 and created a specification, which is now the main contribution for the PoC standard in OMA. Other companies have commented and contributed supporting and improving ideas. The work in OMA is progressing and due date for the standard is during 2004. (Industry coalition 2003),(OMA Charter for PoC 2003)

Key technologies, which define the characteristics of PoC include:

- Wireless radio link, which is Always-on and Always-connected to the IMS Core, to all relevant application servers (AS) as well as to any other Internet access point (APN). Naturally the physical radio is not active all the time but is using the normal paging mechanisms to activate the always-on virtual connection when needed.

- SIP based signaling used in 3GPP/IMS Core. This decision in 3GPP was made several years ago to emphasize the convergence as a goal for mobile and fixed communication domains.

- Half duplex voice over IP connection, which utilizes 3GPP AMR voice codec as default. There is pressure to include other optional voice codecs in order to facilitate PoC as an universal application standard also for non-GSM system technologies.

- PoC Server is a crucial part of the system, which provides the establishment of the PoC sessions and brings the users together. PoC server also multiplies the speaker's bit stream to multiple streams for the listeners of the PoC session. PoC server is essential tool in opening current IP technology bottlenecks: Network Address Translation (NAT) and Firewalls, which isolate the sub-network hosts from the open Internet. Mobile devices connected through mobile network operators' packet data infrastructure are in practice always using virtual, local IP addresses and are behind of the MNOs' firewalls.

- Performance enhancements for wireless friendly transmission are needed, IPv6 header compression as well as SIP signaling compression are both quite important factors to bring acceptable level of service quality to PoC. PoC is not assuming Quality of Service classes, such as streaming class, to be implemented in the networks but it is able to ustilise "better than best effort" QoS when it is available networks in the future.

The main challenges in PoC include:

- Floor control must be agreed. Floor control has to provide high performance (low latency, high spectrum efficiency) and future proof solution (compatibility with floor control protocols in the Internet.

- Some dedicated support to both GSM/GPRS/ WCDMA and CDMA2000 radio access technologies. WLAN, IEEE 802.11x is supposed to work transparently.

- PoC Server to Server interface for global service interoperability.

- General harmonization of approaches in order to provide seamless operation both in mobile and fixed environment.

Critical item in standardization and also in the future IMS based systems in general is the use of IPv6. Currently the IMS is specified fully to utilize the modern version of Internet Protocol but several MNOs are optimizing their plans for short term targets forcing vendors to provide dual stack IPv4/IPv6 products. This may cause legacy problems when PoC is used in multi-operator environment.

4.2. OMA/3GPP PoC Architecture

The goal is to implement PoC as an Application Server and Application Client concept on the top of the 3GPP IMS/SIP Core.

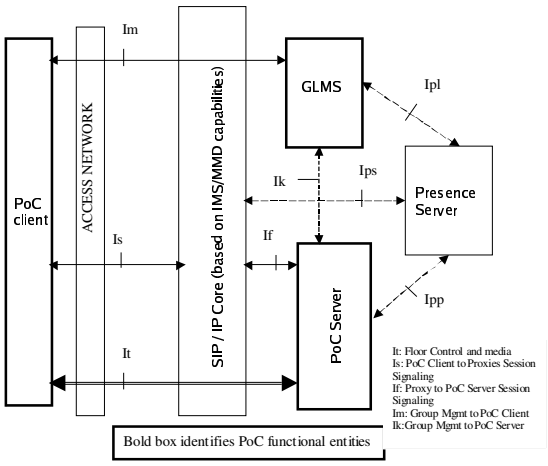

Figure 2. Architecture of PoC (Source: OMA)

PoC specification includes dedicated Group List Management Server (GLMS), which handles the PoC Group call features and functions. PoC however, does not include its own presence server but the intention is to use any applicable Presence server available through Ipl, Ips and Ipp interfaces. Similarly any other application level service enablers such as location may be connected to provide additional capabilities for PoC.

Key element in PoC architecture is, how it can be implemented to support independence from network operator. There are several scenarios where well-defined interfaces between IMS Core and PoC server are needed. The most obvious cases include support for Mobile Virtual Network Operators (MVNO) and Value Added Service Operators but also support of enterprises or independent ISP's to have a possibility to provide PoC services for their own employees or consumer customers directly is a important opportunity.

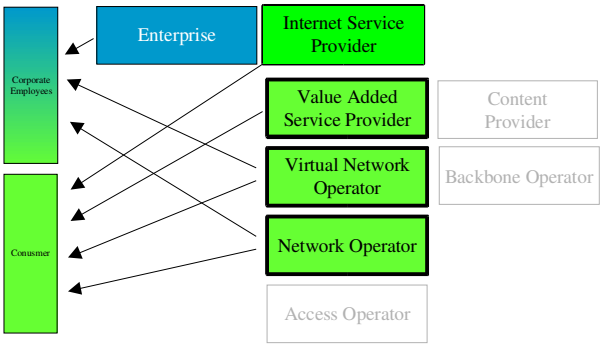

Figure 3. Ideal Value System Options for PoC

The interface between Mobile Client and the network infrastructure is open for natural reasons, but another important interface is inside the mobile terminal devices. It is possible to download PoC Client software afterwards to mobile devices, which have adequate open software Application Programming Interfaces (API) and adequate support of HW performance, including security of the HW and SW platform. These Interfaces are not visible in the standardization architecture but are on the agenda of OMA. These Interfaces are as important as network interfaces to promote development of applications on the top of the Mobile Cellular Business infrastructure provided by Mobile Network Operators, Mobile Virtual Network Operators and Mobile Service Operators.

5. Regulative aspects

It is not very clear what is the opinion of authorities and regulators in different countries in respect to PoC. Internet voice services are not covered today by the same regulation as the PSTN and Mobile Cellular voice services. The main aspects of the regulation, which may have some impact, include issues related to privacy and legal interception.

Privacy is an issue of the user voice traffic. Note that all voice traffic is multiplied by the PoC server and hence can be eavesdropped easily. Similarly privacy of the group membership lists and databases of the GLMS must be secured.

If PoC service is considered as normal voice service, possibly also legal interception requirements will apply to PoC conversations. It is possible to intercept the PoC voice traffic at the PoC server but it becomes more difficult if the PoC server is out of the domain of the authorities (e.g. in different country). Regulators may also choose not to apply any such regulation for IP based multimedia service. This question is open today.

Even if the roots of PoC may be in military and emergency type environments, it should be clear that PoC service as developed now is not able to support real emergency service requirements. Those should be left for more professional system technologies, such as TETRA. Further on, the half duplex mode of operation limits the usability of PoC for normal 112 (emergency, 911) calls. Therefore for all PoC terminals also traditional Circuit Switched voice service support is needed.

Regulators' opinion is very important in facilitating competitive business environment for PoC. There should be no limitations who is able to run the PoC server. Mobile Network Operators shall not be allowed to use their monopoly (or oligopoly) power to keep the price of the data bearers discriminatory high for independent PoC service providers. Maximising Social surplus should be the principal goal for regulators. (Courcoubetis 2003)

6. Competitors to OMA/3GPP PoC

In the value system analysis it is important to consider alternate ways to offer similar service to OMA/3GPP PoC.

As we recall that PoC server is fundamentally an application server running on the top of the 3GPP/IMS Core and may in many implementations based on downloadable client software, it is obvious that similar service may be created using proprietary protocols.

There are several such initiatives but one of the characteristic offerings has been made available by Fastmobile, US originated private SME. They market their service under the name "Fastchat". Fastchat provides similar user experience to the planned OMA/3GPP PoC but the service is available already today. Fastchat client is very well integrated with the Symbian software platform, which extends the relevance of the client beyond the basic PoC. Presence and Groups are both managed by their proprietary server. Because they can not integrate their technology as deeply with the radio standards as the 3GPP/OMA specification teams can, Fastmobile will have problems with performance of the application (latency) and difficulties to address the end users for charging and billing. (Fastmobile)

The Fastmobile business proposal is very welcome to speed up the application development beyond the traditional players, ie. MNOs and their direct suppliers. Fastmobile solution is also some kind of choice for independent service providers and enterprises, should the 3GPP/OMA specification been developed for walled garden (ie. Closed) value system only. Fastmobile is securing their future by participating OMA standardization effort and at the same time selling their solution to operators and other potential customers.

Even more controversial approach for mobile market is to use of emerging peer-to-peer technologies for group and point-to-point Internet Voice Communication. One very interesting development to monitor is the recent voice and multimedia oriented peer-to-peer system, Skype. Skype builds on the experience of KaZaA but is not intended for file sharing but primarily for communication. Peer-to-peer Technologies will have inherent problems in wireless environment, especially in high price cellular systems. But surely it is not impossible task to develop protocols, which can be competitive also in wireless systems and then simply wait the wireless data bit pipe tariffs to go lower to the similar level per transmitted bit as the current competitive wireless voice tariffs. (Kantola 2003). (Oram 2001)

The IETF is also developing Internet Conferencing specifications but without commercial drive it is quite difficult to estimate the availability of such standards.

7. Benefits of PoC

The PoC service will provide benefits to all relevant players of the value system and hence has good likelihood to succeed.

For the end user PoC is a new way to communicate, which supports all kinds of social groups, from sailing to hunting teams and from families and ladies in distributed shopping event (– this last one appeals only to engineers, probably not to the ladies).

Pricing will become one benefit of its own right. This is discussed in more details in the next chapter.

Benefits to network operators and other operators are obvious. PoC is a low capital expenditure technology, which requires only low cost servers to be installed and operated. The server infrastructure even scales with the traffic. Operators can now finally utilize their existing data network capacity, which in the past has been somewhat difficult because of not so many driver applications. For operators PoC is clearly a way to differentiate, as Nextel has shown in the USA. PoC is one obvious way to segment the services. PoC can be seen on a contour, where the minimum value proposition is text (chat or instant) messaging, extending through multimedia messaging (especially simple audio messaging) to PoC and beyond to ordinary voice service and voice conference services. (Nokia 2004)

For mobile equipment vendors PoC is one additional feature, which will fuel the update cycle of the end user devices. For some models PoC will be available also as a downloadable software. This will impact not only the sales of the mobile devices but have some impact to the competition for the winning application platform, too.

8. Factors influencing service diffusion

The investors plan to deploy PoC but they will face the same question as in case of any new service. Will it fly? The Service adoption of PoC depends on the similar factors, which are applicable to any consumer product. Enterprise customers will facilitate consumers' service adoption if PoC is widely used by businesses.

There are several ways to estimate service adoption. A consultancy firm CONSTAT is using simple model with five steps: Being aware, Engage, Activate, Purchase and Use. The adoption process is initiated by combination of following factors: Environmental (traditional diffusion), Marketing and Communication and Personal factors of potential customers (They call this "Adoption DNA") (Constat 2001).

8.1. Service Adoption Process

In the USA Nextel proven use case provides reliable estimate of the principal willingness of the consumers to adopt PoC type service. In Europe this question is much more difficult to answer. There are some implications that Asian consumers are somewhere in between in their awareness of Push to talk type service. Awareness of consumers and also corporate customers may be enhanced with proper marketing and advertisement but fundamental factor is the Environmental pressure (Diffusion) of the other PoC users. It is critical that PoC service is globally adopted, since this is the best way to increase the diffusion.

Critical success factor for many new services is the convenience of service trial. PoC has some advantages. Especially the application downloading possibility will make it easy for end users to engage with the service. It would be even better, if trial versions of the software were easily available for downloading and for super-distribution via MMS. But it is not enough to simply have the software available. Simple provisioning (setting and configuring the product, application and the service) is one basic requirement. Settings must be available with the application, preferably automatically or at least using some over the air method like OMA provisioning.

Price of the engagement phase must be minimized. Trial version of the software is only one element. Also the service should be available for free for some short test period.

Successful adoption of the service requires that positive decision to purchase and activate the real service is made. Decision to buy permanent software license or completely new PoC oriented terminal may become easy since as quoted by Nokia, in 2005 majority of Nokia terminals will have PoC client as standard feature (like MMS is today). Calculating simply the PoC enabled terminal penetration is not enough. Also the service has to be enabled. It is not known what strategies operators will adopt. Orange is expecting to have 1 million PoC customers within 12 months. Orange is also planning to have some PoC products with Microsoft software platform.

Critical factor for continuous use of the service is the positive network externality, i.e. many compatible products and networks in order to maximize the value of the service according to Metcalfe's law. The critical mass is achieved much earlier if there is no technology fragmentation. This requirement is valid also for normal features and functions such as roaming and inter-network operation, which should not limit the usability of PoC either.

For the consumer it is essential that the User Interface and the service quality satisfy her needs. Nextel is demonstrating latency lower than 1 s for push to talk. In OMA specification the target value is 1.6 s. It is a bit unclear if this performance figure is good enough. Another target for perceived voice quality, in OMA MOS > 3, is also at the lower end of the expectations of the ordinary user. GSM voice codec today provides MOS > 4. For good usability some easy to understand and easy to use keys and icons must be provided for "Push to talk" function. This has to be taken into considerations also while using headset or speakerphone options of the terminal device.

As explained by Geoffrey Moore (Moore 1995), the principal enabler to cross the Chasm is that a "Whole Product" must be offered to the potential customers. (Whole Product means kind of total package, which include all necessary elements to satisfy one clear customer need and purpose 100%)

8.2. Pricing

The fundamental factor in sustainable service adoption is still the price of the service. The value proposition and its price to the potential customer must be in a rational relationship. If we compare PoC to circuit switched voice conference we will get some kind of

upper limit for the acceptable price. Price of a teleconference without any multimedia content may be defined as

$$Pc = (n*p+a)*t \quad (1)$$

where n is the number of participants, p is circuit switched call per minute and a is a surcharge for conference. In case of GSM multiparty service a=0.

Price of a PoC teleconference is much more difficult to define. We may however define additional parameter, duty cycle of average speaker, dc, which is between [0,1]. We have to select also some parameters of the PoC voice conference, which characterize the quality of the conference as well as take into account some estimation of impact of IP based voice transmission.

Following set of parameters is quite rough estimation.

- Speech coding rate: 4.75 or 5.15 kbit/s => Average 5.0 kbits/s
- Forward Error protection Coding overhead: 100%
- IP overhead: 60%
- 8 bits per Byte
- Charging of GPRS for all ends and for both directions. PoC is using Half duplex mode => Multiplier (n+1).
- Block rate r €/MB
- 60 seconds per minute

Price of a PoC conference may be approximated as follows

$$Pp = (n+1)* 5*2*1.6/8* r / 1000 * t*60$$
$$= (n+1)*0.12*r*t*dc \quad (2)$$

We may assume, that PoC traffic is using best effort service class. In order to compare directly with circuit switched voice, some better QoS calls should be used. This estimation hence gives a price estimation for lower bound of the acceptable service quality level.

Current tariffs in TeliaSonera network are:

$$Pc = n*15snt/minute >> Pp=(n+1)*18€/100*0.12$$
$$= dc*(n+1)*2,16 snt/minute \quad (3)$$

It is obvious that value proposition is quite good at this price level but it is open, if the service quality is good enough.

In order to use PoC service in everyday life, the application has to be such that it can be integrated with other daily behavior. Good application usability requires nice integration with other relevant applications at the user interface level. These include at least presence, messaging and phone book manipulation as in the client software from Fastmobile.

Whether PoC is able to really gain a role as mainstream service, it has to have credible evolution path, which allows the service to improve at the pace of the hardware and software evolution capabilities. In practice this means that PoC conference has to support some day also full duplex voice conversation. But even more important it is to extend the set of supported content formats from current AMR voice content to any multimedia content (MIME formats). This way it is possible to share any audio or video or any other document file as part of the PoC conference. PoC is wisely just PoC, not only Push to talk over Cellular.

For ultimately broad service adoption, PoC shall be usable also for business environment and using any applicable radio interface, GPRS, EGPRS, WCDMA, CDMA2000 and WLAN.

9. Distributed or Centralized

Business model uncertainty includes question which parties can successfully operate the new service. Current work in 3GPP and in OMA is targeted to provide an application client/server system. Only part of the needed interfaces have been specified so far and therefore it is unclear how well various business models can be implemented. The most notorious models such as strictly operator controlled WAP will have severe difficulties to gain large market acceptance. More distributed approaches, which may be based on proprietary or even peer-to-peer technologies will loose in creating network value because of poor inter-operation and most likely because of poor performance.

One analogy model, which could be used here, is the competition between Centrex and PBX. Depending on the level of market uncertainty one or the other has more business strengths. The leader in the PBX-Centrex game has changed several times during the last 30 years. Every new technology disruption or innovation has moved the advantage towards more distributed solution, like PBX and with maturing concepts centralized solution has gained better acceptance because of lower cost and competitive feature set. (Gaynor 2003)

Similarly in case of PoC it is possible to estimate the importance of the open interfaces and distributed business model in PoC. Today the market uncertainty with PoC, especially in Europe is high. There are several standards proposals and proprietary systems, there is no dominant designs or even platform, any expert would state uncertainty high and so on. Only proven use case, the Nextel, is in USA.

Therefore at least for the next few years it is very important that distributed business models are not disabled by short sighted standardization neither with traditional walled garden business models of the mobile operators.

Evolution of the PoC feature set has not yet been discussed extensively in standardization but simply looking what is already been proposed in various teams and bodies, the level of innovation is very high. Service enhancements such as providing and sharing any MIME content in a PoC conference is natural path forward. Providing better performance in the form of better QoS classes for the transmission and enabling full duplex conversation will require additional work throughout the system.

Hence, it is not expected that the PoC technology gets mature in the near future. Experimenting in various distributed systems, which at the same time can maintain full interoperability regardless of radio system technology, is the dream towards fully converged Mobile Multimedia, where Push over Cellular is only the first step.

10. Conclusions

This paper discussed technology and standardization issues related to PoC. There are some important decisions to be made but the overall concept seems to the quite stable. Performance and therefore end user expectations have not yet been compared to the full extent but the proven use case of Nextel indicates that there may be a good match.

OMA standardization process together with 3GPP, IETF and others is likely to produce competitive solution, which will limit the market fragmentation and pave to way to successful service adoption. This is however depending on various other factors such as price. None of the discussed elements seem to be any showstopper for PoC.

Market uncertainty is however high and service adoption is impacted by added value of experimentation. This can be best achieved when the interfaces in the standards are open and also when the business models do allow also distributed configurations. There is a lot of work still to be done but no fundamental bottleneck exists on this path towards new mainstream service.

Final success can only be estimated many years from now. This however is more likely if PoC conference will support any MIME content format, will operate over any major air interface system and finally interwork also with other conferencing clients in the Internet.

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