Ubiquitous Services in the Next Generation Network: Constraining and Facilitating Forces

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Abstract

As envisioned some seven years ago, the Next Generation Network (NGN) with its emphasis on ubiquitous services was to revolutionize the lives of its users. The NGN, resulting from the merger of telecommunications, Information Technology (IT) and the Internet would provide on-demand, always-on services to its users. Service providers were to be affected by the increase in revenues paid by the users of these new services. Equipment vendors would have a difficult time keeping inventories of the NGN infrastructure. The truth has been somewhat different. In this paper, we characterize a set of constraining forces and as well as some positive facilitating forces acting on the NGN.

1. Introduction

The Next Generation Network was formed from the union of traditional telecommunications, IT and the Internet; its most public face has been Internet telephony. Internet telephony has been characterized as a disruptive technology for the telecommunications industry since it aimed to supplant the sustaining technology, the traditional circuit switch based telephone network.

The beginnings of Internet telephony can be traced to 1998. The Internet had by then already achieved widespread deployment. It had successfully moved from its roots in academia and commercial research labs to mainstream adoption. With the advance of the Internet, academic research and commercial laboratories started to pay closer attention to digitizing voice and transporting it as discrete packets across a packet-switched network.

The idea of packetizing voice is not new; it has been a subject of research since packet switched networks have been in existence. What was new seven years ago were four things: first, the widespread availability of a global network in form of the Internet ensured reachability among its participants. Second, computing power had matured to the point where it was feasible to encode and decode voice packets in real time, even in hand-held devices. Third, the collective knowledge in the field of real-time transport of delay sensitive data (like voice) was coalescing around a set of standards -- Real-time Transport Protocol (RTP), Session Description Protocol (SDP), ITU-T's H.323 protocol suite, and Session Initiation Protocol (SIP) -- that could be implemented by organizations other than telecommunication vendors. And finally, the global deregulation of telecommunications industries (including the U.S. Telecommunications Deregulation Act of 1996) created a level playing field by forcing the incumbent telephone service providers to share their equipment and network with upstarts. The combination of these four effects resulted in a shift in telecommunications. The stage was set for the disruptive technology to take over.

Early Internet telephony was characterized by emphasis on the media (voice in this case). Internet telephony was viewed as a means to get around paying the telecommunication operators for using their networks (a practice called toll arbitrage). If instead, one could use their personal computer to digitize voice and the Internet to packetize and transport it, one would not have to pay the telecommunication operators for the privilege of communicating with others. Toll arbitrage was a powerful motivator at the onset; many startup companies were funded to create dense port voice gateways that would convert circuit voice to packets, yet others were funded to demonstrate better ways of multiplexing more voice channels over a transport or a better codec. However, this stage did not last for long. Incumbent telecommunication operators, sensing the threat, countered by lowering voice tariffs on local and long distance calls. This continued to the point where the rates to set up a circuit call were about the same as those for an Internet telephony call. Since the quality of the voice was much better on the circuit switched network than it was on an un-managed and best effort delivery network like the Internet, Internet telephony had to find a better answer than toll arbitrage. Thus Internet telephony entered in its next (and current) shift: emphasis on services.

The rest of this paper is structured as follows. Section 2 details the role services play in the NGN. Section 3 argues that the growth of NGN is being constrained by a set of inhibitors that work against the facilitating forces, which will be discussed in Section 4. Section 5 concludes the paper.

2. Services in the NGN

Once the toll arbitrage argument waned, services assumed importance in the NGN. We define a service as a value added functionality provided by the network operators to the network users. Thus, electronic mail and WWW are Internet services while Call Waiting and Call Forwarding are services provided by the traditional telecommunications network. Early work in services for Internet telephony centered on providing users the same set of services they have been accustomed to on the PSTN [1,2]; however, clearly, the realization was sinking in that there was a far richer set of services which could be harnessed by making the Internet and the traditional telecommunications network work in concert.

This idea – both the networks working together to provide services – quickly gained currency [3,4,5,6] and was generally viewed as an important step towards the NGN. Consider the rich services which are possible through such co-operation: click-to-dial (clicking on a link in a web page would initiate a call between the web user and a customer service representative), third party-call control (enabling a detached application to simultaneously establish a call between two or more endpoints without it being part of the call), providing presence and availability for telephone lines, having the PSTN send discrete Instant Messages (IMs) to its subscribers on missed calls or voice mail alerts, interactive text chat between a computer user using IM and a cell phone user using the Short Message Service (SMS), tracking location of a cell phone user in real time and displaying it on a computer map grid.

Currently, it is certainly technically feasible to author and offer converged services. The technical know how exists as do proof of concept implementations [5,7]. It is possible to perform third-party call control or to impart presence and availability of a telephone device on the wireless and wireline circuit switched network. It is feasible for an SMS to migrate into an IM and be delivered on an Internet host, as it is to participate in a click-to-dial service. It is also possible for the traditional telecommunication network to send out discrete electronic mail messages or IMs to users informing them of interesting events (missed call, voice mail arrival). However, despite the demonstrated feasibility of such services, we have not witnessed a wholesale adoption of them. Outside of the industry participants, the average user of the Internet or the telephone network is blissfully unaware of the potential of such services. Why have these services, which were promised to be ubiquitous, not materialized? We now take a critical look at the reasons that are inhibiting as well as facilitating the potential of the NGN to offer such services in a pervasive manner to its users.

3. Inhibitors to Ubiquitous Services in the NGN

We first characterize the inhibitors to ubiquitous services deployment in the NGN.

3.1. The Unfulfilled Potential of the Softswitch

The softswitch debuted in 1998 and quickly gained mindshare. The concept of a softswitch was very powerful and alluring. In its early incarnation, a softswitch was a programmable entity that insulated switching fabric and acted as a signalling gateway between endpoints that could not communicate directly between themselves [8]. For instance, an SIP endpoint would use a softswitch to setup a session with a H.323 endpoint, or to setup a session with a wireline or wireless telephony endpoint. A softswitch, in this model, would also control a media gateway to set up a bearer path between the endpoints. Besides performing these functions, a softswitch was also viewed as a platform for providing personalized services such as third party call control and personalized execution of service logic applets depending on the time of day or the recipient/originator of the call. It was envisioned that services that would normally take months -- or even years for some services -- to specify and deploy in the traditional telephone network would now be completed in weeks, if not days. Furthermore, since the softswitch was viewed primarily as an Internet entity, the industry could leverage the mass of IT programmers to author services based on standardized APIs in general purpose languages such as Java (more on this later).

However, the promise of the softswitch was not borne out. Softswitches were deployed, but mainly in the core of the network and not at the edges where their potential to act as personalized service execution platform was the greatest. They did render programming of end user service easier by hiding the details of telecommunications service complexity behind general purpose programming languages and object-oriented frameworks; however, this success was overshadowed by other issues which remained unresolved such as scalability, performance, mass deployment strategies for softswitch based services, and interoperability between services developed for one vendor's softswitch executing on another vendor's platform. In our mind, the biggest advantage of the softswitch was its ability to act as a gateway to bridge multiple signaling protocols. However, that advantage was short lived as the industry coalesced around SIP as the protocol of choice for the NGN. Soft-switches still exist in the NGN under the guise of application servers.

3.2. Walled Gardens vs. Open Oases

Internet purists who espouse the end-to-end nature of the Internet tend to view with trepidation the "walled garden" model created by telecommunication service providers. This model is advocated out of necessity imposed by the need for centralized control of network resources, as well as the providers' necessity to remain high on the value chain. Such a network forces signalling (and even media) to traverse a given set of centralized intermediaries. The walled garden concept provides a fertile ground for the "optimization" of the standardized version of a protocol (SIP is a good example). As much as one can appreciate undercurrents leading to such "optimizations" (arguably slow pace of standard bodies, "chattiness" of the protocol, or a less number of states in a call model), such practice can lead to very undesirable results. Such results, typically exhibiting themselves as non-standard solutions and requiring, once again, gateways at the network boundaries, will clearly inhibit NGN growth.

The 3rd Generation Partnership Project (3GPP, or 3G; see http://www.3gpp.org) Internet Multimedia Subsystem (IMS) network is an example of a walled garden model, as is the current wireline and the cellular telecommunications networks. Such service providers have complete control over the access network, and can charge the subscribers for services rendered by the network. The deciding argument for the centralized control is the notion that one charges only for what one controls; security and fraud prevention considerations come near second.

In contrast to this arrangement is the "open oasis" model of the public Internet, where all that is needed to establish a communication session is the recipient's Internet Protocol address, a uniformly understood protocol, and endpoints that implement the protocol. Which view is better? It can be argued that an incumbent NGN operator using the walled garden approach is better suited to offer existing telecommunication services which use the legacy network (since the legacy network is already tuned towards centralized control). Thus, it can provide a seamless move towards an expanded NGN service portfolio to its subscribers by initially offering existing services over a different access network. If a pure Internet operator was to enter into the telecommunications market anew, there is a valid reason to fear that in order to keep the end-to-end nature of the Internet intact, it will reinvent PSTN services such as Call Transfer, Conferencing, and Call Hold at the endpoints (indeed, this fear is not without reason; note the plethora of such services in SIP that have been reinvented to play well with the end-point model).

If the NGN is to succeed, it must become more than simply a replacement for the traditional telecommunications network, and public Internet telephony must move out of recreating existing services and focus on providing innovative services for a converged network.

3.3. Lack of Third-Party Programmability

The industry recognized early on that for NGN services to flourish, third party programmability was a must. It was – and indeed still is – viewed as very critical to leverage the expertise of IT programmers in the telecommunications domain.

Arguably, one reason for the success of web services was standardized technologies such as HyperText Transfer Protocol (HTTP) Common Gateway Interface (CGI), HTTP servelets, and standardized APIs such as active server pages, Java server pages, the Service Object Access Protocol (SOAP). At the onset of the Web, programming meant learning a markup language (HyperText Markup Language, or HTML) and a scripting language – such as tcl or Perl -- to write CGI scripts. This limited the field to a practicing few only. The web programming industry exploded with the advent of Java. The fledgling language found a good partner in WWW. Its interpreted nature enabled Java bytecodes to be down-loaded dynamically and executed in the web browser. The language spawned later derivatives such as Javascript and Java Server Pages to ease the burden on web programming. The latest addition furthering web services is the service-oriented architecture structured around the eXtended Markup Language (XML) to describe and transport discrete services using technologies such as Web Services Description Language (WSDL) and Simple Object Access Protocol (SOAP). It is instructive to note in the advancement of web services that APIs in the form of servelets and service-oriented frameworks came later; the initial stages were characterized by adherents learning fairly complex and protocol centric meta-languages like HTML and CGI.

In contrast to web services, the telecommunication industry believed in APIs and frameworks from the very beginning. The first abstract sets of APIs were defined as part of the Intelligent Network (IN) [9]. IN decoupled call processing from service execution by having a switch defer to a service execution platform on how to handle a call. Building blocks were specified that would allow vendors to write services that would run in conjunction with switches from different manufacturers. With the advent of the WWW, the industry defined a Telecommunication Information Network Architecture (TINA). TINA further specified an open architecture (through a standard set of APIs) that attempted to focus the recent advances in the computer and networking industry on telecommunication services. As was the case with web services, the advent of Java changed the field as the concepts of TINA were used to create new Java-based frame-works like Java API for Integrated Networks (better known by its acronyms, JAIN; see http://java.sun.com/products/jain/api_specs.html) and Parlay (see http://www.parlay.org). These protocol-agnostic APIs attempted to leverage the mass of IT programmers to create telecommunication services regardless of the underlying network.

With the advent and use of SIP in the telecommunications domain, the focus changed from APIs to protocol centric technologies such as SIP CGI, servelets and an XML-based Call Processing Language (CPL). The telecommunications industry attempted to replicate the success of web services by defining similar constructs, including the use of SOAP as a payload in a SIP request. Other standardized protocol-centric solutions such as PINT[7] and SPIRITS [10] appeared as SIP-based service enablers. All of these have been successful in their own rights; however, none has established itself as *the* solution for third-party programmability.

Implicitly associated with the lack of third party programmability is the lack of a *platform* on which such programmability could be built. Had the Softswitch as a general purpose platform succeeded, it would have furthered the cause of ubiquitous NGN services. But the perceived failure of the Softswitch to live up to its promises coupled with a clear standard on third party programmability conspired against the ubiquitous deployment of NGN services.

3.4. Is Developing Web Services Equivalent to Developing Internet Telephony Services?

In the NGN, the initial stages of approaching telecommunication services mirrored those that had proved successful with the web. For instance, building upon the success of HTTP CGI, the industry defined a SIP CGI model; SIP servelets mirrored HTTP servelets; end users were empowered to create their own services through the use of CPL. Softswitch vendors even pushed the web service model aggressively to customers including promising platforms that would download and run services in the form of Java bytecodes. However, it is instructive to note that telecommunications services are not web services.

For one, the Web is a visual and presentation-oriented technology; its users use multi-media machines to access and enjoy the content. A web service normally presents some information to the user for consumption. As the information is generated at the web server, it is pushed to the browser for display. This process repeats for a finite amount of time until the user is satisfied. Telecommunication services, by contrast, do not strictly follow this model of pushing content. Compared to the presentation nature of web services, telecommunication services are currently more *aural* in nature. Every processing switch in the telecommunications network has access to the media stream; this is not true of Internet telephony where media flows end to end. It is indeed possible to route media through intermediaries in Internet telephony, however, doing so is not without its costs in terms of the complexity that arises when an architecture that espouses end-to-end media flow is forcibly shunted to obey the needs of a centralized control model.

Yet another factor why web services are different from their telecommunications counterpart is user expectations. A web user encountering a site that requires the installation of a plug-in does not hesitate to download it. A few more seconds of wait time is well worth the immersive sensory experience that the plug-in may provide. The same cannot be said of telecommunication services. Requiring a user to download and install a plug-in before making a call – an emergency call, for instance-- is unacceptable. While in web services, the thrust is on presentation and sensory expectations, more often than not; the thrust in a telecommunications service is on timing -- how quickly can the call complete, or how quickly real-time data like presence information for a telephone device be disseminated.

A final factor we consider is deployment. The deployment strategies for web services ranges from individually generating and pushing content from web servers (HTTP CGI, servelets, Java server pages, active server pages) to using a centralized repository and scheme to describe the services (the SOAP and Universal Description, Discovery and Integration model). Even in traditional telecommunications, deploying services in a scalable and consistent manner has been a challenging aspect; while the NGN allows services to be created far more quickly, it does not aid in deploying these services to the endpoints expeditiously. In fact, a case can be made that the more powerful NGN endpoints make service deployment that much more difficult since they exacerbate the feature interaction problem and make it harder to deploy a service in a consistent manner when there are many assorted NGN endpoints, each with differing capabilities (portable personal desktop assistants doubling as phones, personal computers and laptops doubling as phones, smart cellular phones, dual-band 3G cellular and IEEE 802.11 capable phones, and finally, legacy phones and 2G/2.5G phones which still need to be supported). In a way, by allowing diverse and smarter endpoints, we increase the entropy in the system. In order to provide profitable services network and application providers have to expend their resources to contain that entropy.

3.5. Security and Privacy

The traditional telecommunications network is deemed secure partly through unintended obfuscation and partly through legal protection. Unarguably, it is much harder to tap into a telephone network and usurp signaling traffic. The communication lines and switches are physically secure from intruders. Attack scenarios hardly scale for circuit-based networks. Direct proximity is almost a requirement for mounting a successful assault on the traditional telecommunications network.

Furthermore, the inner workings of traditional telecommunication protocols while not entirely confidential, have not been subject to as much public scrutiny as Internet protocols have been. Over the years, as the society realized the benefits of a telecommunication network, legal means appeared that afforded protection to the conversing parties and made it a crime to eavesdrop without appropriate judicial authorization.

Comparatively, it is much easier to tap into an Internet network to observe, and even modify, the traffic flowing through it. Most of the traffic on the Internet is not encrypted; all that is required is a network sniffer to capture the packets and extra software to maliciously modify the headers or the payload and insert them back in the network. The situation is dire still with newer technologies like IEEE 802.11 wireless networks. They can be compromised simply by using a wireless transceiver with close proximity (not physical proximity) to the wireless network. Clearly security of the transport medium is paramount for users to feel confident in the network.

Along with security, privacy is another axis where the Internet falls short. On the traditional telecommunications network, the identity of a caller (or caller's terminal, to be exact) can be delivered authoritatively to the called party; the service provider acts as a trusted intermediary to deliver identification information. The same cannot be said of the Internet; notice the unprecedented level of spam that purportedly arriving from one's well known contacts and colleagues. Privacy is that much more important when location-based services are added to the mix; potential for harmful consequences exists if the location of a cellular user falls into unscrupulous hands. At best, it may violate the privacy of the cellular user; at worst, revealing the location may prove physically detrimental. Who is to blame if revealing a location escalates into fraud, economical and, quite possible, violent crime: the network provider who provided location information without consent of the cellular user? The cellular user for not setting up appropriate filters and access control lists?

Privacy in the NGN encompasses not only authentication of the peer party, but also fine-grained control over individual events that can lead to NGN services [10]. Who should get the presence data related to a phone device? How does the system ensure that only that person receives the data and no one else?

Answers to these questions will, in part, determine how quickly ordinary users accept the NGN and its services.

3.6. Billing and Government Regulation

Finally, we mention two other inhibitors: billing and government regulation. Billing has proved elusive thus far; one reason for this may be the lack of a business and charging model. NGN operators do not yet know what the user will actually pay for. The traditional telecommunication network has a well-developed billing structure that should adapt itself in a manner that makes sense for NGN services. This should include strategies on billing for discrete services such as IM and access to presence and location events. The most basic billable entity in the today is making a call. In the NGN, making a call may be a by-product of good presence indication (i.e. if my party is present and available, only then will I make a call). Does that mean that presence will translate into premium billing? If a service provider supplies location information of a user to a vendor, who pays the service provider? the vendor? the user? The user simply may have acquiesced to allowing vendors access to their location information; she may not be willing to pay the service provider for each vendor who actually received her location. Likewise, if the vendors did not make a sale, would they be willing to reimburse the service provider?

A final inhibitor is government regulation. Thus far, and rightly so, in the US, the Federal Communication Commission (FCC) has decided not to intervene by regulating VoIP as traditional telephony and requiring such features as Universal Access, Emergency Services and Lawful Intercept. At this early point in the trajectory of the NGN, government regulation may seem conducive to the NGN development. However, by creating uneven playing field for incumbents and newcomers, the FCC arguably creates market hesitation.

The FCC decision has been challenged by incumbent telephone service providers, but so far, FCC has not changed its view, and in fact, the courts have upheld the view that VoIP should be beyond regulation. The only certain outcome is that the incumbent service providers will continue to contest the FCC view. Ongoing battles around this issue will act as an uncertainty and a depressor for NGN, at least in the interim it takes to sort the matter out.

4. Facilitating Forces for Ubiquitous Services in the NGN

Having studied the inhibitors, we now focus on the facilitating forces for the NGN. Some of these facilitating forces counter the inhibitors, while others are yet in their nascent stage of providing the needed influence.

4.1. Adoption by the Enterprise

Enterprises have been the most eager adopters of the NGN. We outline two primary reasons for this. First, enterprises have been uniquely suited to being early adopters since they already possessed the key ingredient: a working packet switched network in the form of a local Intranet. These enterprises own or lease their IP-based data networks and thus control network admission policies, available bandwidth, quality of service, routing and security, all issues that act as inhibitors when the NGN is deployed in a wider setting. In addition, the majority of enterprises do not require any extensive billing system to deploy NGN services.

Second, enterprises have aggressively embraced emerging technologies like presence and IM, and in fact, merged them with traditional telephony. Presence has long been viewed as a component in routing telephone calls [14,15] and the telephone status has been used to deduce the presence state of a user [12,16] and provide other services like IM. In many cases, enterprises have coupled their Private Branch Exchanges (PBX) and voice gateways to an Internet-based common platform with reusable components to provide quick, easy and localized service deployment.

For enterprises, the value proposition of Internet telephony has been easy: the packetized voice network was simply layered on top of the local Intranet to result in substantial cost savings. Integration of voice and data networks, as well as simplified network and element management from a single management platform leads to the OPEX savings. Deployment experience has, however, suggested that aggressive voice packets tend to starve other enterprise applications that are using the Intranet simultaneously. Nonetheless, we view the adoption of the NGN by the enterprises as a very important facilitator.

4.2. The Advent of 3G

The next step is to scale the use of NGN from enterprises to nation wide (and even world-wide) service providers. 3G as the designated successor to the cellular network is a step in that direction.

The worldwide cellular network has expanded with unprecedented growth. In the US alone, there were 92,000 US cellular subscribers in 1984 as compared to approximately 140 million US subscribers on December 31, 2002. The rise of the cellular network as epitomized by 3G is an important facilitator. 3G is a collaboration agreement between telecommunication standards bodies and adhered to by telecommunication service providers and equipment manufacturers. 3G blends the cellular network with the Internet and traditional telecommunications like never before. It promises greater transport capacity for voice and data and worldwide compatibility. On the wireline side, the traditional telephony vendors witnessing the rush to VoIP and 3G have responded in kind. If the new wireless network is constructed to be packet to the core, then the wireline network must follow suit. The traditional telephony vendors already own the infrastructure (under-sea cables, T1/E1 and optical circuits, etc.) on which the Internet runs; spurred by the optimistic projections of 3G and witnessing a stagnation of their core switching business, they are looking at the NGN to generate the needed revenues in form of new services.

Early 3G deployments are already in progress. 3G and the resulting upheaval may yet prove beneficial to the NGN in the long run.

4.3. SIP: The Preferred Protocol

At the onset of the NGN, many signalling protocols dominated; SIP, H.323 and BICC were the primary contenders. Among these three, SIP has endured. The choice of SIP as the protocol is a facilitating factor. Currently, all switching entities – traditional circuit switches and the new 3G IMS – support SIP in some form. Traditional circuit switches use SIP-T [13] as an inter-switch communication protocol, media gateways use SIP and inter-work it with the telecommunications network, and 3G not only uses SIP but has also extended it in several ways to make the protocol more amenable to a centralized control model.

While interoperability is a concern, the fact that the industry has coalesced around one protocol is a big advantage. Regardless of whether services in the NGN are provided in the core or at the endpoints, they will use SIP. Traditional telecommunications networks used a distinct protocol for signalling (SS7), service fulfilment (INAP or TCAP), and end point control (tip-and-ring, or a PBX-based protocol). When compared to the traditional telecommunications network, the use of one protocol is a definite advantage.

4.4. IEEE 802.11 (WiFi) and 802.16 (WiMAX): Friends or Foes?

While some may consider WiFi, WiMAX and emerging IEEE 802.20 technologies as competitors to the NGN, we actually view these as enhancers to the NGN. Even though these technologies will be disruptive to the nascent NGN, in the long term they will provide needed flexibility of the access network by serving as additional radio access networks (RAN) to extend the reach of the NGN. Current trends already point to synergies between WiFi and 3G; equipment providers already have dual-mode handsets that can use the Internet to transport a voice conversation when they detect the presence of a WiFi hotspot, and revert back to using 3G when they are out of the radius of a hotspot.

Beyond the use of 802.11 and related technologies as a RAN for transporting voice packets, other non-voice services will play an important role. There has already been work at integrating the 3G core infrastructure with 802.11 such that a 3G user roaming into a hotspot can leverage the existing trust relationship between the 802.11 operator and the 3G operator to access AAA servers of the 3G carrier [11]. Thus, the user profile and policies stored in a 3G carrier's network are available to a hotspot operator for providing advanced services.

4.5. Rapid Introduction of New Services

"Faster time to market" was a mantra of NGN proponents since the mid 1990's. Switching to all-IP network does not, however, render faster service development and introduction cycles. The advent of such service development enablers as SIP in the protocol space and PARLAY in the API/framework space has truly made it possible to achieve that. While creating services themselves becomes easy, it is instructive to note that these development tools do not address marketing and provisioning aspects, which generally take significant time.

For the new services to rapidly produce revenues, the NGN must, at the very least, address the following factors: end-user acceptance business system readiness and last, but not the least, inter-working between carriers

4.6. Synergies in Inter-related Services

Unlike the traditional telecommunication network that was tuned towards voice, services in the NGN will go beyond only voice. Location-based services, presence-based routing, context-aware routing, user-specified routing policies, plurality of communication devices (computer, personal digital assistance, cellular phone); all of these will engender new services, some of which we have already witnessed [12,14] and others that we cannot currently fathom.

It is instructive to look at how the utility of the Internet became that much more indispensable as synergies in the services it provided increased. In the beginning stages of the Internet, electronic mail, file transfers and remote shells were key services that the new technology provided. When the Web was added to this mix, the utility of the Internet grew tremendously with the synergies the new entrant (Web) provided to existing services. Note how the Web has changed electronic mail. Using the ubiquitous browser and a mail account established with a portal (Yahoo!, AOL, etc.), one can check his or her email from anywhere in the world; instantly becoming accessible. Such was not the case before the advent of the Web. As an added example, sharing files and information is a simple act of clicking the links on a browser. The capability to share files and information was already there in the Internet (remember tools like gopher, archie, and veronica?); the new ingredient was how easy the Web made this information available. Searching is now a multi-billion euro business!

In a similar vein, we expect that the synergies established by NGN services will drive its acceptance. Two users who wish to communicate with each other are no longer relegated to playing phone tag; the presence service can indicate to each of them when the other is accessible and the availability service can allow them to arrive at a set of suitable communication means (text chat, phone call, SMS, MMS). In the end, the search for one killer application is probably doomed since in reality many applications working synergistically will enhance the overall user experience on the NGN.

5. Conclusions

The emerging NGN is taking its shape under the pressure of various facilitating and inhibiting forces. As we described in this paper, many of these forces are intertwined and highly dependent on each other. We have attempted to analyze each force and, wherever appropriate, outlined the inter-related nuances.

Clearly, for the NGN to succeed the affect of inhibitors must be minimized and that of the facilitators must be encouraged. Certain inhibitors like security and privacy require a technical component (e.g. public-key infrastructure), a legal framework, and a cultural acceptance (having details of ones movements and call patterns being made available to others). Technology can only help with the first one; legal and social changes are required to overcome the other two. A common platform, including the APIs, over which services can be developed, will be another way to minimize the affects of some inhibitors we discussed. The 3G IMS could serve as such a platform.

The 3G IMS provides a great framework and “ideology” for the NGN to become a success story. However, based on our experience, these highly “ideological” frameworks can win only when rigidly adhered to, which might be a very expensive proposition to many service providers. Undoubtedly, some of them will select to forge their own way to success. Only future will show us which way will work.

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