Migration towards NGN: Common Applied Strategies

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***Abstract*—Telecommunication service providers (SP) around the world are still in the process of migrating away from legacy networks towards next generation networks (NGN). The strategies for this have been and are different depending on the size of the market, historical background or financial resources of the SP just to name a few. This paper addresses these strategies mainly from a non-technical point of view aiming at seeking commonalities amongst different SPs. The migration processes of two smaller European countries have been looked at more closely to complement the dominant research done towards similar processes in larger countries to see if there are equally compatible strategies for different SPs irrespective of their background and properties. The work concludes that above all the size of the operator is a key factor in the transition to NGN.**

***Index Terms*—IMS, migration strategies, next generation networks, PSTN.**

I. Introduction

Telecommunication operators have been making great strides in recent years to migrate their legacy networks, users and services towards next generation networks (NGN) [1]. Although the concept of NGN and the need for its adoption is well known, discussions on different strategies for migration are still pertinent. Due to the complicated nature of this issue the number of approaches nearly equals the number of operators, at least from a technical point of view. However, there are aspects and keywords most agree upon - for example the use of IP Multimedia Subsystem (IMS) [2] as the basis for future multimedia services.

The primary aim of this paper is to identify the common steps that different telecommunication service providers (SP) have taken migrating their business towards NGN. Previously published papers have been taken as the basis for the research and also two operators have been studied in more detail. The SPs, Elion Enterprises Ltd (EE) and TeliaSonera Sweden (TSS), are both part of TeliaSonera group but are based in different countries (EE in Estonia, TSS in Sweden) and also differ substantially in size, albeit they operate in small countries compared to central European countries for example. The choice of TeliaSonera also comes from it being the biggest telecom operator in North-Europe (Scandinavian countries and the Baltic region), a region comprising mainly of small to medium size countries. The size of the country is important in the sense that it often determines the size of the operator. Even with international operators, its size mostly depends on the size of the native country. The secondary aim of this paper is to clarify which migration strategies have proven successful and does the size of the operator play any role in this part. So far the published material on this matter has many gaps and usually only considers countries and more specifically operators with a very large customer base, like British Telecom for instance.

The structure of this paper is as follows: Section II expands upon the main considerations when migrating from legacy networks to NGN. The concept of migration to next generation networks is discussed briefly and the section continues to open up the main technical and non-technical aspects of migration. Concrete actions taken by chosen SPs are studied in Section III. The topic is concluded in the final section of the paper.

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II. Different Aspects for Migration

Migration to NGN became a hot topic among major service providers worldwide around 2005 [3] when the drive from the market for new and innovative services became extremely apparent. The fast developing telecommunications sector empowered the client to ask more from the SPs in terms of services and therefore protection against customer churn required a transition to a new paradigm, namely NGN. With a new direction in the way services were offered a need for new access technologies arose and having said that, keeping up with the times became a must. Aging equipment was, and still is, an issue for many SPs, so migrating to NGN facilitated the long overdue replacement of legacy technology as well.

In the broadest sense of the phrase, when talking about migration to NGN, a move away from public switched telephone network (PSTN) is meant. It is also often not specified whether the legacy network in question is a fixed or a mobile network or will the services be migrated as well in conjunction with the users. There are a few possibilities regarding the choice of platforms to which the migration is planned as well, IMS or a softswitch solution [4] for example. The main emphasis in the current paper, not excluding others completely, is on migration from legacy fixed networks to IMS mainly from a non-technical point of view.

Before definite steps were to be taken by the SPs, a myriad of issues had to be considered, starting from the question of exactly what needs to be migrated to NGN and to what extent. On a high level those questions could be divided into two main categories: technical and non-technical.

A. Non-Technical Issues

The most important issues for any SP wanting to migrate away from legacy networks encompass choosing the right strategy, starting from the motivation [5] and ending up with a specific model of execution [3], and the financial aspects.

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1) Migration cost

It is safe to say that PSTN has paid off for nearly all the incumbent operators. So the question arises whether it is financially viable to keep offering services to customers using the already existing networks with the only cost being the operating cost (OPEX) or to make a substantial one-time capital expenditure (CAPEX) towards NGN and essentially transform the company's model of operation. An important issue here is also the time at which to make the investment if this path is chosen because at some point it will be more expensive to provide services on legacy networks compared to IMS for example. According to [5] the savings generated over the period of 5 years from power consumption, personnel and equipment maintenance is 24%. This data is of course specific to a certain SP but it gives an idea of the magnitude of OPEX that can be saved. Similar research [6] concluded that the start time plays a significant role: the possibilities of not losing money during the migration process increased with the earlier start of the process.

The issue of migration cost is in a sense an inevitable problem to tackle simply because it is a matter of survival. An operator not willing to consider NGN will undoubtedly eventually wither.

Another consideration is the extent of migration with regards to cost. An SP should assess if it is a financial necessity to eliminate the legacy networks at once or to use an overlay approach and migrate step by step. It may also be feasible to keep offering some services using the existing network – this is the case when the migration of a service is more expensive than offering it as is.

2) Migration strategies

When it comes to migrating away from PSTN there are a few general approaches that have been accepted among service providers: firstly complete PSTN replacement, secondly an overlay solution with PSTN and an NGN operating simultaneously, fading the PSTN out slowly while keeping it in operation for services close to their end of life and thirdly a softswitch solution. Many service providers have also chosen to develop their broadband (BB) networks in correlation with migration from PSTN to NGN. This seems logical as there is a definite need for a broadband connection towards the customer to provide modern multimedia services. Complete PSTN replacement is suitable for service providers that are either operating on a small scale or have very little historical background with PSTN. In the case of the SP operating on a small scale, the main issue is the cost. The CAPEX for migration is simply a lot smaller than it is with big SPs. Also the youth of such a service provider is a benefit in this case due to the lack of a large number of services, users and support systems. Looking at the telecommunications market realistically, SPs that have not engaged themselves deeply with PSTN networks are usually very young and therefore at least theoretically capable of complete PSTN replacement.

The most common approach to migration towards NGN seems to be the overlay solution. Keeping PSTN alive in parallel while going forward and developing an NGN is reasonable for many reasons. First of all, as mentioned before, the CAPEX for immediate PSTN replacement is enormous and this is the case even with a step-by-step migration where the initial resources needed for the core of the NGN are still considerable. The biggest obstacle is however the size of the service provider. One cannot imagine a fast transition from PSTN to IMS in a short timeframe [3]. Legacy network in such cases will eventually be closed, but this may take several years if not decades. Looking at [7], the sheer size of the geographical location, the multitude of technologies in use and the market itself forces the SPs to pass through many smaller steps before reaching the desired end goal of a migration to IMS.

With the overlay solution there is also a question of the amount of PSTN services that should be migrated. It might not be reasonable to start migrating a service if the process for it is too complex or expensive. In this case creating a similar, if not an enhanced service on the new platform should be considered. Fig. 1 illustrates a high level overview of an overlay solution with the breakout gateway control function (BGCF) used as the node to connect the packet switched (PS) and circuit switched (CS) domains.

A softswitch solution is often not considered a carrier grade solution with limitations in redundancy and scalability. However, since the CAPEX for such solutions is more to the liking of smaller SPs it will appeal to starting or fairly young companies.

B. Technical Issues

After an operator has made the decision or perhaps is forced to migrate form legacy networks to NGN the technical process can begin. The actions taken are based on the choice of the migration strategy and can therefore be quite straightforward, in the case of a complete PSTN replacement, or much more complicated when moving to an overlay solution.

With an overlay solution a PSTN emulation subsystem (PES) is needed to support a wide range of PSTN services on NGN.

For IMS, interactions between the access gateway control function (AGCF, similar to BGCF in Fig. 1) and PES application server (AS) was first published in May 2006 in the telecommunications and internet converged services and protocols for advanced networks (TISPAN) standard TS 183 043 [8]. A similar setup for IMS is well described in [3].

The biggest technical issue with any migration strategy is however not the core of the NGN but rather how to incorporate the old into the new, meaning business support systems/operations support systems (BSS/OSS). An issue that has been expanded on in [9], where not only the OSS was found to be a problem but also the fact that the development of technology imposes a similar need for the personnel. A complicating factor here is the nature of IMS in its attribute to merge the classical telecommunications domain with Internet technologies hence requiring hybrid competence from the workforce.

With BSS/OSS the problem lies in the tailor made nature of such systems. If the interfaces between core IMS nodes are standardized and well documented then with BSS/OSS this is usually not the case. The fact that an operator has many support systems is nothing out of the ordinary, but often times than not these systems duplicate each other. For example bigger operators, doing business both in mobile and fixed

networks may have a billing or provisioning system for both of them. The stovepipe nature of services running on legacy network has led to this situation and creating a single BSS/OSS system, or even reducing their number, is difficult, time consuming and costly.

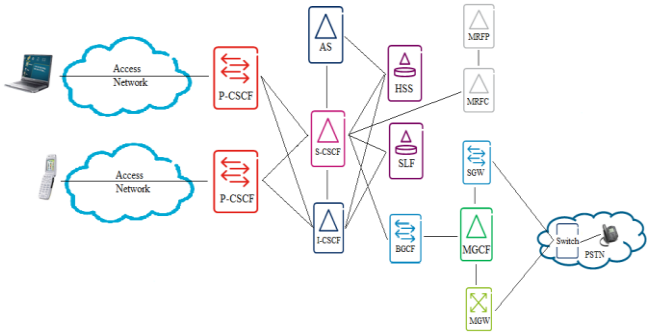

Fig. 1. High level view of an overlay solution [2], adopted by the author

III. Applied Strategies

A. Elion Enterprises Ltd

According to [10], the basis for the following section,

90% of the operators' profit came from the PSTN in 2001. In 2011 the same number had dropped down to 20% of the total profit. The fading business from PSTN, clearly visible after the turn of the millennium, forced EE towards broadband. It was very unclear how or to what extent broadband would develop but the key matter was the recognition of BB as the way to the future. It was not until 2005 before concrete steps were taken towards migration to NGN. The direction taken was IP Multimedia Subsystem.

The decision was naturally preceded by quite a substantial period of time spent on analyzing the telecommunications market and the different technologies for PSTN migration. It was clear from the beginning that there were two considerable ways to move forward: a softswitch solution or the IMS. The softswitch solution, however, was not considered suitable for large operators looking for a carrier grade solution. At that time Elion had 300 000 clients that needed to be moved to NGN.

In addition to the end of the lifespan of the PSTN network in operation a more alarming problem had arisen – support for the PSTN network was ending or had already ended to some extent. One of the two major switching nodes in the network was also working under constant overload condition. Still, it was clear that PSTN was not going to fade away quickly. Estimation at that time for complete PSTN migration was the year 2020 whereby it was thought clients would migrate before the operator had to face problems with major equipment deterioration.

A partner for procuring and setting up the IMS core was found in Ericsson - a strong brand with high technical capability. By 2006 the IMS core network was up and running. All that was missing were services to attract users away from legacy networks. With the now rapid growth of broadband and the fact that Elion was the market leader with 60% in offering private branch exchange (PBX) services for business clients, a similar service was worked out using session initiation protocol (SIP) trunks.

After SIP trunking was operational BroadSoft Inc. was chosen as a partner for providing services to business clients in the form of hosted PBX. Cloud services were seen as the way forward, especially when considering convergence with the cellular world.

1) Current developments and future outlook

Today, 175 000 business and private customers have migrated to IMS which is seen as the fastest and simplest platform for generating revenue in the area of voice over internet protocol (VoIP) communication. Some services are created in-house and applications created by BroadSoft and Ericsson are used.

By the end of 2012, 40% of business clients and 30% of private clients have been migrated to IMS and by the end of 2015 an estimated 70-80% of voice customers have been migrated. Today there is no forceful tactics to migrate users from the legacy networks through a service pack change although it is highly recommended and suggested by the operator. The only time when customers are facing a certain upgrade form legacy networks to NGN is when old equipment is being decommissioned. In other times the decision is up to the customer. All new voice customers are naturally automatically provisioned in IMS. A major contributor here is internet protocol television (IPTV), which is seen as a good aspect for selling voice affiliations since IPTV is part of triple play alongside a telephone connection.

It is also planned that in 2015 there will be more direct campaigns towards users to migrate them from the legacy networks and to close PSTN by 2017. The reason for the expedited schedule is the already mentioned lack of support for old technologies.

2) Obstructions in the migration process

The biggest obstacles came from inside the operator. It took a long time to arrive at the understanding that cloud based services such as hosted PBX was the only viable future strategy. The break in this matter came in 2008 when the SP came around to the fact that selling integrated services digital network (ISDN) connections to customers will not provide future revenue and client loyalty.

Another issue to tackle was IP network monitoring and management. The keyword here was and still is quality of service (QoS). It was speculated, based on the early trials with VoIP, that problems would arise with IP network quality and the only way of mitigating them was to put in place an extensive monitoring system. There are some QoS issues today but these are mostly caused by the clients own IP infrastructure. Currently, the monitoring is working as a proactive system with the goal of identifying problems before they appear to the customer.

Since the signaling protocol for IMS is SIP, there was a need to monitor it for better management and troubleshooting. The same can be said for signaling system no. 7 (SS7) since IMS and PSTN were to be working as an overlay solution for a period of time.

The provisioning of services along with customer premises equipment (CPE) had to be made automatic. It was a clear demand from the operator that the client did not have to make any complicated operations when migrating to NGN. All that he or she had to do was plug in the CPE and start using the

service.

B. TeliaSonera Sweden

Based on [11], similarly with Elion Enterprises Ltd in Estonia, TeliaSonera Sweden started putting a lot of effort into NGN in 2005. The biggest pressure for the move coming from the fast expanding and developing technology of IP networks. The age of the PSTN network and specifically some of its components was also considered a problem, given the fact that at the time nearly 900 000 customers were still connected to Ericsson automatic cross-connection equipment (AXE) telephone exchanges.

Due to the aforementioned reasons a strong enough business case was created to get the migration process towards IMS underway. Although alternatives in the form of a softswitch solution were considered, financial calculations indicated the advantage of IMS compared to replacing nodes of the PSTN network.

The contract for the procurement of the IMS core was done in the spring of 2007 and the actual setup of the nodes began in the second half of the same year. Integration work took place in 2008. The provider for the IMS core, surprisingly Nokia Siemens Networks and not Ericsson, cleared up after a procurement process.

1) Current situation

The migration process is still ongoing. Currently there are approximately 500 000 users in IMS and roughly 1, 9 million still in legacy networks. Despite the initial predictions of migration lasting only a few years, it is now said that the Swedish PSTN network will remain for at least another decade. Although the plan initially included a fast migration of services and users, which seems logical considering the timeframe, this has not come to be. Before the project started, the biggest problems were seen to arise from IT integration and processes. More specifically it was the multitude of different systems and processes that now had to be combined to work together – an unfortunate yet inevitable legacy of an operator with a long history. This issue has been a pervading one throughout the history of migration to IMS in TSS.

The first clients were provisioned to IMS in 2009. Today, migration is purely voluntary progressing at a rate of roughly 100 000 users per year. Virtually the only service offered using IMS is plain old telephone service (POTS) replacement and all new customers are automatically offered this service from IMS. Therefore a way of coaxing users away from PSTN was needed to speed up migration. Today this lure is triple play. Since the majority of the clients in IMS are residential, with only a marginal amount of business clients, this seems a solid strategy.

2) Future outlook

PSTN migration will be an ongoing process for years to come with many obstacles to overcome of which the biggest at this point is the matter of TSS broadband. Namely, services on IMS can today only be offered to users that are connected to TSS broadband. Currently TSS fixed broadband market share is close to 40%, narrowing the field of potential NGN customers significantly.

Migration from legacy networks so far has mainly been the responsibility of the TSS broadband section. However, future plans include a tighter cooperation with the TSS mobility section in terms of fixed-mobile convergence (FMC) and voice over long-term evolution (VoLTE). There are many issues to solve here but the biggest hurdles are seen in the area of BSS/OSS and more specifically ways to integrate mobility into the already established systems used by the broadband section.

IV. Conclusion

Despite the fact that EE and TSS are both part of the same concern, they have taken independent paths towards NGN. Both saw the need for NGN before 2005 and since then have made strides to migrate legacy networks at the maximum pace possible. Looking at the services and clients it is clear that EE has managed the move to IMS more efficiently. A simple testament to this is the multitude of services ranging from basic VoIP to IPTV integration whereas TSS currently uses IMS virtually only as a POTS replacement. There is a major difference in served client groups as well. Although TSS has nearly 500 000 customers, compared to the 175 000 in EE, these are nearly all residential VoIP clients. The 175 000 at EE is divided between residential (75 000), business (75 000) and other (international, mobile and PBX) clients.

Looking at the data studied and the examples presented for this paper it becomes clear that there is no single path to follow during migration which is suitable for every operator. Still, despite the size or geographical location of the operator there are common strategies that have been applied: complete PSTN replacement, a relatively quick PSTN fadeout or an overlay solution combining legacy networks with NGN during which replacing old equipment and infrastructure over a longer period of time. Comparing experiences of operators differing in size shows us that migration strategies and the success of these strategies is not so much dependent on the strategy itself as the size of the market and legacy of the operator. Legacy in the sense that the more history a service provider has the more equipment there is and the more technologies are in use, making a move towards a new paradigm more difficult. Migration to NGN will be an ongoing process for at least another decade and the simple truth is, the smaller the operator the faster it is to implement any of the mentioned approaches.

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