

# PSTN INDUSTRY ANALYSIS AND SERVICE PROVIDER STRATEGIES: SYNOPSIS

BELL LABS ANALYSIS FOR BT APRIL, 2013

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# **TABLE OF CONTENTS**

1	INTRODUCTION	. 1
2	OPTIONS FOR PSTN SERVICE MIGRATION	. 2
3	REGULATORY AND GOVERNMENT ACTIONS AND ACTIVITIES	. 3
4	SERVICE PROVIDER AND MARKET ACTIVITIES	. 8
5	TECHNIQUES FOR SUSTAINING PSTN	.12
6	PROPRIETARY CASE STUDIES	.13
7	BELL LABS OBSERVATIONS	.18
8	IN CLOSING	.19
9	LEGAL NOTICE	.19
10	REFERENCES	.19
11	GLOSSARY OF ACRONYMS	.21

# **TABLE OF FIGURES**

Figure 1:	ATIS PSTN Transition Focus Group - Sub-Team Focus Areas	5
Figure 2:	Examples of Municipally Sponsored Broadband Access Projects - Europe 8	3
Figure 3:	Voice Spending in the Largest Telecom Markets, 200910	)



# **1 INTRODUCTION**

#### **BACKGROUND: BELL LABS ANALYSIS**

The following document contains a synopsis of the results of a study conducted by Bell Labs investigating the motivations that are influencing telecommunications service providers (SPs) to sustain or to move away from their legacy PSTN networks and services. In most regions the PSTN is still a viable service, both in terms of market conditions and in terms of technical environment. Competition and market conditions are changing, however, and the legacy switching technologies have reached the point where end-of-life planning scenarios are needed. These changes are driving the migration of services to VoIP, mobile, cable and other next generation network (NGN) technology platforms. The multiplicity of possible NGN architectures and solutions drives differences in approach and strategy; the results presented here reflect the findings of the analysis, which surveyed the strategies of different SPs worldwide who are facing or have faced this challenge.

#### **OVERVIEW OF FINDINGS**

The study identified several trends common to all the surveyed SPs evaluated, taken in response to either market trends, government actions or to internal pressure within the SPs themselves as best practices. All SPs are investing to maintain the performance quality of their legacy network through End-of-Life (EoL), even if this reduces the earnings margins. Key findings and common activities across the SPs include:

- When considering wireline voice services only, the business case for large SPs may not justify retiring PSTN assets and moving subscribers to next generation networks; revenues from triple-play or broadband access must be considered in order to justify the case to move a subscriber. This financial balance will change in the future as PSTN platforms approach EoL and operational expenses per subscriber line increase.
- For small SPs whose footprint in the telecom market is dominated by data and wireless services, the business case may already indicate that turndown of PSTN would be beneficial.
- Migration to next generation broadband voice is seen as an inevitable end state, due to PSTN technologies reaching eventual EoL. In addition, PSTN subscription rates for most SPs are in decline as subscribers move their service to voice over broadband or mobile solutions. However, PSTN shutdown is not expected to happen in most regions until approximately 2020 or beyond.
- Most governments and regulatory agencies have addressed the life cycle of the legacy PSTN primarily from a service perspective. As long as service continues to be delivered to the end subscriber at the required levels of performance, few architectural or network requirements have been imposed. Additionally, they are working to understand the impact of emerging technologies such as mobile, VoIP and broadband access in meeting the social and economic needs of the served areas.
- Service providers all have an overlay next generation voice platform, but an industrywide standard solution for next generation voice does not exist as of yet. Current

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migration rates to the next generation broadband voice platforms are generally dominated by external (market and government) forces.

• Proactive planning requires the collaboration of SPs with their customers, their vendors and the appropriate government and standards bodies. This collaboration is needed to ensure that all PSTN features planned for migration are appropriately addressed in the next generation platforms.

#### APPROACH

This document provides research and analysis in two areas: publicly available information and proprietary information held privately by Bell Laboratories and Alcatel-Lucent. Information from these proprietary sources has been, and will be, kept anonymous and confidential. Section 3 provides an overview of the regulatory actions around the world, while Section 4 presents an overview of the actions that SPs are taking in response to the PSTN end-of-life issues. Section 5 provides an overview of the strategies used by SPs to sustain their networks. Section 6 provides six case studies from different regions.

## **2 OPTIONS FOR PSTN SERVICE MIGRATION**

There are several different options for moving customers and services from the PSTN network to an NGN network, with advantages and disadvantages. Commercial migration to VoIP, for example, may trigger substantial churn and comes with lower ARPU. Technical migration (more or less transparent to customer) requires considerable investment. Niche technical migrations are applied under special circumstances. Regional differences in PSTN utilization as well as fibre rollout plans and competition activities are the key drivers to decide which migration solutions are most suitable for the SP on a region-by-region basis. The following potential PSTN migration scenarios are the most often considered:

#### **Commercial Migration (VoIP on IMS)**

In this scenario, the customer is encouraged to discontinue PSTN service and migrate access and directory number to a voice over broadband solution. The concerns surrounding this scenario are:

- Unknown impact to services, quality, availability and in-house situation.
- Customer needs to install CPE in order to use VoIP.
- In regions with strong competition, having a commercial migration is to be considered primarily in FTTH locations.
- Commercial migration to VoIP may trigger substantial churn and comes with lower ARPU; generally this solution is under consideration only when the resulting additional churn is projected to remain below critical level (~20%).
- Forced migration is considered as a last resort option because of the risk of losing customers to other commercial substitutions.



#### **Technical Migration**

In this scenario, the SP replaces the PSTN equipment at the CO with an alternative solution that is (mostly) transparent to the subscriber. The two main technical migration alternatives are POTS line card in MSAN and ISDN-over-IP. The main points of this scenario are:

- Technical migration requires a considerable investment for a potentially interim solution.
- POTS line card in MSAN
  - No changes to services, quality, availability or in-house situation.
  - Compliant to telecom regulation for Universal Service Obligation.
- ISDN-over-IP
  - Look-a-like ISDN service, quality, and availability.
  - Enables reuse of in-house ISDN installation.
  - Builds upon other business voice applications.

#### **Niche Technical Migration**

In this scenario, PSTN POTS services are replaced by POTS via mobile. This scenario is considered for remote areas where only few PSTN subscribers remain and the PSTN CO can be decommissioned. The subscriber line is served by the mobile network using Voice Call Continuity (VCC). Two variations exist:

- Subscriber is given a new handset which is, in effect, a mobile handset built for home use (e.g., AC powered)
- A mobile gateway or Fixed Wireless Terminal (FWT) is deployed at the home with an RJ-11 interface that then interfaces to the mobile network

The main points surrounding this scenario are:

- Look-a-like POTS service, availability and in-house situation.
- Differences in voice quality between mobile and landline.
- Compliant to telecom regulation for Universal Service Obligation (also in other European countries).
- Re-use of same solution planned for Fixed/Mobile business market.

# **3 REGULATORY AND GOVERNMENT ACTIONS AND ACTIVITIES**

#### **OVERVIEW**

Most regulatory agencies have addressed the life cycle of the legacy PSTN primarily from a service perspective. As long as service is delivered to the end subscriber at the required levels of performance, there are no architectural or network requirements. Hence, most regulatory agencies' definition of PSTN service can be met by a wide range of solutions. For instance, copper pair terminating on a POTS emulation card on an MSAN, as long as the underlying VoIP infrastructure can support the required features (e.g., CALEA, emergency services) at the appropriate level of quality (e.g., availability). Instead, regulators have been more focused on fostering competition, for example by mandating physical unbundling of local loop, and by developing the requirements for next generation broadband platforms. In other words, regulating new technologies has taken on a higher priority than deregulating or changing regulations for legacy ones. Specifically as the importance of the legacy PSTN declines, ensuring



that other growing technologies such as mobile, VoIP and broadband access meet the social and economic needs of the served areas.

Until now, regulatory body activities more focused on the legacy TDM assets' end of life have been concentrated in North America. Most of this work is ongoing with a targeted completion of late 2012. This sections discusses current regulatory action around the world; activities in Europe are not included as it is assumed the reader already has extensive knowledge regarding these regions.

#### **REGULATORY BODY ACTIONS AND ACTIVITIES IN THE UNITED STATES**

#### Background

The regulatory bodies in the United States have been visibly active in investigating the implications of shutting down the PSTN. This activity has been driven in part by AT&T's request to the FCC to create a timetable allowing them to shut down, or "sunset" their PSTN. AT&T said that doing so is the only way to meet Congress' goal of covering all Americans with broadband services, as the sunset of the PSTN would result in more investment flowing to its IP-based initiatives.

AT&T argues that having to maintain and invest in two networks – packet-based broadband and circuit-based PSTN – means Congress' universal broadband coverage goal will not be met efficiently or in a timely manner. The company said that while 90 percent of Americans have access to broadband services, reaching the remaining 10 percent would require an investment of about \$350 billion (ref [8]).

#### What is the PSTN Sunset?

A target date of end of 2018 has been stated for the PSTN sunset in the US; however, it remains unclear how the PSTN is defined within this context or what is meant by a sunset. FCC documentation (ref [11]) defines sun-setting the PSTN as:

- The orderly transition from the PSTN's role as a "system of record" for achieving key national goals; and
- The identification of and migration to alternative mechanisms of achieving the subset of those goals that remain important to our society and economy.

There is not one specific date when the PSTN network will cease to exist and/or will be replaced by another entity. Rather, the legacy network will continue to atrophy and other networks will grow in importance until a tipping point in time is reached when:

- The PSTN is no longer needed for the national economy to grow.
- It is no longer an essential element of national communications.
- Most of the population will have a variety of telecommunications options at their disposal, the PSTN being only one of them, in addition to mobile telephony, e-mail, VoIP, social networking, etc. By the end of 2011, the percentage of US residents who had already replaced their wireline phone with a mobile line (i.e. "cutting the cord") was ~30%. Mobile only households are higher in younger demographic groups as well, comprising 37% in the 18-24 and 30-34 age groups.
- A drastic increase in the per subscriber operational costs as the density of the PSTN decreases. PSTN access lines are decreasing by approximately 5-7% annually. At the end of 2018, the PSTN is projected to serve only 6% of the US population ([8]).

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The combination of the above events is expected to form a compelling case for removal of the remaining policies and government regulations from the PSTN (ref [8]).

#### **Regulatory Policy Issues Related to the PSTN Evolution**

The FCC and ATIS work is still ongoing, addressing a wide range of areas including competition, universality, power, non-voice services, QoS, numbering, nomadicity, and security and emergency/law enforcement services. There are many features and capabilities that exist implicitly within the PSTN that are not clearly defined as part of next generation voice platforms. For instance, the interworking between nomadicity and emergency services is not clear. Subscribers must identify their new locations every time that they move their VoBB lines. If this is not automated or universally accepted by the subscriber base, there is a risk that responders may go to an incorrect location in an emergency.

Figure 1 provides a comprehensive representation of the issues related to the PSTN lifecycle and transformation and how they are being addressed by the ATIS focus group (ref [16]).



Figure 1: ATIS PSTN Transition Focus Group - Sub-Team Focus Areas

# CANADIAN RADIO-TELEVISION AND TELECOMMUNICATIONS COMMISSION

#### **Recent Regulatory Action Regarding PSTN**

In January 2012, the Canadian Radio-television and Telecommunications Commission (CRTC) announced new policies that would encourage subscribers to move away from TDM services, by encouraging expansion of universal, low cost IP services. The CRTC is not mandating the retirement of PSTN, but encouraging the market to drive in that direction with technical initiatives. As of February 2012, the CRTC's rules and penalties stated that in areas where a large telephone company uses IP to transfer calls to any other provider (including affiliated



Page 5

networks), it must provide similar arrangements to any additional provider that requests it, within six months of the request. While no deadline was set at the time, the expectation of the CRTC was that interconnection arrangements for IP voice network would be completed or significant progress to have been made by January 2013 (ref [7]). However, the technical complications of this task have impeded significant progress to date.

#### Industry Response to New Regulations

The CRTC said this shift to IP will cut costs and promote the development of innovative new services for Canadians. "The networks of the future will be primarily based on Internet Protocol," said CRTC chairman Konrad von Finckenstein. Overall agreement across the set of service providers points to a high likelihood that implementation will be rapid, and subsequent turndown of PSTN will follow relatively soon after that. The LECs initially argued that they still have significant investments in TDM facilities, and that these investments risk being stranded by an immediate change ("flash cut"). However, during the course of the negotiation proceedings, many parties modified their positions in support of a framework containing additional financial incentives.

Specifically, the rules have been simplified for sharing the costs of transferring calls between a wireless and a wireline provider. "The Commission has decided that wireless carriers can interconnect with LECs for the exchange of local voice traffic on a shared-cost basis compensation method and will no longer be required to provide such alternative long-distance access given that they already offer a variety of plans and Canadians can already choose from other long-distance options, such as prepaid cards and local access numbers. This will level the playing field regarding voice network interconnection between wireless carriers that have no LEC affiliations and wireless carriers that are affiliated with a LEC." These changes will reduce costs for many wireless providers, and potentially level the playing field between independent providers and those that are affiliated with a larger communications company. Note that this reduction in wireless costs will come at the expense of the incumbent SP revenues.

A major issue raised during the proceedings addressed the costs associated with converting voice traffic from TDM to IP, and vice versa. At present, IP-based carriers must install and maintain conversion equipment in their networks to exchange IP voice traffic with the TDM-based carriers (mainly the ILECs). These IP-based carriers are fully responsible for the costs associated with voice traffic conversion. The CRTC recognized the inequities, especially given the increasing use of IP technology in carriers' networks, but decided that since protocol conversion is a temporary issue that will be decreasingly relevant as legacy TDM networks are migrated to IP networks, and since the bulk of necessary capital expenditures have already been incurred by IP-based carriers (although there are continuing operational costs associated with maintaining conversion equipment), it would be inefficient to force the ILECs to incur the expense of duplicating conversion equipment that already exists (ref [7]).

#### **Impact on Service Providers**

As mentioned above, this regulatory environment will see a reduction in wireless costs at the expense of the incumbent wireline revenues. In addition, two other issues are worth noting.

First, the CRTC provided for general subscriber education regarding the differences between PSTN and IP telephony, namely they require VoIP providers that offer local telephony to offer

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911 services to contact their customers and inform them of any limitations associated with such services. In 2013, the CRTC will continue to educate new VoIP providers to ensure that they understand and comply with these obligations (ref [5]).

Second, in reference to off-tariff negotiations for legacy TDM network interconnection agreements, the CRTC decided the existing policy should apply for the forseeable future and, as such, considers that all carriers should continue to have the option to interconnect on a circuit-switched basis pursuant to approved tariffs (ref [6]).

# REGULATORY BODY ACTIONS AND GOVERNMENT ACTIVITIES IN OTHER NATIONS

In other parts of the world, regulatory policies and recommendations have focused more on fostering competition, the future of broadband access and the universality of services than on the retirement or sunset of the traditional PSTN. While most European regulatory bodies have expressed the intention that requirements such as lawful intercept and emergency services continue to function in next generation voice platforms, technical questions such as nomadicity or the authentication of calling party identification have not been addressed yet or are in the early stages of discussions.

Government authorities have been rolling out wide scale broadband access platforms, such as Australia's National Broadband Network (NBN) Company, which plans to reach 93% of the country's homes with fibre and the remaining 7% using wireless and satellite technologies (ref [1]). As part of the initiative, the government is requiring the network operator to transition all subscribers from the PSTN to a VoIP connection within 18 months of the fibre deployment ([23]). Additional information on the Australia NBN deployment is noted in Section 4 below.

In Singapore, the government is rolling out the open access Next Generation National Broadband Network (Next Gen NBN) that will offer pervasive ultra-high speed connectivity by 2015, supporting a range of high-speed services (ref [13]).

Other nations rolling out government subsidized (including municipal and local entities) broadband access initiatives include the US, as referenced in the above section and some examples of projects throughout Europe are shown in the figure below (ref [19]).

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PSTN Industry Analysis and Service Provider Strategies: Synopsis

Figure 2: Examples of Municipally Sponsored Broadband Access Projects - Europe

Peter Waters, a partner at Gilbert & Tobin, notes that an aspect of public-private NBN ventures that should not be underestimated is the potential impact of government investment in next generation broadband infrastructure, which can be viewed as the next natural monopoly in the telecom sector. Waters said that while government investment in NGN to some extent was inevitable, as are infrastructure monopolies, how the networks are designed to ensure private competition is not inevitable, and it needs to be discussed now. "NGN is the new PSTN, and the decisions made now will impact competition in the next 20 years," he says.

# **4 SERVICE PROVIDER AND MARKET ACTIVITIES**

This section summarizes market reports and other publicly available information on major global telecommunications SPs, noting how and why they are evolving away from their PSTN networks. Early VoIP offerings by incumbents, such as CallVantage by AT&T and VoiceWing by Verizon were created to address the threat of OTT VoIP operators such as Vonage and SunRocket. However, as the competitive over-the-top (OTT) players struggled or disappeared, the early VoIP services offered by incumbents followed suit. Now, service providers are taking varied approaches to the evolution, depending on their subscriber demands, state of their infrastructures, economic conditions, and competitive and regulatory environments. Typically VoIP is now offered by incumbents with broadband access as part of a bundled triple-play offer.



#### **Service Provider Motivation for Migration**

In late 2011, The Yankee Group conducted a study of five major PSTN SPs in the United States to assess their progress, insights and attitudes towards network transformation. The study showed that while the main driver for SPs to evolve to VoIP is the aging infrastructure of the TDM, there is no imminent need to migrate. Hence, for the most part, the companies interviewed did not have specific transition plans in place, with transformation occurring slowly and only as needed (ref [18]).

Specific drivers for TDM to VoIP transformation included:

- Aging infrastructure of the TDM leading to end of manageable lifecycle issues
- Adding new features and functionality to enable cloud and other enhanced services to provide greater scalability, flexibility and bandwidth efficiency.
- Cost reduction, particularly in the case of maintaining parallel TDM/voice and data/VoIP networks, resulting in two different operations processes and organizations from back office systems to customer support.
- Unforeseen events/natural disasters, i.e., when the event happens, "Do I keep existing architecture and get some grey market stuff or do I let the event drive a local transformation?"
- Issues such as loss of expertise/personnel and unavailability of spares are cited as concerns for the future, though in the near term, the TDM switches are "performing wonderfully". Thus, there is a general inertia against the transformation process.

Factors hindering the transformation include:

- The business case lack of incremental revenue, or reduction of revenue, from VoIP replacing a PSTN line
- Quality of service "TDM is the gold standard"
- The VoIP maturity curve
  - TDM services not all fully defined in the VoIP world: telemetry, alarms, auto-diallers, 911, CALEA, etc.
  - VoIP solution bugs/glitches
  - Some OA&M (Operations, Administration and Maintenance) features are not supported (e.g., one soft switch did not support remote line testing)
- Time and effort required to migrate each line/switch.

#### **Global Service Provider Actions**

Current global trends all indicate the decline of POTS service as a result of migration to VOIP carried over a combination of mobile telephony and NGN wireless/wireline broadband access. The exceptions are the Middle East and Africa, which are still exhibiting moderate PSTN line growth (5.48% CAGR, 2008-2014) (ref [19]). In spite of the decline, since the PSTN assets are mostly cost-depreciated in the network, offering this service is generally still profitable for operators in the near term. Hence, for most SPs, the business case does not justify retiring the PSTN assets and migrating the subscribers to next generation broadband when only considering voice services.

#### **Global Spending on PSTN**

It is expected that eventually, when enough subscribers have migrated away from the PSTN, that its operational cost per line will escalate and its shutdown will be warranted. While this

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point in time is still several years off, service provider investment in the PSTN is limited due to the downward trend in customers as well as the general discontinuation of the technology and support by vendors. Instead, service providers are focusing their spending on the mobile and broadband access networks where growth is being experienced.

The following diagram taken from a January 2010 IDC report illustrates a breakdown of telecom spending by country in the largest telecom markets in 2009. The positioning of each flag on the grid indicates where the next generation broadband network spend is occurring. Countries with less developed wireline infrastructures, such as India, Saudi Arabia and China show higher investment in mobile (hence higher on the vertical scale). Countries with highly developed wireline networks show higher investment in IP networks (including broadband access), as can be seen with Canada, The Netherlands, North Korea and Japan. Flag size indicates spending on traditional voice services (ref [10]).



Figure 3: Voice Spending in the Largest Telecom Markets, 2009

#### **Global Sustain Activities**

Many major service providers are taking on a converged network strategy, however, with no specific plans to shut down the PSTN. For instance:

- Verizon's business case "does not support a technology-led migration off of the PSTN • with the combination of land line loss, the economy, competing priorities and competitive dynamics". While they would want to shut down the PSTN, it is not feasible.
- Telefónica has a similar situation and only plans to migrate subscribers off the PSTN as • "business forces dictate we do".

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- KPN halted its publicized plans to move to an "all-IP" network and is now actively positioning legacy TDM before VoIP due to higher profit margins (ref [17]).
- In other areas, such as Latin America, service providers have taken on a more technology-laggard approach and have been less inclined to decommission legacy systems (as can be seen by Mexico in the above graph), though some of the larger operators (e.g., Telefónica, América Móvil) have been offering triple play services (ref [15]).

#### **Aggressive PSTN Migration**

Other service providers have expressed more aggressive plans to shut off the PSTN, and are putting these plans in progress. Such plans to shut down the PSTN should be closely monitored in light of the open issues identified by ongoing working groups as well as learnings from earlier SP transformation projects such as KPN's All-IP and BT's 21CN. These aggressive migration efforts include:

- AT&T's petition to the FCC to enable service sunset, discussed in Section 3.
- Australia's £30B NBN initiative, which will provide access to high-speed broadband to 100% of Australian premises, is driving Telstra to accelerate implementation of their migration plans.
- New Zealand government's efforts to provide universal broadband is motivating TNZ to accelerate their migration efforts. The Ultra Fast Broadband (UFB) initiative will deploy fibre to the premise (FTTP) to 75% of the population by 2019 (ref [20], [2]).
- In Japan, all investment in TDM has been essentially stopped; NTT has announced that they will begin to discontinue the PSTN by 2020, with the project expecting to take 5-6 years (ref [21]).
- Telenor Norway has been aggressively migrating away from PSTN, although the work is not complete. As of 31 March 2012, Telenor had 1 million fixed telephony subscriptions (PSTN, ISDN, VoIP) (ref [22]). It is estimated that approximately half of these are PSTN (ref [14]).
- Orange France announced that has started an experimental copper-switch-off in the city of Pariseau, to be completed by end of 2013 or start of 2014, which would make Pariseau the first city Orange has covered by only fiber.
- Other countries that are in the process of shutting down the PSTN are Singapore, Hong Kong, South Korea, Qatar and the United Arab Emirates (ref [3]).

#### **Completed PSTN Migration**

There are some specific examples to be found of a completed PSTN migration to a next generation broadband architecture. These examples exist where the serving area is small and/or the existing PSTN equipment is antiquated. Such is the case of Post and Telecommunication of Kosova (PTK) which migrated a voice network serving approximately 141,000 subscribers, primarily based on semi-electronic switches, to a VoIP network (ref [4]).

#### **Industry Practices Conclusions**

Global SPs are at different stages of the migration from PSTN to next generation platforms. Many of the incumbents' initial forays to migrate to VoIP were stalled or delayed since the OTT VoIP providers they were meant to defend against were faltering and/or the business cases for migrating voice services only did not prove in. Currently, PSTN migration is occurring at the pace dictated by the market and competitive environment or in certain cases, government

Page 11



mandates. While SPs recognize that the PSTN will eventually reach EoL, in the near term, they are generally not shutting down PSTN assets unless so pushed.

Government bodies are primarily interested in regulating telecommunications service to ensure availability to the general population and foster fair competition. They generally do not address the details regarding how legacy features or services are to be implemented in the next generation networks. Exceptions in this regard are the FCC and ATIS in the United States, who have established a cross-industry working group addressing a deeper level of detail on how key PSTN features and services will function in order to gracefully retire the PSTN.

# **5 TECHNIQUES FOR SUSTAINING PSTN**

Most of the local exchanges/Class 5 switches currently in service were installed during the 1980s with significant growth in the 1990s. Most of the switch hardware is already in DA, and one vendor recently issued a statement terminating their support of PSTN equipment; other vendors are expected to do the same in the near future. Therefore, sustaining a PSTN network until 2020 or beyond presents a significant challenge. The SPs that are taking this approach and keeping their PSTN networks in service are discovering the need to invest capital to maintain performance quality even though this reduces the earnings margins. Key findings and common activities across the SPs are described here.

#### **Grooming and Consolidation**

The service providers who express strong confidence that they can reach life expectancy are performing some form of line card and/or switch module grooming. This grooming has several positive impacts: reduced power consumption, reduced heat load, reduced operations costs and increased operational efficiency. It frees up real estate, which for some SPs may be returned for additional cost savings or reallocated for deployment of equipment supporting new services. Grooming reduces the cost of executing additional grooming in the future, and enables harvesting of spare components for repairs. It also reduces the cost of migrating to NGN in later years.

#### Switch Capacity Utilization

In all regions except the Middle East and Africa, PSTN subscriber levels have been primarily dropping. As a result, switch utilization levels have been decreasing in most networks, to a point where line loss and grooming can offset each other to maintain consistent utilization, typically at 30-60% of capacity. This lower utilization level allows a higher quantity of components to be harvested for sparing and enables the achievement of higher RoI/IRR figures and shorter payback periods. Decreasing traffic per subscriber as well as decreased number of subscribers result in reduced traffic on switches. There is also some evidence that reduced traffic levels result in lower failure rates across certain switch components (ref [24]).

#### **Component Spares**

Service Providers who are most confident of their ability to support PSTN to the end of the planned lifespan have all placed a high emphasis on amassing and maintaining an adequate level of spare components available for reuse. In some cases, the methods used were aggressive, as all required a general increase in expense.

Page 12



#### **Expertise Retention and Knowledge Sharing**

All of the Service Providers analyzed confirmed that loss of expertise as skilled technicians retire will become an issue in the future, but few of them felt that this was a problem in the near term. Some felt that the shrinking PSTN service base would be sufficient to counteract the problem, possibly until the end of the PSTN lifespan. Others were taking deliberate steps to counterbalance the loss of talent.

#### Software, Tools and Automation

The aging of the IT systems supporting the PSTN platform is also a major concern. While the hardware support can be reduced as the network shrinks in size, the software platform must remain wholly in place until the network is completely shut down. In addition, the complexity of the software and tools environment can be extremely unwieldy. One SP reported that they had over 4000 separate software instances supporting their national network. Multiple IT and OSS systems are generally needed to support the PSTN platform because over time, changes and additions have been followed by add-on, rather than upgraded or updated software and tools. Some OSS/BSS systems may only be operational in a single region, and it does not make financial sense to optimize OSS/BSS systems on a local basis.

## 6 PROPRIETARY CASE STUDIES

#### **PROPRIETARY CASE STUDY 1: ASIA/PACIFIC SERVICE PROVIDER**

This case study considered the details of a large telecom SP in the Asia/Pacific region. The subscriber base for traditional voice is shrinking at a rate of about 3% per year as customers move to newer IP or mobile services and because growth in new voice services is occurring primarily within the IP network. The regulatory environment is mandating a move to IP, although the schedule for final shutdown of PSTN is under negotiation. Because of the large existing PSTN base and without mandatory movement to newer technologies, this SP is expecting to maintain the legacy network until a time between 2020 and 2025.

In the subject country, migration of subscribers away from the PSTN network is currently occurring at a rate motivated almost exclusively by market forces, with only small government incentive or intervention until final shutdown is mandated. This migration occurred slowly over the last few years because the service is stable, with few failures or customer SLA violations. In 2006 the SP, concerned about lifecycle issues, executed a study to analyze the expected EoL considerations in the PSTN network and its components. In response to this study, the SP has implemented a program of rigorous life extension activities, allowing them to plan to support the PSTN network until at least 2020, and possibly beyond to 2025.

• In order to turn down the PSTN network between 2020 and 2025, it will be necessary to migrate customers to alternate services or solutions at a rate faster than the current 3% per year. In fact, the rate will need to increase to about 12% per year, if steady migration were to begin immediately. The service provider is currently investigating three possible approaches:

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- Migration of subscribers to alternative services such as VoIP or wireless.
- Deployment of next generation technologies that support POTS lines. POTS service is implemented in a FTTH architecture through an analog line interface at the ONT or STB. From that point into the network, the POTS service is carried over Ethernet and fibre.
- Grooming and Consolidation of Switches. Resources have been allocated to conduct network grooming and consolidation on an ongoing basis. As the number of customers on a switch decreases, the SP reclaims equipment, pulls cards and turns off modules.

#### **PROPRIETARY CASE STUDY 2: EUROPEAN SERVICE PROVIDER**

This case study considered the details of a large telecom service provider in Europe. The SP is the incumbent fixed operator and controls a large market share in country. however, the SP is experiencing line erosion on the order of 10% annually. This line erosion is primarily due to increased competition from cable operators, other fixed SPs taking advantage of a favourable unbundled local loop regulatory framework, and migration of subscribers to wireless voice services. Migration of subscribers away from the PSTN network is motivated almost exclusively by market forces and the increasing availability of broadband access. The service provided is extremely stable, with a low rate of failures or customer SLA violations.

The SPs PSTN embedded base network consists mostly of equipment deployed in the early 1990s and the SP has no immediate concerns regarding equipment reaching the end of its lifecycle through 2020. Because the service is stable and the risks are viewed as low, the SP has no specific plans to turn down PSTN service. While long-term shut down is seen as inevitable, turn down will not occur earlier than 2020 and possibly significantly later.

- Since the SP has no specific target date to turn down the PSTN, and it is not expected to happen sooner than 2020, the primary goal of current PSTN activities is smooth operations on a long-term basis.
- While not forcing migration away from the PSTN, the SP is initiating a broadband expansion program, which allows for customer-initiated migration to new services. The SP is deploying FTTH in targeted areas where the competitors' service offerings are more attractive from a price/speed viewpoint. The SP is deploying GPON with rates on the order of 50-100 Mbps as part of a multi-play offer. The voice service component of this offer is IP-based, and while not completely feature -compatible with the existing PSTN service, it is allowed by the overseeing government commission.
  - The voice service substitution facilitates the targeted customers' migration off the PSTN at a minimal cost. The new voice CPE is integrated into the ONT; hence, with one truck roll, the SP is able to address both the FTTH installation and the voice service migration at the customer site.
  - The SPs long-term plan is to achieve a 50/50 split of fibre vs. copper as part of its access evolution. For voice only single-play subscribers, the SP may decide to deploy an MSAN with voice cards to provide emulated service.
  - Lastly, the SP has no plan to close down COs even as the new broadband expansion strategy will require more deployment of MSANs in street cabinets, especially in the targeted copper areas. The motivation for keeping the existing COs in operation is

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so that the SP can use the space to deploy new equipment to expand into the cloud and content distribution businesses.

#### **PROPRIETARY CASE STUDY 3: EUROPEAN SERVICE PROVIDER**

This case study considered the details of a large SP in Europe. As the incumbent, the SP has a majority share of the customer base in country, both POTS and ISDN. The subscriber base has been shrinking at a rate of about 20% per year as customers move to newer VoIP or mobile services; growth is primarily happening within the IP network.

For traditional voice services, no regulatory constraint other than 'Universal Service Obligations' exists for the PSTN in the subject country. The SP is required to offer voice services as determined by a regulated tariff which stipulates the obligation to provide POTS services to every customer willing to pay the regulated fee. The SP also has the obligation to facilitate, for the POTS customer, other services including carrier, preselect, wholesale, line rental, fax service, etc. The controlling regulatory agency is not mandating move to IP or away from PSTN at this time.

Because of the difference in ARPU between traditional PSTN and VoIP services, in conjunction with lower PSTN costs, the SP has been pursuing a strategy of minimizing PSTN line loss. However, as PSTN subscriber numbers erode and network element utilization declines, high fixed PSTN infrastructure cost that cannot be reduced proportionately, resulting in increasing Total Cost of Ownership (TCO) per PSTN subscriber. In other words, in the future, the differences in margin between PSTN and VoIP services is expected to reverse, making VoIP the more profitable service and motivating the SP to encourage market migration.

The main concerns of this SP are:

- PSTN continues to be a key revenue and profit driver, but PSTN is not a strategy for the future.
- By 2015, they expect that the PSTN platform will no longer be the most profitable way of bringing voice services to the market.
- Technical EoL of TDM and SDH equipment is threatening, due to lack of spare parts and an aging, complex IT landscape.
- Loss of expertise due to an aging workforce approaching retirement age is increasing.
- The costs to maintain PSTN OSS are high, and increasing.
- At least 2 years notice to the market in advance is required to start switching off the PSTN.

In 2010, this SP executed a study to evaluate different PSTN rationalization and migration scenarios. In addition to the above points, this evaluation showed that geographic areas with low utilization open opportunities for regional mitigating activities. This drives the SP to evaluate the trade-off between decommissioning PSTN COs and technical migration to alternative solutions. The SP evaluated commercial migration from PSTN to IP in fibre or VDSL areas where the risk of churn is considered acceptable.

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#### **PROPRIETARY CASE STUDY 4: NORTH AMERICAN SERVICE PROVIDER**

This is a large SP in North America. The current subscriber base drops by 7-10% per year. The reasons for the loss of customers include competition from cable companies, customers migrating to VoIP as part of NGN network deployment, and customers giving up their POTS lines and exclusively using wireless service for voice. More than 50% of the customers have access to broadband but approximately 10% live in rural areas and do not have broadband access. The SP is looking to government incentives and funding to provide the rural broadband access. The SP further believes that NGN OpEx costs will be almost same as the PSTN OpEx.

The SP has an existing IMS based NGN network and has been working to implement action plans to retire all PSTN switches over the next 10 years. This has not occurred yet due to the significant expense and long payback period. The SP is currently evaluating the strategy of deploying an extended broadband access network to generate additional revenues as migration to NGN takes place. At this stage, there is some uncertainty on the regulatory issues as it is not clear under what circumstances the associated regulatory agency will allow a regulated PSTN line to be operated under IMS or VoIP. The SP is required by regulatory policy to offer voice services in return for a regulated tariff. Through broadband access, customers are offered high-speed internet and VoIP services. The SP would like to move all customers to VoIP and start shutting down PSTN switches in the next 4 to 5 years, however, regulatory approval has not yet been given for this action.

The SP gives broadband access customers price incentives to migrate to VoIP but none of the customers are forced to migrate to VoIP because of the risk of losing them to the competition. Since the PSTN refresh does not result in any additional revenues, it has been difficult for the SP to launch a large-scale migration to NGN. Most recently, the SP began to evaluate wide scale deployment of broadband access with the expectation that this approach will achieve modernization as well as protect revenue.

Currently ISDN, 800 number service and Centrex services are significant sources of revenue for the SP, and do not have a mature solution within the NGN platform.

#### **PROPRIETARY CASE STUDY 5: NORTH AMERICAN SERVICE PROVIDER**

This case study addresses a mid/large telecom service provider in North America. The SP is an incumbent in a serving area but also serves as a CLEC in other regions. The subscriber base is decreasing at approximately 3% annually as a result of subscribers moving to mobile and/or internet services as well as competition from cable operators. The fixed line revenue is decreasing approximately 5% annually because of the above factors as well as re-pricing pressures. There are no near-term concerns regarding the equipment itself, but the current supplier has notified the SP that their support for the platform will be terminated by 2016. Negotiations and alternate arrangements for extending support of the platform are ongoing.

The SP currently has a small VoIP platform in operation serving several thousand FTTH/tripleplay and business subscribers. They are expecting LTE to grow quickly in their serving area and are looking for a converged next generation voice platform that will be used to:

• Provide voice services for the expanding LTE subscriber base



Page 16

- Migrate the existing VoIP platform onto, resulting in a future-proof, scalable solution
- Ultimately, serve as a platform for the current PSTN subscribers as that platform is phased out.

While they do not have a formal PSTN turn down vision yet, they are migrating subscribers to the existing VoIP platform and commercially migrating from POTS to triple-play/FTTH. The SP is closely working with equipment suppliers as well as external consultants to develop this vision. Preliminary plans indicate the best option for them is a slow retirement of the PSTN conducted in alignment with the continued investments in the broadband access network, along with the deployment of POTS emulation line cards on MSANs only in limited cases where no other feasible alternative exists.

Their overall business strategy is to maintain profitability and offset the aforementioned fixedline erosion by leveraging their FTTH and IPTV investments and continuing to expand their footprint for bundled/triple-play offers. Through this, and by positioning their IPTV offers, they are growing their triple-play subscriber base.

In preparation for the evolution of the voice network, they have recently released an RFI for a converged platform to serve the migrated PSTN lines, VoBB/triple play subscribers and LTE subscribers. One of the RFI requirements is to absorb or transition the existing VoIP platform currently serving the FTTH and business subscribers. The SP is exploring consolidation in sites where multiple switches are collocated.

Their life cycle focus has been more directed at investing in next generation broadband platforms (particularly in higher-revenue urban areas) and using commercial migration to triple-play services as the strategy to maintain subscriber base and profits.

### **PROPRIETARY CASE STUDY 6: EUROPEAN SERVICE PROVIDER**

This case study considered the details of a large telecom service provider in Europe. The SP has a majority share of the customer base in country. The subscriber base for traditional voice is shrinking at 5–10% per year, with little new subscriber uptake, as customers move to newer IP or mobile services. This SP is expecting to maintain the legacy network until 2020 or 2022. Note, however, that since the business case for remaining on PSTN is still positive, life span of PSTN may be extended as long as is viable.

For this service provider, almost all PSTN life span considerations are driven by the positive business case. It is clear, however, that migration to IP is eventually going to occur regardless of economics, so they performed a study to investigate alternative considerations, such as the need to retain customer market share. A business case analysis developed this year showed a payback period of 2-3 years for migrating the top 1M subscribers to NGN. Planning for this transformation included service migration and network consolidation. The SP is supporting the migration of customers to VoIP by providing fibre to the end of the distribution cable. This configuration is currently the only technical replacement solution that yields a positive business case. This approach is based on the broadband access + voice bundle approach. There is a small government funding initiative to provide broadband access in rural areas of the country: the SP



is participating in this initiative. Fibre is proposed to be installed in existing ducts to keep the costs down.

Overall, this SP is letting the PSTN retire itself slowly, maintaining equipment and operations with a minimal but steady expenditure. The relatively rapid rate of commercial migration in the country would indicate that the PSTN will not last much longer than the 2020 or 2022 timeframe.

# 7 BELL LABS OBSERVATIONS

Several clear trends emerged during the course of this study. These trends indicate directions that market and regulatory agencies are taking, and are indicative of drivers for the actions that SPs are pursuing. The overarching finding across all service providers is that only a few, small footprint SPs have completely shut down their PSTN networks; most of the SPs studied herein are investing in both CapEx and OpEx to maintain the legacy network, with lower per-line margins.

#### **PSTN Shutdown Timeframe**

PSTN shutdown is seen as inevitable in the 2020 timeframe, since TDM switches are nearing their EoL; however, few SPs or regulatory agencies have a precise schedule planned. In most cases, parts of the existing PSTN base are being held in place to support the remaining services for which a viable, standardized next generation broadband solution does not yet exist (advanced PSTN or Centrex features, emergency services, alarm systems, etc.). In some cases, standards and regulatory body discussions are ongoing to define the next generation broadband solution. SPs are evaluating their inventory of PSTN features/services to determine whether to emulate, simulate or eliminate them in the next generation broadband platform.

#### **Network and Service Migration**

Across the industry, no one solution for replacing PSTN has emerged as a standard or generally adopted approach. However, every SP is taking some action to move, plan or migrate their customers to one or more next generation broadband platforms. Every SP has an overlay next generation broadband network, and is implementing some combination of technical and commercial (subscriber motivated) migration. In the near term, external market forces will drive the speed of migration. The business case for migrating voice-only or single-play customers often has a negative RoI. In the case of multi-play subscribers, however, even with a lower ARPU for the voice service, the SP can still maintain its overall margin on the bundled offer, and is often able to retain a customer who otherwise might have been attracted to a competitor's service package.

#### Proactive Planning with Regulatory Bodies and Vendors

Several industry initiatives are seeking to guide SPs' efforts in order to migrate off the PSTN smoothly. Many of the SPs examined are part of active working groups chartered to plan the shutdown of the PSTN. The working groups typically have participation from incumbent and competitive SPs, government bodies and/or regulators and equipment vendors, and are formed with the goal of defining the most effective telecommunications evolution scenario for the area served.

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## 8 IN CLOSING

This study analyzed the current industry practices and regulatory directions around the world regarding migration and life cycle management of PSTN networks. Different operators have different targets for sustaining versus migrating PSTN service, and different ways of pursuing these targets. While it was not within the scope of this project to give detailed recommendations, industry practices viewed as successful by other service providers have been noted. We sincerely hope and trust these findings will be of use.

# 9 LEGAL NOTICE

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### **11 GLOSSARY OF ACRONYMS**

AC - Air Conditioning AC – Alternating Current ARPU – Average Revenue per User **ATIS - Alliance for Telecommunications Industry Solutions BB** – Broadband BSS – Business Support System **BT – British Telecom** CALEA - Communications Assistance for Law Enforcement Act CapEx – Capital Expenses CDN - Content Delivery Networks **CLEC – Competitive Local Exchange Carrier** CO – Central Office **CPE – Customer Premise Equipment** CRTC - Canadian Radio-television and **Telecommunications Commission** DA – Discontinued Availability DC – Direct Current DCS - Digital Cross-connect System DSLAM – Digital Subscriber Line Access Multiplexer EoL – End of Life FCC – Federal Communications Commission FTTH – Fibre to the Home FTTN – Fibre to the Node/Fibre to the Neighbourhood FTTP – Fibre to the Premise FTTx – Fibre to the "x" FWT - Fixed Wireless Terminal **GPON – Gigabit Passive Optical Network** GSM - Global System for Mobile HVAC - Heating, Ventilation and Air Conditioning ILEC – Incumbent Local Exchange Carrier IMS – IP Multimedia Subsystem **IP** – Internet Protocol IRR - Internal Rate of Return ISDN – Integrated Services Digital Network **IT – Information Technology** LEC – Local Exchange Carrier LTE – Long Term Evolution

MDF – Main Distribution Frame MSAN – Multi Service Access Node NBN – National Broadband Network (Australia) NE – Network Element NGN – Next Generation Network NTU – Network Termination Unit OA&M – Operations, Administration and Maintenance OEM – Original Equipment Manufacturer **ONT – Optical Network Terminal OpEx – Operational Expenses OSS – Operations Support System** OTT – Over the Top POTS – Plain Old Telephone Service PSTN – Public Switched Telephone Network QoS - Quality of Service **RFI** – Request for Information RJ - Registered Jack RoI – Return on Investment SDH – Synchronous Digital Hierarchy SLA – Service Level Agreement SP - Service Provider STB - Set Top Box TCO - Total Cost of Ownership TDM – Time Division Multiplexed **TNZ-** Telecom New Zealand UFB – Ultra Fast Broadband UMTS – Universal Mobile **Telecommunications System** VCC – Voice Call Continuity VoBB – Voice over Broadband VoIP - Voice over IP VoLTE – Voice over LTE