nobIis.

Protecting Agency Communications from Time-Division-Multiplexing (TDM) Obsolescence

Executive Summary

The American Public Switched Telephone Network (PSTN) employs time-division multiplexing (TDM) technologies and services that are nearing end-of-life, or "sun-setting." Federal government agencies remain significant users of TDM services, including both copper-based analog telephone lines and older access technologies such as T-1 that are used to connect government locations to public networks. Many of these services are procured through GSA contracting programs that will be replaced by the new GSA Enterprise Infrastructure Solutions (EIS) program. Thus, the EIS source selection process provides a timely opportunity for replacing legacy TDM services.

While TDM services are still available commercially and can be provided via EIS contracts, there is no assurance that like-for-like legacy telecom services will be available at current prices or at current locations moving forward. This uncertainty and risk affects all government users presently served by TDM-based offerings. Federal agencies should avoid these risks by adopting IP-based or wireless solutions where feasible when transitioning to EIS. Agencies should plan and budget for transformative solutions when developing EIS solicitations or otherwise seeking replacement for TDM services. This should include expert assistance to conduct requirements analysis, assess technical options, and make recommendations for transformative solutions.

In this white paper…

Problem Statement

The American Public Switched Telephone Network (PSTN) is nearing its end-of-life or "sun-setting1." As result, many major service providers AT&T, Verizon, CenturyLink, et al.) have petitioned the Federal Communications Commission (FCC) and State Public Utility Commissions (PUCs) to seek regulatory approval for de-commissioning the PSTN2. Meanwhile, others have announced that legacy services delivered over copper facilities, as required by section 51.327(a) of the FCC rules, will be retired. The cost of maintaining these services as they retire will be spread over a shrinking revenue base, resulting in increasing costs for remaining customers.

Federal government agencies are significant users of TDM services, including both copper-based analog telephone lines and older access technologies such as T-1 that are used to connect government locations to public networks. Failure to transition to newer, more cost-effective technologies and services in a timely manner may leave government users with obsolescent, higher-cost, lower-performing communications.

The Practical Scope

Many agencies procure TDM services through GSA contracting programs such as Networx, WITS3, and various Local Service Arrangements (LSAs) that will expire in the next three years and be replaced by the new GSA Enterprise Infrastructure Solutions (EIS) program. While TDM services are still available commercially and are provided via the recently-awarded EIS contracts, there is no assurance that

like-for-like legacy telecom services will be available at current prices or at current locations moving forward. This uncertainty and risk affects all government users presently served by TDM- based offerings, including analog business lines, CENTREX, ISDN Basic Rate Interfaces (BRI), ISDN Primary Rate Interfaces (PRI), and T-carrier access (T-1 and T-3) circuits.

Instant messaging or chat, IP telephony, desktop sharing and video - when combined together - are changing the way enterprises operate. The legacy PSTN and central office-based infrastructure simply cannot support these advancements. Task Orders awarded under the EIS program will have Periods of Performance (POPs) of up to 15 years. Thus, the EIS source selection process provides a timely opportunity for replacing legacy TDM services. Federal agencies can mitigate the risks posed by the sun-setting PSTN by adopting IP-based or wireless solutions wherever practical during the transition to EIS.

> " Federal agencies can mitigate the risks posed by the sun-setting PSTN by adopting IP-based or wireless solutions wherever practical during the transition to EIS. "

---

[1] PSTN operating costs are increasing as service providers support a declining number of subscribers. The obsolete and undersubscribed PSTN consumes significant electrical power, while the technical skills needed to maintain the network are becoming scarcer. The low-port utilization and high operating costs are creating unsustainable per-user costs.

[2] Congress has mandated, per Section 214 of the Communications Act, that carriers must obtain FCC approval before they discontinue, reduce, or impair services to a community or part of a community. See 47 U.S.C. §214(a).
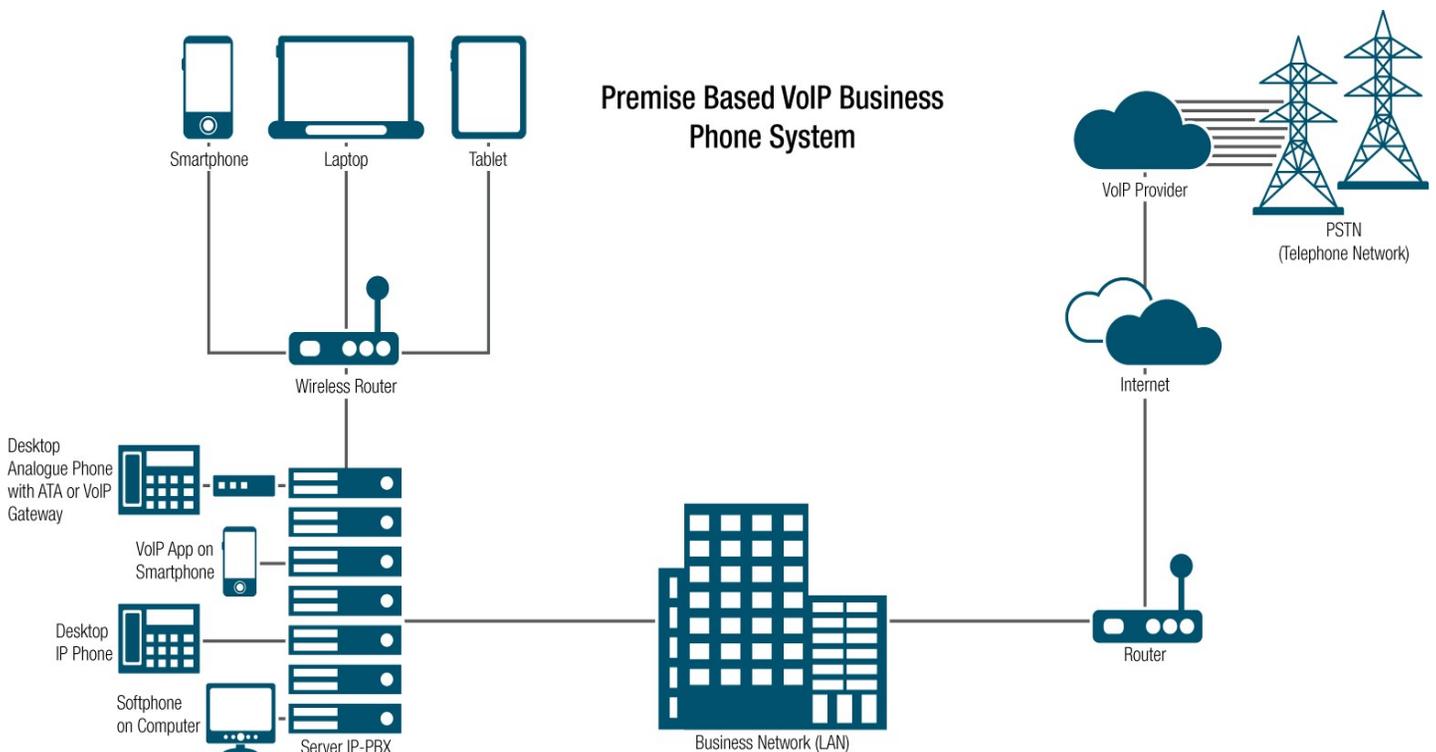
The evaluation criteria for the EIS Program allowed bidders to satisfy voice service requirements by offering TDM-based Circuit Switched Voice Service (CSVS) or IP-based services[3]. Bidders also had wide latitude in determining the mix of services and service locations they would compete for. As a result, service coverage gaps for TDM-based services exist for most EIS awardees. Federal agencies operating in remote or sparsely populated areas will most likely be affected by these EIS coverage gaps. If an agency faces wide-scale service coverage gaps for CSVS, it may have but one option: to seek transformative solutions (VoIP or wireless) for legacy voice services.

Transformative Solutions

Ethernet has become the preferred alternative for physical connectivity from buildings to service provider networks as demand for bandwidth increases. Many agencies have already begun transforming their access circuits on this basis, based on availability and cost. However, transformative solutions for other TDM-based legacy services vary, and are described below. Although the emphasis is on voice solutions, replacement options for low-speed TDM-based data transport - including SCADA - are also addressed.

VoIP replacement options for analog business lines, CENTREX, TDM-based PBX or Key Systems

Internet Protocol-based telephony solutions are widely available in two general options: i) network-based[4] or ii) premises-based. Both solutions are similar and share common infrastructure. The key difference is the premises-based solution uses call processing components located at the agency premises (or agency-designated facility). Call processing for network-based options, however, takes place in the cloud or carrier's network. Scale economies dictate that smaller agency sites are generally more amenable to a hosted service whereas a premise-based service is more suitable for larger sites. Figure No. 1 depicts the components and architecture of a typical premise-based

Premise Based VoIP Business Phone System

Smartphone · Laptop · Tablet · Wireless Router · VoIP Provider · PSTN (Telephone Network) · Internet · Router · Desktop Analogue Phone with ATA or VoIP Gateway · VoIP App on Smartphone · Desktop IP Phone · Softphone on Computer · Server IP-PBX · Business Network (LAN)

---

[3] Both IP- and TDM-based Voice Services could be offered.
[4] Network-based telephony solutions are also referred to as "hosted" VoIP applications.

VoIP solution. Unified Communications and Collaboration (UCC) and cloud-based services are also promising options for TDM voice replacement.

Wireless as a substitute for wireline voice service including CENTREX groups

A wide range of options are available that empower agencies to "cut the cord" by substituting wireless for wireline voice service. Many public-sector organizations are using wireless devices as the sole means of voice communications given recent workspace consolidations, hoteling schemes, teleworking, and allowances for remote workers. One example is the Push-to-Talk (PTT) feature that allows wireless subscribers to collaborate more effectively, by providing immediate voice contact for up to 250 colleagues on compatible devices. PTT-enabled devices can support one-to-one calling, group calling, and broadcast audio.

SIP Trunking as a replacement for ISDN PRI

Session Initiated Protocol (SIP) trunking is available including the circuit emulation of ISDN PRIs. This service is effectively a "PRI hand-off" from a core packet-based network. While the agency- facing network interface remains a T-1 with ISDN 23 B-channels + D-channel signaling, the network side of the service is based on SIP with packetized G.711 and T.38 "bearer channels" within the IP stream. SIP trunking can also be purchased as part of an integrated access solution supporting Quality-of-Service. For this case, CPE is necessary such as gateways or routers to enable SIP trunking.

Ethernet[5] Dedicated Internet service as a replacement for xDSL and T-1

Ethernet data services are increasingly being deployed throughout industry. Ethernet Dedicated Internet Service (EDI) is a symmetrical, high-reliability, high-performance service backed by SLAs. EDI offers a broad range of speeds from 0.5M to 100G, depending on availability of copper, single- mode fiber, or multimode fiber access facilities. Ethernet over copper, however, is not yet widely deployed. Fast Ethernet 100-Base-TX (copper) is in "controlled introduction" with select carriers in 2017.

Wireless broadband service as a replacement for xDSL and T-1

Speeds for most 4G LTE networks – assuming near optimal conditions – may be acceptable as a replacement for xDSL or for use as contingency/backup internet access links. Likely scenarios include smaller and remote agency sites. Data is transmitted securely through IPSec tunnels. Data throughput will vary based on the proximity to the cellular tower, location of CPE within the agency site, building materials (frame versus concrete walls), atmospheric interference, and time of day. Fourth-generation networks operate asymmetrically, like ADSL, offering download speeds considerably faster than upload speeds. According to OpenSignal's report on the State of Mobile Networks[6], 4G LTE latency rates during 2016 for the four largest US wireless carriers ranged from
57.06 millisecond (Sprint) to 64.71 millisecond (AT&T). Although 4G LTE latency rates are greater than legacy wireline services, many data and voice applications could be supported.

---

[5] Ethernet access arrangements can also support WAN services such virtual private networking. This section considers how Ethernet can replace Internet access services provided via xDSL or T-1.
[6] Refer to https://opensignal.com/reports/2016/08/usa/state-of-the-mobile-network/ .

Support for supervisory, control, and data acquisition (SCADA) in a post-TDM/PSTN environment

The legacy PSTN provides end-to-end networking that works synchronously, enabling customer premises equipment to rely on nearly jitter-free circuit paths. Options for providing timing and synchronization over packet/Ethernet links include IEEE1588v2 and SyncE. Single low-speed Ethernet circuits can be installed to support SCADA locations or can be designed as part of higher bandwidth Ethernet facilities that support other data services at an agency location.

SCADA applications can also be supported through wireless services. One American wireless carrier plans a nationwide deployment of its LTE-M network for Internet of Things (IoT) in 2017. LTE-M networks and related chipset technology for endpoints are being designed for carrier-grade security and longer battery life. Early pilot applications included residential water meters, consumer devices, and smart shipping pallets.

Support for SCADA in a post-TDM environment poses security concerns. A move from a closed serial network to an IP-routed solution opens many potential security vulnerabilities due to the open connectivity of IP networks. The best way to secure IP-based SCADA networks is to restrict access from corporate or third-party networks.

Avoid the Risks of Obsolescence— What Agencies Can Do

Agencies should consider the following steps to avoid the cost and performance risks associated with the sun- setting of PSTN and TDM technologies:

- Obtain expert assistance to conduct requirements analysis, assess technical options, and make recommendations for transformative solutions

- Establish a long-term plan and comprehensive network architecture to support transformation away from TDM-based services, including voice, access and SCADA applications

- Include costs of upgrading of LAN infrastructure or CPE to support transformative, next-generation services[7] in budgetary planning

- Plan and budget for transformative solutions when developing EIS solicitations

- Specify Ethernet access as the requirement or preferred option for building connectivity in enterprise data network solicitations

- Consider a separate Fair Opportunity for voice services

---

[7] Capital expenditures (CAPEX) neccesary to adopt IP-based telephony

Contact the authors of this white paper:

GERARD BROSNAN
Managing Consultant, Noblis
Telecommunications and Networking
Gerard.Brosnan@noblis.org

HUGO BONUCCELLI
Senior Consultant, Noblis
Telecommunications and Networking
Hugo.Bonuccelli@noblis.org

To learn more about Noblis' telecommunications services and research, contact:

JIM SOLTYS
Telecommunications Fellow, Noblis
Director, Noblis Telecommunications Center of Excellence
Jim.Soltys@noblis.org

About Noblis
Noblis, Inc. is a nonprofit science, technology, and strategy organization that brings the best of scientific thought, management, and engineering expertise in an environment of independence and objectivity. We work with a wide range of government and industry clients in the areas of national security and intelligence, transportation and telecommunications, citizen services, environmental sustainability, and health. Together with our wholly owned subsidiaries, Noblis ESI and Noblis NSP, we tackle the nation's toughest problems and support our clients' most critical missions.