



White paper

Maintaining Reliable Data Connections with the DCC and RDL

Introduction

Telephony is changing, making modem communication more and more unreliable.

Across the country, products relying on modems to communicate data have experienced a host of connectivity issues. Modem reliability has been degrading due to the declining ability of phone lines to carry modem data, and the reality is that telephone infrastructure is changing in ways that will continue to make modem communication less and less reliable.

Inovonics is not immune to this problem. The Inovonics data concentrator and communicator (DCC) was designed to communicate via a modem over the public switched telephone network (PSTN).¹ As the PSTN is no longer maintained and faces obsolescence due to the emergence of voice over IP (VoIP) telephony, connectivity issues are becoming the norm. As a result, Inovonics has received a number of questions about intermittent connectivity issues from TapWatch customers still using a DCC or a remote data logger (RDL) using a modem connection.

This white paper will briefly discuss the reason for the switch from the PSTN to VoIP, its impact on the DCC and RDL, why VoIP is inadequate for modem communication, and end with a recommendation to migrate from modems to IP-based communication.

The Disappearing Public Switched Telephone Network

Until recently, all voice traffic was carried over the PSTN. By its nature, the PSTN was inherently stable and reliable for analog voice communication. Because of the way modems operate, turning digital data into a modulated electrical signal for transmission across telephone lines, that reliability also applied to modem communication.

As Walker and Hicks explain in *Taking Charge of your VoIP Project*, the PSTN's reliability was a result of the dedicated circuits. "[W]hen you make a call, you receive a dedicated circuit from one telephone to the other, through everything

1. Jane Laino, *The Telephony Book*, (San Francisco: Miller Freeman, 1999), 90

The public switched telephone network is disappearing, and being replaced by voice over IP, which is inadequate for modern communication.

More and more telecommunications companies are moving to voice over IP over broadband because of the reduced cost.

that is in the middle.”¹ That dedicated connection is central to the PSTN, and is the reason for its stability and reliability.

Over the years the PSTN has become increasingly more expensive to operate. Most voice grade land lines, and the supporting switchgear, have been in service for decades. As land lines and switchgear age, more maintenance is required. Furthermore, the cost of maintenance has increased by the rising cost of labor and materials. And because subscribers are decreasing, there's a smaller customer base over which to spread maintenance costs.

Because of this, telecommunications companies have been searching for cheaper methods of phone service delivery.² Recognizing the expenses of maintaining PSTN infrastructure, telecommunications companies are already “pressing to be freed from the obligation of providing low-cost fixed-line telephone service.”³ AT&T recently led a petition with the Federal Communications Commission (FCC) asking to be allowed to replace their PSTN-based services with IP-based services.⁴ These new services are being classified as information services, not as telecommunication services, thus avoiding the quality and availability requirements of the regulations applied to telecommunications utilities.

The PSTN looks to be on track for complete obsolescence. According to one article, “the FCC is on course to let Verizon, AT&T, and other phone companies stop maintaining the old Public Switched Telephone Network (PSTN) by around 2020, eventually moving everyone to Voice over Internet Protocol (VoIP) phone service.”⁵

The reason for this is clear. Deploying VoIP is significantly cheaper than maintaining a phone line, as the customer is already paying for the maintenance and operation of a broadband Internet connection. The use of VoIP also allows the telecoms to retire the PSTN switchgear in favor of cheaper IP-based switchgear.⁶ As such, more and more phone services have been migrated to VoIP.⁷

1. John Q. Walker and Jeffrey T. Hicks, *Taking Charge of your VoIP Project*, (San Jose: Cisco Systems, 2003), 5

2. GIGAOM, 2009. “A Dying Landline Business Sounds a Lot Like Static.” <https://gigaom.com/2009/04/28/a-dying-landline-business-sounds-a-lot-like-static/>

3. Cecilia Kang. (2012, April 12) “Landline rules frustrate telecoms.” *The Washington Post*. Retrieved from www.washingtonpost.com

4. AT&T, 2012. “AT&T Petition to Launch a Proceeding Concerning the TDM-to-IP Transition.” <http://publicpolicy.att.com/att-petition-to-launch-a-proceeding-concerning-the-tdm-to-ip-transition>

5. arstechnica, 2014. “How Verizon lets its copper network decay to force phone customers onto fiber.” <http://arstechnica.com/information-technology/2014/08/why-verizon-is-trying-very-hard-to-force-fiber-on-its-customers/>

Designed to transmit data, VoIP communication is neither as reliable or as stable as the PSTN for voice communication. And because of the way VoIP communication handles data, it is less reliable for modems. It is a mismatch in requirements. Again in the words of Walker and Hicks, “[t]he audio portion of the call needs to be converted from analog to digital, cut into packets, sent across the network in packet format, reassembled, and converted from digital back into analog.”¹ This is usually suitable for voice conversations, but makes modem communication unreliable.

Problems with VoIP for Modem Communication

Changing phone service protocols to voice over IP has led to two problems for modems: Compression and packet loss.

With the migration from PSTN infrastructure to IP-based infrastructure, the protocols used to transmit the audio information of a phone call have changed. PSTN used a protocol referred to as time division multiplexing (TDM) which guaranteed a certain amount of capacity to be allocated to a particular phone call.² The VoIP protocol does not maintain this guarantee,³ introducing two problems for modem reliability: Compression and packet loss.

Compression

The TDM protocol uses 64kbps (kilo bits per second) channels to carry voice information,⁴ while the VoIP protocol usually compresses the voice information into an 8kbps channel.⁵ According to Lawrence Harte, “The process allows IP Telephony service to have lower data transmission rates

6.AT&T, 2012. “AT&T Petition to Launch a Proceeding Concerning the TDM-to-IP Transition.” <http://publicpolicy.att.com/att-petition-to-launch-a-proceeding-concerning-the-tdm-to-ip-transition>

7.Edward Wyatt (2013, November 19) "F.C.C. Chairman Calls for Transforming the Technology Used by Phone Systems." *The New York Times*. Retrieved from www.nytimes.com

1.John Q. Walker and Jeffrey T. Hicks, *Taking Charge of your VoIP Project*, (San Jose: Cisco Systems, 2003), 13

2.Time-division multiplexing. (n.d.). In *Wikipedia*. Retrieved December 21, 2015, from https://en.wikipedia.org/wiki/Time-division_multiplexing

3.Voice over IP. (n.d.). In *Wikipedia*. Retrieved December 21, 2015, from https://en.wikipedia.org/wiki/Voice_over_IP

4.T-carrier. (n.d.). In *Wikipedia*. Retrieved December 21, 2015, from <https://en.wikipedia.org/wiki/T-carrier>

5.Voice over IP. (n.d.). In *Wikipedia*. Retrieved December 21, 2015, from https://en.wikipedia.org/wiki/Voice_over_IP

than standard telephone service while providing for good quality audio.”¹

However, this creates problems for modems, which need more bandwidth than is provided with VoIP compression. Because most modems operate at data transfer rates between 19.2kbps and 56.6kbps, the VoIP 8kbps channel is simply not capable of carrying the full modem data.

Voice over IP protocols guarantee neither the bandwidth nor the data delivery assurance necessary for modems.

The TDM protocol also allocates time on the channel to guarantee the delivery of data. This allocation does not happen on IP-based infrastructure. As a result, packets can be dropped in the communication channel, causing errors in modem communication.

Packet Loss

Packet loss can occur because of “broken line connections, distortions from electrical noise (e.g. lightning spike), or through intentional discarding due to congested switch conditions.”² Usually, those packet losses are discovered by counting the number of data packets sent vs. those received, and if packets are missing, retransmitting them. However, with voice transmission, it is common “that packet retransmission requests are not performed and the lost packets simply result in distortion of the received information,” making modem transmission of data unreliable.³

Packet loss can be minimized, but cannot be eliminated. According to Ted Wallingford, “[p]acket loss is a fact of life . . . even the most well-intentioned network engineer will only be able to minimize, not completely eliminate it.”⁴

With the reduced data rates and packet loss, the quality and bandwidth needed to operate many modems is simply not available on IP-based infrastructure. As Rob Walters writes in *Computer Telephony Integration*, “quality is traded for efficiency.”⁵

1. Lawrence Harte, *Introduction to IP Telephony: Why and How Companies are Upgrading Private Telephone Systems to use VoIP*, (Fuquay Varina: Althos Publishing, 2006), 13

2. *Ibid*, 15

3. *Ibid*, 16

4. Ted Wallingford, *Switching to VoIP*, (Sebastopol: O’Reilly Media, 2005), 124

5. Rob Walters, *Computer Telephony Integration: Second Edition*, (Boston: Artech House, 1999), 409

The Solution: IP-Based Communication

For reliable data communication, Inovonics recommendation migrate to IP-based solutions.

As the PSTN ages, maintenance becomes more expensive. Likewise, as use of the PSTN declines, the costs per subscriber to maintain the PSTN infrastructure increases. For these reasons, telecommunications companies are pushing towards the cheaper alternative of VoIP, reducing the quality of telephony services.

As a result, the capability of modem communications has been adversely affected, and will continue to degrade. The PSTN is fast approaching obsolescence, and modem communication is soon to be a thing of the past. In the not too distant future, the only option available will be an IP-based solution. In the meantime, the intermittent connectivity issues common to all modems will continue, and increase, until modem communications are altogether obsolete.

For this reason, Inovonics strongly recommends replacing all modem-based communications. For those TapWatch customers still using the DCC, this will mean replacing it with an IP-enabled RDL and ensuring an IP connection. For those customers already using an RDL, but communicating via a modem, this will mean upgrading the RDL firmware to version 2.0 or higher and ensuring an IP connection.

For more information about the Inovonics IP-based solution, please contact Inovonics sales at 303.939.9336 or sales@inovonics.com.