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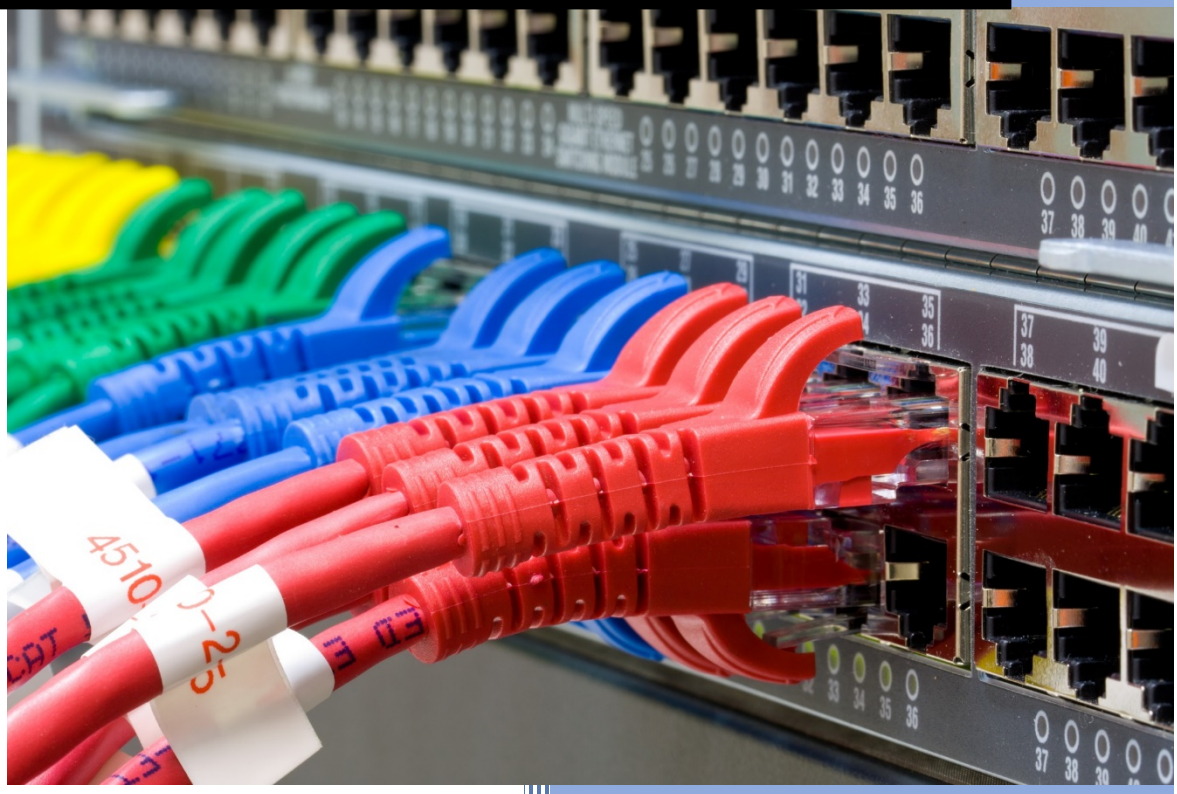
VoIP: Is your network ready?



What you need to know before you implement a VoIP phone system.

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About the Author

Thomas Kay has a Master's of Science degree from Norwich University with a specialization in Information Security and Assurance along with over 16 years of practical industry experience. He has also obtained many industry certifications to prove his industry experience including: CompTIA A+, Network+, Security+, Cisco CCNA, and several Microsoft Certifications. He has also been teaching at a college level for over three years to upcoming trade professionals at Northampton Community College.

Abstract

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Introduction

Voice over IP, or VoIP, refers to the delivery of voice and multimedia such as video over IP based networks. The steps involved in originating a VoIP telephone call are signaling and media channel setup, digitization of the analog voice signal, encoding, packetization, and transmission as Internet Protocol (IP) packets over a packet-switched network. On the receiving side, similar steps (usually in the reverse order) such as reception of the IP packets, decoding of the packets and digital-to-analog conversion reproduce the original voice stream.

Since VoIP requires transmission of data packets through the IP network, the quality of communications is inherently less reliable than circuit switched public telephony standards (POTS) and the quality of phone calls is directly related to the network infrastructure. This document discusses the many different aspects of how VoIP works, what the most common problems are for VoIP, and how to solve those issues.

Terminology

It is important to understand the many different underlying technology standards in order to understand how to fix the issues. This section discusses briefly some of the main terms used in VoIP technology.

SIP

SIP is the Session Initiation Protocol and is current standard in VoIP telephony, similar to H.323. SIP, like traditional telephony, requires a clear understanding of the call process and setup. In SIP there are two phases to call processing including the first phase: call setup. Call setup contains all the information of the call including the source and destination of the call. The

second phase of the call is called data transfer and is used to coordinate the transfer of packets across the network.

Jitter

The job of routers and routing protocols is to allow smart decisions to be made about how a packet will transfer across the network from its source to the destination. In some cases, an internet based route change can happen and the tempo in which packets are sent and received can change mid-stream. When packets arrive at their intended destination in a different order then they were originally sent, the result is a call with poor or scrambled audio (avadtechpr, 2015). Jitter is technically the measure of the variability over time of the latency across a network. Jitter is one of the most common VoIP call quality problems.

Latency

VoIP delay or latency is characterized as the amount of time it takes for speech to exit the speaker's mouth and reach the listener's ear. Latency sounds like an echo (avadtechpr, 2015).

Determining if Your Network is VoIP Ready: First Steps

One of the first and most important tasks in determining if your network is ready for a VoIP implementation is to perform a full network assessment. In some cases, performing a network assessment can be a rather tedious and time consuming task, especially for larger networks. In other cases, the network assessment can take very little time at all, especially if there is already sufficient documentation available. In either case, this vital component to the VoIP implementation can determine if the implementation will go smoothly, or if problems will appear that require remediation. This section of the document will discuss how to perform a site

survey, what to take into consideration, and how to remediate some of the simple issues seen in many implementations.

Site Survey

A site survey can give the network designer or engineer a substantial amount of crucial information about upcoming projects. This initial assessment allows the network engineers to determine what is already on site what could possibly be needed. A proper assessment should include as much information as possible. Keep in mind that VoIP technology is less than ten years old and thus the network equipment that VoIP will be utilizing should also be newer than ten years old.

Some of the information that should be gathered during this initial assessment would be the following. This table represents a starting point, but the more information that can be gathered, the better that the end solution will be.

Table 1. Site Survey Information

Category	Information Sought
Number of users and types of equipment	How many network connections are in use and what is being used on those connections? This information should include how many network computers, users, printers, servers, phones, cameras, etc. are already on the network. The researcher should also determine how many devices, users, etc. will be added over the next 12 months.
Projected growth	What is the expected growth of the company or organization? Will any of this expansion impact the network such as the addition of network devices or users? Will any other buildings or branches be added that require shared network resources? This area of the site survey will allow you to invest in the network infrastructure correctly the first time without additional capital expenses down the road.
Internet connectivity	What type of internet connection do you use (Cable, DSL, Fiber, Ethernet, etc.)? Does the ISP provide equipment or does the organization own the equipment? Who maintains the equipment? Does the Internet Service Provider provide a SLA and if so, what are the terms of that SLA?
Application requirements	What applications does the network need to support? The site survey should detail what network traffic is found on a typical day of use including: significant use of file transfer protocols (SMB, CIFS, FTP, etc.), video streaming services, multimedia applications, etc. The site survey should also determine what additions are being made to the network including the addition of VoIP services and any multimedia devices. These additions may require the increase of internet bandwidth or networking infrastructure.
Existing network infrastructure and physical layout	Working hand in hand with the number of users and types of equipment being cataloged, one should determine the number of networking devices installed on the network. This should include any multi-function devices, printers, scanners, time clocks, or any and all other devices that are seen on the network. This is an excellent opportunity to pull any relevant configurations from these devices and retain them as part of your documentation.
New services required	Will any new services be required now or in the future? This could include any remote access functionality, VPN, video conferencing, etc. Knowing this information will allow a proper upgrade of network equipment and extend the functionality of the upgrades.
Security and privacy requirements	What is the status of the current firewall configuration? Do you have any other in-line security appliances that could hinder network infrastructure? This could include Web Filtering devices and IPS/IDS devices.

Category	Information Sought
Wireless requirements	Is there currently a wireless network implemented? How many users are accessing network resources through the wireless connection typically? The number of wireless users should be included in the other areas of the report and be accounted for so that the bandwidth can be accounted for. It should also be noted what type of wireless access points are in use (802.11a/b/g/n/ac). This is again an excellent time to document the configuration of the wireless access point for review later.
Reliability and uptime expectations	When looking to implement VoIP circuits of any kind, the site survey should determine what the expectation is for reliability. This should include information about any SLAs that you may have on network equipment, firewalls, routers, ISP connections, etc. This will correctly determine where fault points are and determine where adjustments may be necessary. The concept of reliability will allow the organization to determine what happens when a link fails and calls cannot be received or made as well as what the effects are of the outage.
Budget constraints	What is the budget for the implementation? Is it a yearly budget or a one-time allowance for the infrastructure change? System performance, reliability, and scalability are all expensive to achieve. The project budget normally is the deciding factor as to what can and cannot be done. A complete cost-benefit analysis must be completed to determine which features and services are the most critical and which could be put off to a later date.
Asset information	The site survey should be used to document all serial number, model number, and warranty information as well as where the asset is located.

(Reid & Lorenz, 2008)

This may be an excellent time to obtain and document the wiring of the organization on a floor plan in order to determine if there are any other issues that may arise. The floor plan could determine if there are places where wiring cannot be accomplished due to plumbing, firewall, or other property problems exist. As part of the documentation of the floor plan, the site survey individuals should determine where battery backup devices are required and if any are in need of servicing. When organizations are expecting a higher reliability, the organization should determine if alternate power systems should be implemented such as on-site generators.

Physical and Logical Network Topology

It's important to understand and document the different network topologies that are in use in your network. In some cases, the physical topology and the logical topology may be the same, in others the topologies may be very different. The documentation obtained in this section of the documentation phase can be used to easily identify areas of the network that suffer from network congestion and buffer overflows.

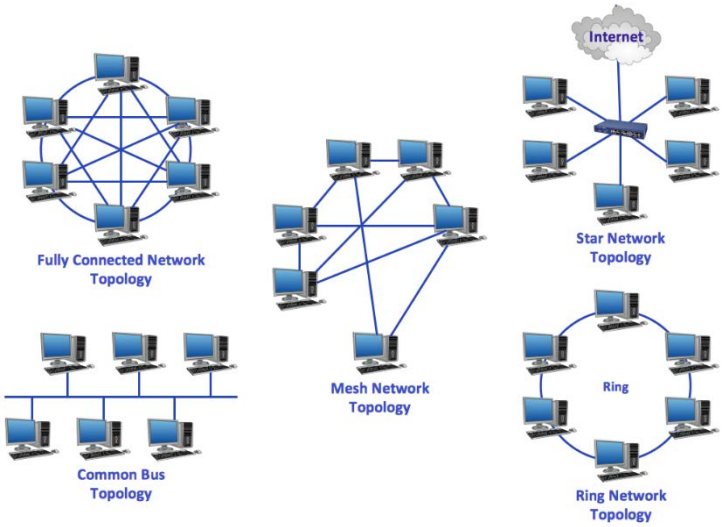


Figure 1. Network Topologies

As network grow over years of company expansion, many organizations will notice that their networks follow the diagram of an extended star topology. In a star topology, each device is connected via a single connection to a central point, which is typically a switch or a wireless access point (Reid & Lorenz, 2008). The advantage of a star topology is that if a single connecting device fails, only that device is affected. However, if the central device, such as the switch, fails, then all connecting devices lose connectivity. An extended star is created when the central device in one star is connected to a central device of another star, such as when multiple switches are interconnected, or daisy-chained together.

Although extended start topologies can be used in many of today's network successfully, extended start topologies can also reveal areas of bottlenecks which will hinder the implementations of VoIP services. For example, if a network has multiple 8, 12, 16, and 24 port

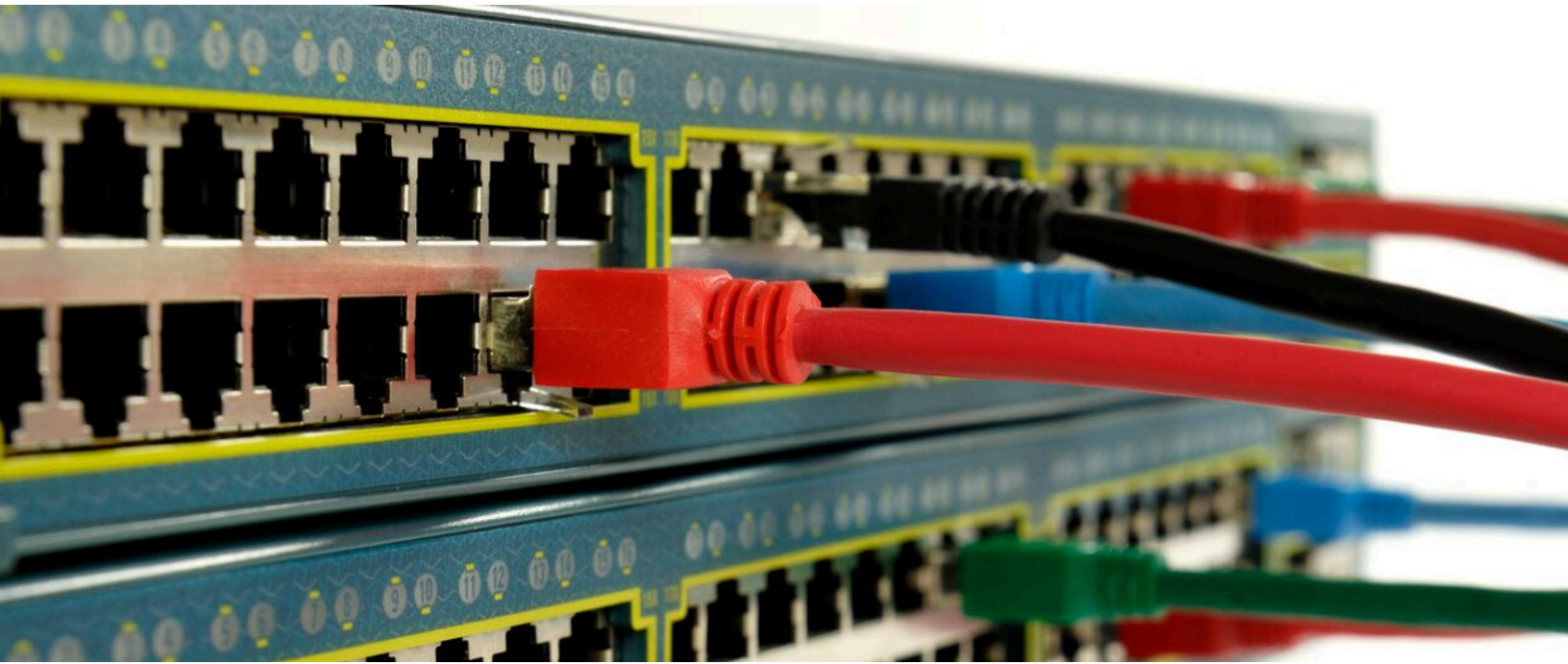
switches throughout a building that are then connected using one connection to a core switch, the documentation can reveal over utilization of that one connection link to the primary switch.

Network Addressing

Just as important as documenting the logical and physical network topology is, it should be part of the site survey to determine what network is in use and determine if the appropriate network subnet has been utilized. In many cases, organizations select the simplest network configuration for ease of administration, but this can often lead to excess broadcast traffic on networks causing excess bandwidth and switch utilization. Instead, a proper network engineer will determine how many devices are on the network, account for growth, and determine if another network would be better utilized for the needs of the organization.

Enhanced Documentation using Wireshark

Originally named Etherreal, Wireshark has gained a large following with many network administrators and network diagnosticians alike. The open source utility is a network packet analyzer and can used to determine what information is being transmitted through a network. When performing a site survey, a network administrator may find it helpful to run a packet capture using the Wireshark utility for a specific duration of time in order to determine if there is



excessive traffic on network switches and if there is any traffic that is unknown to the network administrator.