Understanding the Development and Applications of IP Technology

Abstract:

Technology has been advancing exponentially since the advent of the Internet. New forms of communications have made possible a sharing of ideas and information that has launched the business world into a new "digital" age. Organizations around the world are now searching for the next step in the communication boom that can tie all of the existing media together into a system enabling face-to-face virtual interaction. Recent innovations in the Voice over Internet Protocol (VoIP) field have been quickly approaching the final barriers restraining the full integration of current communications systems.

CONTENTS

I. Introduction

VoIP technology has been developed to condense telephone voice data and transfer it along the signaling data lines now present for Internet and Intranet communication. These advances aspire to considerably reduce the amount of hardware and physical space needed to support available technology, the supervision necessary to maintain both networks, and the cost of the call.

Perhaps the greatest advantage of an IP system is its capacity to unify an organization's communications system in ways that are unachievable with PBX and Centrex technology. An IP system can seamlessly integrate all forms of office communication, making any information available to any member of the office at any time.
Functions made available by IP technology include

- The convergence of voice mail and email into one multimedia system, accessible from remote phone, office phone or PC.
- Multi-media video conferencing delivered to any endpoint in an office.
- Remote location access to all of the physical and data resources of an office.

As will be discussed, VoIP's consolidation of the traditional office communication system into an easily accessed multi-media resource represents a leap forward that stands to change the face of business for the future.

II. How it Works

In every Internet/Intranet digital data network there is a vast amount of bandwidth that goes unused. VoIP technology capitalizes on this dormant bandwidth, using it to transmit voice data along with the signaling data, instead of relying on the Public Switched Telephone Network (PSTN).

When a call is placed using a VoIP system, standard telephone voice data is passed to an IP platform where it is encoded into packets. Once compressed, these packets are transmitted to the signaling data network (LAN, WAN), which carries the connection for digital communication. From the Data line, these packets are capable of traversing any network including Internet, ATM, Frame Relay, and satellite. This enables all forms of communication to be accessed digitally and circumvents the long-distance tariffs and pay-per-call charges imposed by the PSTN. By implementing an IP solution, an organizations communication costs are reduced to a flat-rate volume based billing system which can decrease the cost of communication by up to 80 percent in a high traffic, long-distance situation. Under these conditions, a solution system can feasibly pay for itself in less than two fiscal quarters.

III. Considerations

Once a broad understanding of IP technology has been established, it is important to consider the details required of a successful operating system.

VoIP technology, as with all telecommunications technology, is governed by sets of standards that have been established by the International Telecommunications Union. For an IP solution to be successful it must communicate following ITU specified protocols that dictate the requirements for audio and video transmissions over the Internet. For VoIP, H.323 is the most widely supported protocol, followed by Session Initiation Protocol (SIP) and Media Gateway Control Protocol (MGCP); but platforms should also support H.324 and H.320 for PSTN and ISDN communication respectively. The above standards representing a "common ground" between systems, making IP systems compatible with existing systems for conference calling, video conferencing, and virtual meeting applications.

One major contention that has been placed against VoIP technology in the past is Quality Of Service. In earlier IP systems, sound quality was poor and inconsistent. As the technology moved forward, sound quality improved but some issues remained inherent to the packetizing procedure, "jitter" and delay being the most prevalent.

Jitter refers to a voice data problem that occurs because of a systems varying allotment of times allowed between packets. To compensate, a receiving system has to wait for all of the transmission packets to arrive before playing them, which results in delay. **Delay** is the result of a number of contributing factors including jitter, but is primarily caused by an improper amount of bandwidth available in a system. In a large, high-volume application, voice data packets can run into interference and experience delay as a result of high traffic patterns. To counteract the delay problem, different voice coding systems have been introduced to change the size of data packets and increase the amount of compression; minimizing the quantity of bandwidth needed to transport voice data.

Current voice coding systems or CODEC protocols include; G.711 for 64 kbit/s PCM **voice** coding, G.723.1 for 5.3 and 6.4 kbit/s **voice** coding, G.729A for 8kbit/s **voice** coding, T.37 for Store and Forward **Fax** coding, and T.38 for Real Time **Fax** coding. Each CODEC provides different levels of compression that can be applied as traffic increases and available bandwidth shrinks. The only drawback to the CODEC system is that voice quality decreases as more compression is implemented. For example, the G.711 CODEC is ideally suited for a corporate application where bandwidth is abundant, because it provides no compression but delivers superior sound quality. While G.723 is better for a residential application because it's high compression rate will counteract the delay caused by the smaller amount of available bandwidth.

With these issues taken into account, we can examine the two current platforms that can support IP technology.

IV. How it is Implemented

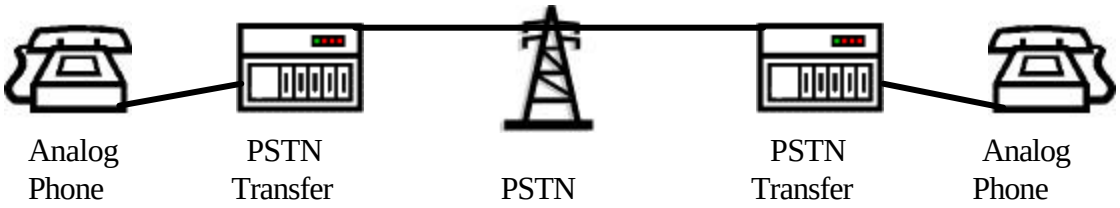
A. The IP Gateway

The gateway was the first "stand alone" form of IP technology; a separate piece of hardware that is placed onto an Intranet above a phone endpoint. Once in place, it converts an existing network of traditional analog phones into a network of Voice over IP phones, while continuing to allow the phones to place calls through the PSTN.

When a call is placed, standard voice transmission from the phone is compressed and transferred in a gateway-to-gateway format.

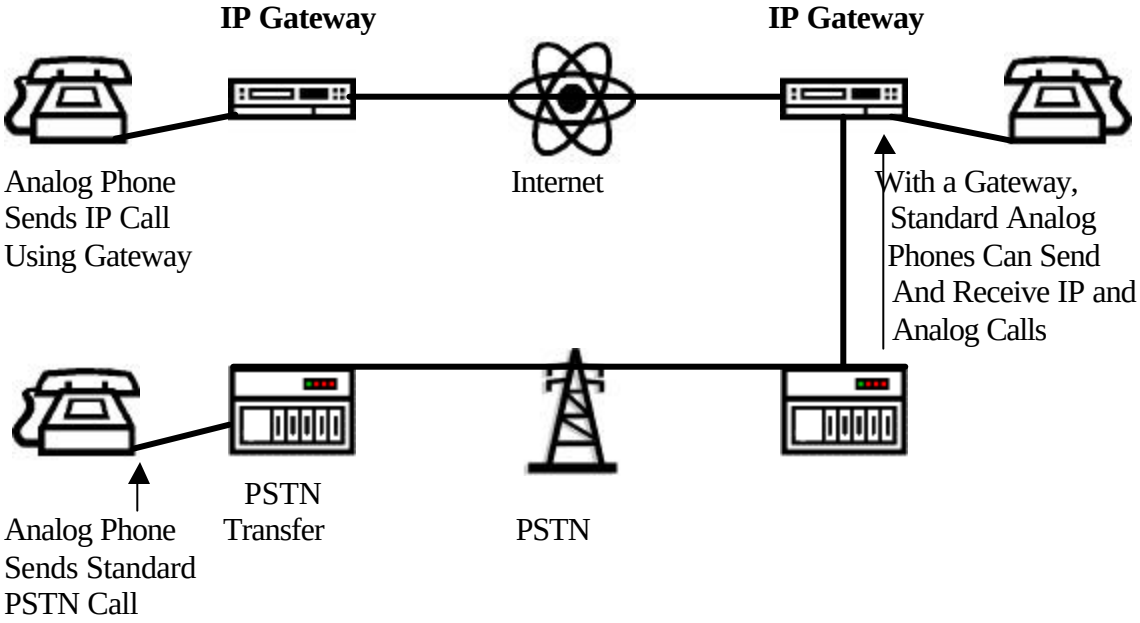
Traditional Analog Phone Connection

Fig 4.1



VoIP Gateway System

Fig 4.2



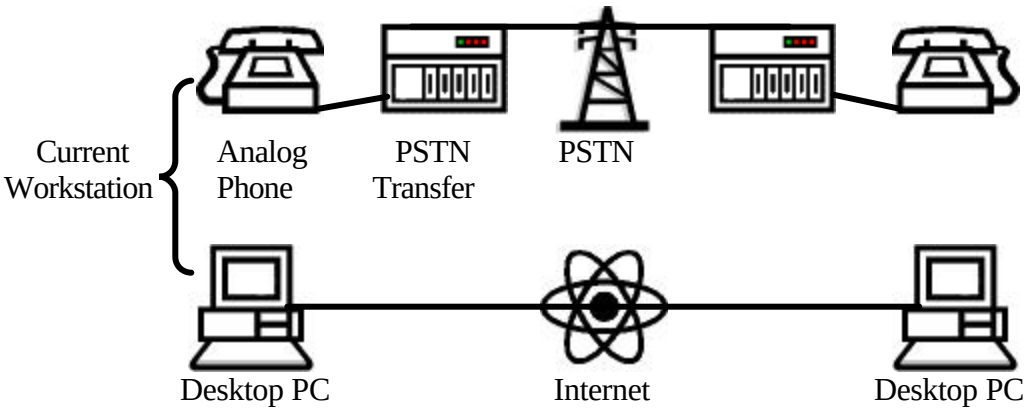
B. The IP Phone

The IP phone implements the same technology, packetizing voice data and transmitting it over data signaling lines; but it combines this technology with the features of an office phone network in one platform.

The primary advantage to the phone is having IP capability without having to add any hardware to the communication chain. It appears in an office environment as a standard desktop phone, but delivers the functionality and savings of IP technology.

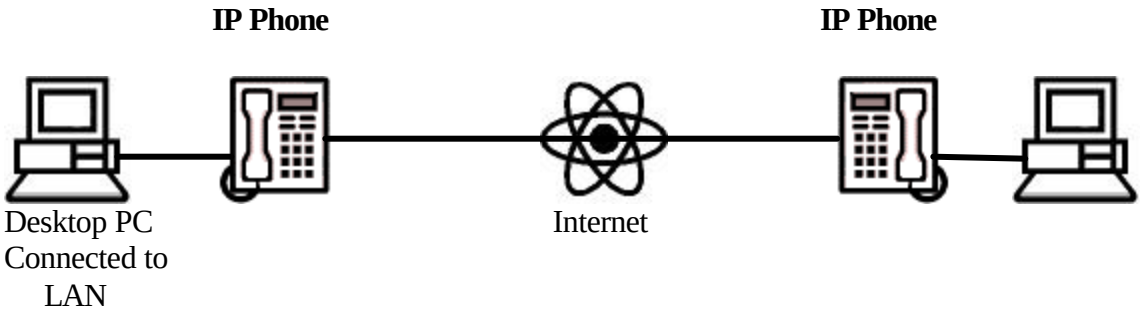
Traditional Office Communication System

Fig 4.3



VoIP Phone System

Fig 4.4



V. General Applications For An IP System

IP systems are tremendously versatile and are capable of cutting costs and enhancing performance in almost any environment. They can be engineered for optimum service with a minimum amount of work and minor changes to an existing system. But to get a better idea for their possible applications, the following three examples will be explored.

A. Enterprise Environment Application:

Communication is the key to big businesses performance. Without a good communication system, an organization can fall quickly behind from repetition, poor service, and missed opportunities.

A VoIP system greatly reduces the chances of such pitfalls by consolidating the communication chain and unifying the office environment. Any organization could quickly replace their traditional analog system with an IP system, largely because the structure is already in place. As was discussed before, to employ a gateway system, phone system, or a combination of the two, only involves a change of endpoints. Once implemented, an IP system provides many features that aren't available with PBX technology. One example is the "voice-button", a button that is placed on an organizations web page that, when pressed, automatically connects a call to a selected department. This allows the company to maximize a customer's interest, at the time of interest.

Another example is the combination of voice mail and email systems. In a VoIP network it is possible to have voice mail transmitted to a users email box and then played on the recipients PC or to have email retrieved by a voice mail system and read back over the phone.

These "shortcuts" maximize an organizations performance by making all information (digital, voice, or even paper) available to anyone with access to the company's Intranet, and breaks down the constraints imposed by traditional communication system.

The Enterprise IP Solution:

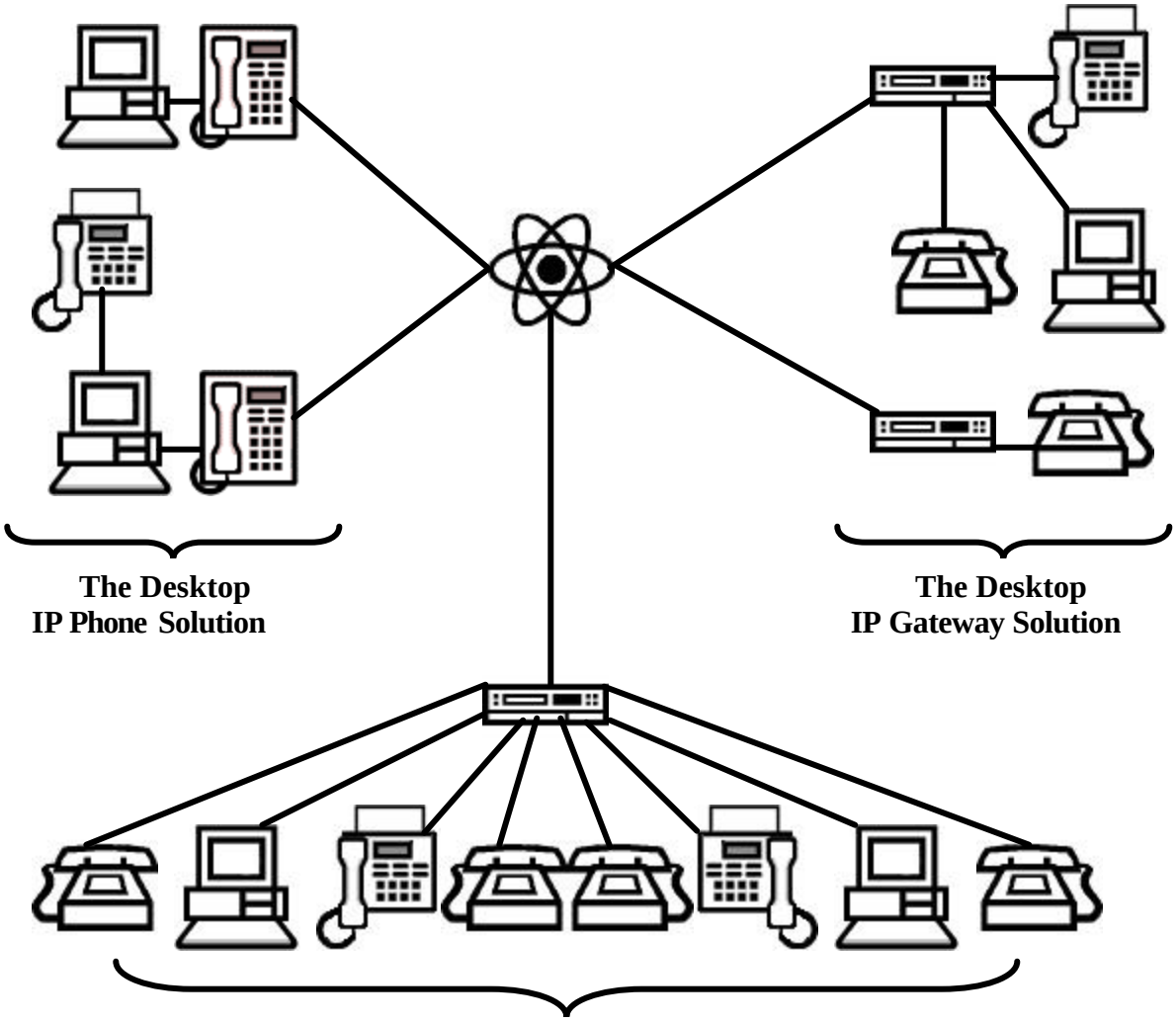
A large organization with multiple offices located in different areas can stay connected through an IP system with any arrangement of endpoints. One option is the desktop IP phone solution. The desktop IP phone can take the place of any traditional office phone, without having to maintain the traditional connection. The existing phone lines can be physically removed from an office because the IP phone only requires a computer connection. Calls can be made between offices or between continents with no difference in cost, while retaining access to the same voicemail, email, and other office systems.

In the same situation, gateways can be installed at individual workstations to IP enable specific departments, using the phones and extension systems that are already in place.

There is also the "in the closet option". Which refers to IP enabling all the phones on a current system by installing a multiport gateway further up in the communication chain. Locating the gateway in the electrical center of a building, or "the closet" allows the office environment to remain unchanged.

Enterprise IP Solutions

Fig 5.1

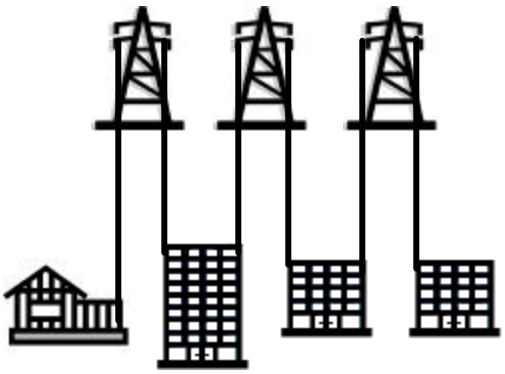


B. The Remote Worker / Branch Office Application:

Distance is no longer an issue in today's communication enhanced society, workers can be stationed around the world and still contribute as part of the core office team. An IP system can be applied in this situation to maximize communication and make the services of an office headquarters available to a remote location.

Traditional Remote Worker and Branch Office Communications

Fig 5.2



The Remote Worker / Branch Office Solution:

In the remote worker solution, an IP platform is capable of providing all the services of an office environment including network call control, multimedia conferencing, voice coding, real time fax, and store and forward fax to any location around the world. The VoIP systems infrastructure also allows a user to dial directly into their Intranet database and access systems like digital directories, on-line planners, and project portfolios. The system makes it possible for a worker to perform with "at the office" efficiency, from any location.

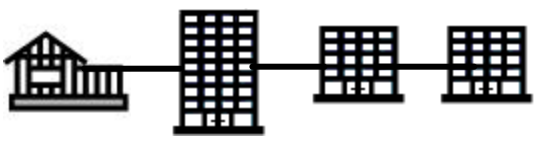
The branch office solution is similar to the remote worker solution in that multiple functions are available and the cost of calling is greatly reduced, but the branch office system saves on a much larger scale, enabling a network of callers with features that simplify office communication.

With an IP system in a branch office environment, locations are capable of instant call conferencing and one-touch speed dial connection to any office, while retaining simple out-of-network calling. Any number of locations supporting any number of workstations can also participate in a "whole network" extension system.

The possibilities represented by this technology will unify the workforce and create a base from which any company can draw the strength of better communication.

Remote Worker and Branch Office Communication, IP Simplified

Fig5.3

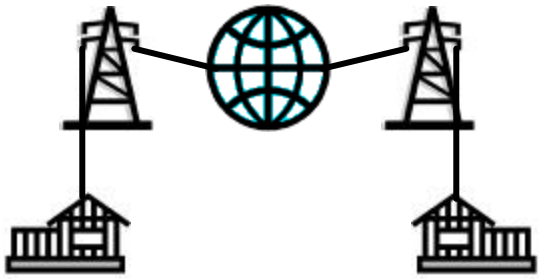


C. The Residential Application:

The residential application represents the final implementation of IP technology. In the future, IP systems will be present in every household, providing reliable service around the world, minimizing cost, and tying together all available media. But when considering the residential application, it is possible to get a clear picture of its future and current benefits.

Traditional Residential Communication

Fig 5.4



The Residential Solution:

The benefits of a residential IP system are quickly becoming apparent as it is applied in a small environment that is meted by tight budgets and monthly bills.

Currently a household can only gain access to Internet calling through an Internet Service Providers (ISP's); but both parties are rewarded from this symbiotic relationship. Subscribers can purchase blocks of long distance calling each month for a static base rate, dramatically reducing the cost of typical long distance communication; while the ISPs only have to pay for the local charges incurred before gateway-to-gateway transmission.

In this application when the subscriber places a call, it is first sent to the ISP's nearest gateway, where it is then packetized and transmitted over the IP network to the gateway that is closest to a calls destination. Once there, the packets are translated and switched to the PSTN to make the final connection. By employing the IP system, providers avoid the long distance tariffs that govern the PSTN.

While this previous scenario allows IP communication in a residential application today, the benefits of a true residential solution have yet to be realized. As the larger communications companies become more involved with the IP market, a residential unification of incoming media is beginning to evolve. Advances in gateway technology are now being aimed the consolidation of residential entertainments multiple media signals. These "household gateways" are being designed to act as a communications hub for a home, receiving all transmissions from a single line and providing channels for Internet connection, television programming, and telephone communication throughout the house.

Residential Communications, IP Simplified

Fig 5.5

VI. Conclusions

The applications presented in this paper focused on the possibilities that become available to the user of an IP system. As discussed, the advances made in Voice over IP field stand to revolutionize the communications industry as new products are developed. Interest has grown in recent years as Telecom industry reports announced data transfer surpassing voice transfer usage in 1997, increasing demand and fuelling the search for successful standards-compliant IP platforms.

Since it's inception, e-tel corporation has been working to develop H.323 standards based platforms that present viable IP solutions for most applications. Shortly after the successful release of its FreeRide Gateway, e-tel announced the completion of one of the first standards-compliant IP phones. For further information about e-tel and its product line, visit www.e-telcorp.com.