

INTERNET AS A COST EFFECTIVE TELEPHONE NETWORK OF THE WORLD

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ABSTRACT

The paper focuses on the developments of telephone network, and the internet as the cost effective solution telephone network. In order to justify the internet as the telephone network of the world, the circuit switched and the packet switched telephone networks were compared based on several parameters such as the benefits, cost and overall aim of ingenious innovations. The internet telephony was in many ways proven cheaper, and its fast growth rate indicates future dominance.

Keywords: Internet, circuit switch, Packet switch, Telephone Network, VoIP.

INTRODUCTION

Telecommunication is the extension of communication over a distance [4]. In practice it recognizes that something may be lost in the process; hence the term 'telecommunication' covers all forms of distance and/or conversion of the original communications, including radio, telegraphy, television, telephony, data communication and computer networking. Therefore, computer communication across the Internet, such as e-mail and internet faxing, is just one of many examples of telecommunication [4].

Decades ago, telecommunication was viewed as solely the telephone industry. Today, telecommunication is an exciting area of study, involving fast moving and sophisticated technologies of the telephone, television, radio, computers, the Internet, and more. Plotting a strategic course through the telecommunication landscape while it undergoes revolutionary change involves a multidisciplinary approach, as represented by the research agenda of the Telecommunication Studies Group.

The latest telecommunication technology can be installed on your premises with the help of telecommunication consultation. Internet, pay-TV and telephony, satellite networking, over xDSL or CATV systems, Video-on-Demand (VoD) are some of the popular options available today.

Voice over Internet Protocol (Voice over IP, VoIP) is one of a family of internet technologies, communication protocols, and transmission technologies for delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks, such as the Internet. Other terms frequently encountered and often used synonymously with VoIP are IP telephony, Internet telephony, voice over broadband (VoBB), broadband telephony, and broadband phone [12]. IP communications technology has transformed the economics of business communications by bringing voice onto the data network. With new productivity features on the horizon, look for next-generation business telephone systems to deliver even more value [16].

OVERVIEW

All telecommunication networks are made up of five basic components that are present in each network environment regardless of type or use. These basic components include terminals, telecommunications processors, telecommunications channels, computers, and telecommunications control software [11].

The Telephone and Telephone Network

The telephone is a telecommunication device that transmits and receives sound, most commonly the human voice. Telephones [18] are a point-to-point communication system whose most basic function is to allow two people separated by large distances to talk to each other such as the analog telephone (figure 1), IP telephone (figure 2), and mobile phones, etc. It is one of the most common appliances in the world and has long been considered as indispensable to household, businesses and government.



Figure 1: An analog telephone [18]

A telephone network is a telecommunications network used for telephone calls between two or more parties. There are a number of different types of telephone networks:

- A fixed line network where the telephones must be directly wired into a single telephone exchange. This is known as the public switched telephone network or PSTN.
- A wireless network where the telephones are mobile and can move around anywhere within the coverage area.
- A private network where a closed group of telephones are connected primarily to each other and use a gateway to reach the outside world. This is usually used inside companies and calls centres and is called a private branch exchange (PBX).

Public telephone operators (PTOs) own and build networks of the first two types and provide services to the public under license from the national government. Virtual Network Operators (VNOs) lease capacity wholesale from the PTOs and sell on telephony service to the public directly.

Digital Telephony

The Public Switched Telephone Network (PSTN) has gradually evolved towards digital telephony which has improved the capacity and quality of the network [18]. End-to-end analog telephone networks were first modified in the early 1960s by upgrading transmission networks with T1 carrier systems, designed to support the basic 3 KHz voice channel by sampling the bandwidth-limited analog voice signal and encoding using PCM. While digitization allows wideband voice on the same channel, the improved quality of a wider analog voice channel did not find a large market in the PSTN. Later transmission methods such as SONET and fiber optic transmission further advanced digital transmission. Although analog carrier systems existed that multiplexed multiple analog voice channels onto a single transmission medium, digital transmission allowed lower cost and more channels multiplexed on the transmission medium. Today the end instrument often remains analog but the analog signals are typically converted to digital signals at the Serving Area Interface (SAI), central

office (CO), or other aggregation point. Digital loop carriers (DLC) place the digital network ever closer to the customer premises, relegating the analog local loop to legacy status [18].

The Internet

The Internet is a worldwide, publicly accessible series of interconnected computer networks that transmit data by packet switching using the standard Internet Protocol (IP). It is a "network of networks" that consists of millions of smaller domestic, academic, business, and government networks, which together carry various information and services, such as electronic mail, online chat, file transfer, and the interlinked web pages and other resources of the World Wide Web (WWW) [15].

Internet Protocol (IP) Telephony

Internet Protocol (IP) telephony (also known as Voice over Internet Protocol (VoIP)), is a disruptive technology that is rapidly gaining ground against traditional telephone network technologies. As of January 2005, up to 10% of telephone subscribers in Japan and South Korea have switched to this digital telephone service [18]. A January 2005 Newsweek article suggested that Internet telephony may be "the next big thing" [5]. As of 2006 many VoIP companies offer service to consumers and businesses [18].

IP telephony uses an Internet connection and hardware IP Phones (figure 2) or softphones installed on personal computers to transmit conversations encoded as data packets (figure 3). In addition to replacing POTS (plain old telephone service), IP telephony services are also competing with mobile phone services by offering free or lower cost connections via WiFi hotspots. VoIP is also used on private networks which may or may not have a connection to the global telephone network. VoIP also functions directly through the computer, as a user can connect his headphone with a microphone to the computer's headphone jack and using such service providers as Skype, yahoo or live, talk free over the internet. IP telephones have two notable disadvantages compared to traditional telephones [18].



Figure 2: A VoIP phone [18]

- Unless the IP telephone's components are backed up with an uninterruptible power supply or other emergency power source, the phone will cease to function during a power outage as can occur during an emergency or disaster, exactly when the phone is most needed. Traditional phones connected to the older PSTN network do not experience that problem since they are powered by the telephone company's battery supply, which will continue to function even if there's a prolonged power black-out.
- A second distinct problem for an IP phone is the lack of a 'fixed address' which can impact the provision of emergency services such as police, fire or ambulance, should someone call for them. Unless the registered user updates the IP phone's physical address location after moving to a new residence, emergency services can be, and have been, dispatched to the wrong location [6].

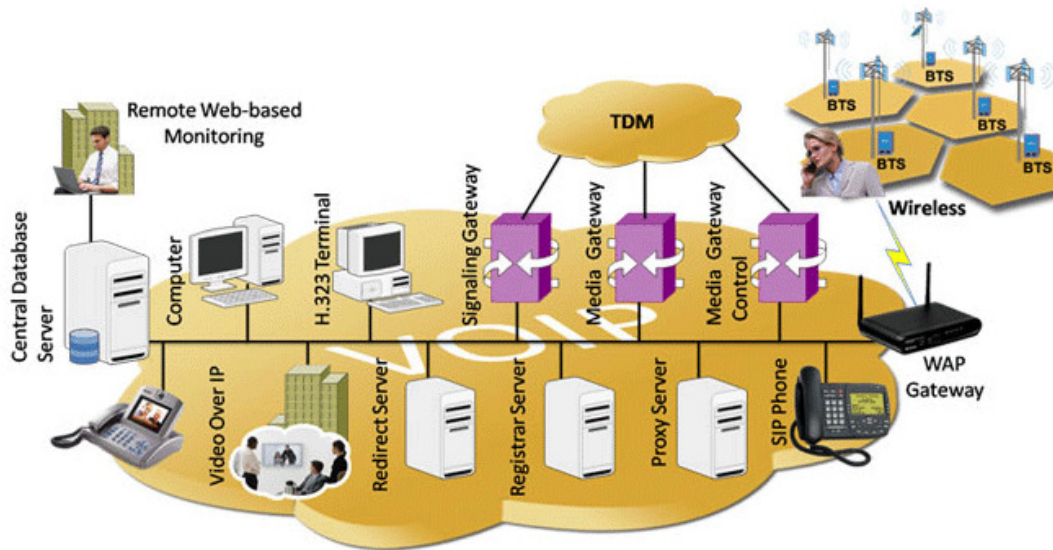


Figure 3: VoIP integrated data network [17]

Benefits of the Telephone Network and Internet

The telephone and the Internet are very useful in many areas such as business, education, health, governance, etc. People discover various benefits of the telephone and Internet for business. Unlike grassroots companies that don't use the Internet or phone for business transactions, firms that do have the potential to grow their business, earn greater revenue and save money by opting to do a large percentage of their business online. New businesses and established companies also increase their visibility by marketing and advertising because of the accessibility of the web. It is more visible to a larger customer base, allows networking among companies, and more money can be saved on office supplies.

Comparison and Advantage of the Internet and Telephone

The public switched telephone network (PSTN) is the network of the world's public circuit-switched telephone networks, in much the same way that the Internet is the network of the world's public IP-based packet-switched networks.

From the above reviews we can see that the telephone network and internet's primary purpose is communication. The telephone helps us communicate in far distances. With the advanced technologies and functions of the telephone system we were able to introduce the internet to it with such functions as VoIP, we can cost effectively contact people even in the remote areas as long as there is internet

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One of the reasons in the motivation to send voice over IP on a dedicated enterprise network (intranet) is the cost advantage that this process offers to organizations due to integration of computer and telephony on the same platform. However, this advantage is not obvious when we are talking about a carrier grade network for carriage of voice traffic on a backbone network of the type deployed by local and long-distance carriers in their country, where QoS is not a trivial issue [10].

IP telephony serves as a strategic enabler for cost savings and other factors that allow businesses to gain a competitive edge. One area in which IP telephony offers significant savings is network management and maintenance. IP telephony solutions nearly eliminate the cost of additions/moves/changes [9]

Although reducing long-distance network costs is always a popular topic and provides a possible reason to introduce IP telephony, the actual savings over the long term are still under scrutiny and debate. Some commentators believe that the savings from lower prices are based on avoiding telephony access charges and settlement fees. Others believe that IP telephony has the potential to benefit the customers through efficient provisioning of converged services on a single network. Saving on bandwidth cost is pronounced where the volume of data traffic is heavy and has overtaken voice traffic [10].

IP telephony also offers productivity gains to employees and management alike, with applications such as [9]:

- Teleworking
- Unified messaging – collapsing voicemail and e-mail into a single application

Comparison of IP (fixed and mobile, access and core networks) with Circuit-Switched (fixed and mobile) Telephony

An integrated infrastructure that supports all forms of communication allows more standardization and reduces the total equipment and spares complement. The economies of putting all forms of traffic over an IP-based network will pull companies in this direction, simply because IP can act as the unifying agent regardless of the underlying architecture. This combined infrastructure can support dynamic bandwidth optimization. However, the present-generation Internet (IP) was designed only for data traffic and does not guarantee any QoS for real-time voice and video. The standards for real-time traffic are still evolving [10]. For the sake of comparison, we will take a look at the cost structure between the circuit-switched network and the IP-based next-generation network [10] (table 1). The comparison between Interconnect charging in circuit-switched and Internet (packet-switched) networks will also be detailed in the results (table 2).

FINDINGS

The comparison between the traditional telephone and the IP telephone networks was first based on the cost structure, as given in table 1 below.

Cost Based on Structure

Table 1 – Cost structures [10]

Cost components	Costs with circuit-switched Networks	Costs with next-generation network (Internet)
Carriage of voice calls	Strong distance dependent Strong dependence on call duration	Weak distance dependent Weak dependence on call duration
Access costs	Relatively low fixed cost per basic telephone line (assuming infrastructure access pipe is available)	Same as for circuit-switched (assuming broadband access is not required)
Customer support	Staff intensive, so high cost or low level of support	Automated, so higher level of customer support for the cost of providing customer support on a circuit-switched network
Adding new services	High	Low
Dealing with growth in data traffic	Very high	Substantial but much less than for a circuit-switched network
Data services	High because of the requirement to run separate overlay networks	Relatively low, because all services – voice and data – run over a single network

Cost Based on Interconnection

The following table provides comparison between Interconnect charging in circuit-switched and Internet (packet-switched) networks [10].

Table 2 – Interconnect charging: circuit-switched networks versus the Internet [10]

Interconnect arrangement for charging	Circuit-switched networks	Internet (IP)
Terminating traffic	Charge per minute	No charge between IP networks of the same size Large ISPs charge small ISPs on the basis of the BW of the IC link
Transit traffic	Charge per minute	Charge on the basis of the BW of the IC link
Interconnect link	Cost sharing on Causation basis	Smaller IP networks normally bear the cost of the link in full

Internet Telephony Growth Model

The worldwide Enterprise Packet Voice Market was forecasted to grow 49 percent in 2003 to \$2.03 billion. Synergy Research is forecasting this market to grow to \$6.03 billion by 2007, representing a CAGR of 31.2 percent [9].

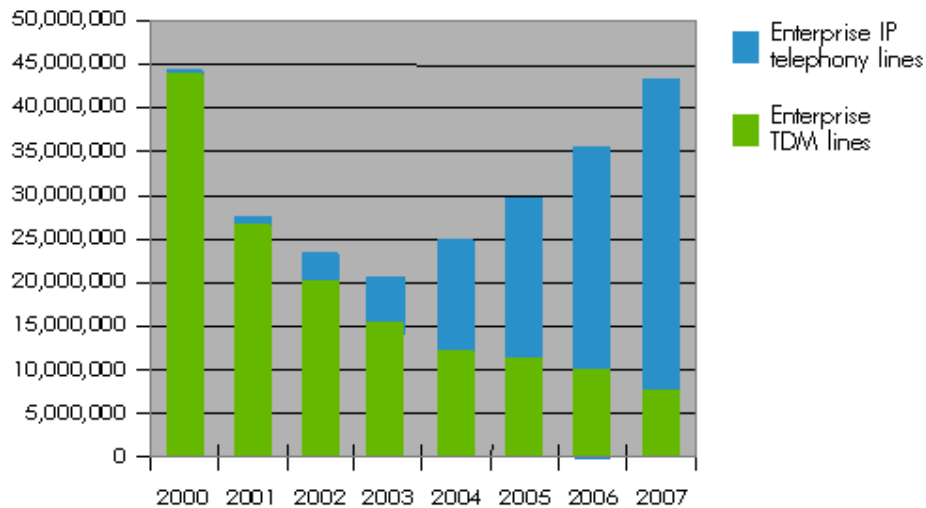


Figure 4: Enterprise packet voice market [9]

DISCUSSIONS

From table 1 above, it can be seen that [10]:

- The cost of voice calls on a next-generation network deploying IP is not sensitive to distance or duration. So there are opportunities for a next-generation network operator to move to a flat-rate pricing for IP telephony calls.
- Access pricing may be a key issue for next-generation networks. How can they recover the high cost of providing integrated broadband access without deterring customers?
- There are opportunities for next-generation network operators to price services at levels below those of their circuit-switched competitors.
- The next-generation network operators need to think about how they will recover the cost of meeting the data traffic growth generated by their customers. They may expect their network

components to double their price: performance ratio over 18 months (as per Moore's Law), but data traffic will increase by as much as ten times over the same period.

Today the market for IP telephony is rapidly maturing [9] [13] (Figure 4). There has been widespread deployment and acceptance of IP telephony solutions in a broad range of market sectors, such as government, education, healthcare, finance, and manufacturing where competitive advantages depend on the ability to enhance productivity and increase mobility. Opportunities are not limited to these markets; in fact, new organizations have deployed IP Telephony solutions, considering a range of benefits that include cost savings, increased revenues, and new opportunities to drive business innovation. Even companies that had not been favorably disposed toward IP telephony now realize the advantages of introducing this technology into their own enterprises. From the research highlights, it is expected that the Internet protocol telephone will be expected to take over the market against the circuit switch traditional telephone. Thus, the various enterprises offering dual network serves to ensure data and voice communication can skillfully singularize into one network, the internet for both services and many more at a minimum cost [9].

Top Ten Ways to Save Money with VoIP

Voice over Internet Protocol (VoIP) phone systems is legendary for their ability to slash communications budgets [16]. Flexibility, integration with the data network, and streamlined technology add up to sizable cost savings. The following points are the ten ways [16]:

- 1. Lower Long Distance Bill.** Because VoIP services use the data network rather than the public switched telephone network (PSTN), they eliminate the long-distance tolls associated with traditional phone service.
- 2. Less Equipment.** IP communications systems dispense with the costly equipment of traditional business telephony: the private branch exchange, and switchboards. Hosted services remove the infrastructure cost altogether, requiring only a company local area network (LAN) and handsets. Even on-premises VoIP systems eliminate physical equipment because the system runs on the existing data network and IP private branch exchange (PBX) software. Many IP communications solutions can also repurpose legacy hardware, saving companies even more on equipment costs.
- 3. Single Network Infrastructure.** In most cases, the IP communications infrastructure is already in place. VoIP trades PSTN wiring and switchboards for the existing data network, running on the same network the company uses for data communications.
- 4. Maintenance Savings.** Data networks are cheaper to maintain than traditional wired business telephone systems. Moves, adds, and changes, for example, used to require the manual rewiring and rerouting of office phone lines. IP communications can be reconfigured with the click of a mouse. Today's business telephone systems feature self-service interfaces that allow the user to configure his own preferences, without involving IT. The upshot: significant savings in technical support costs.
- 5. Facility Savings.** IP communications is the basis for increasing virtualization in the workplace. Workers can telecommute from anywhere, reducing the need for a central workplace. Many companies have realized significant savings in overhead costs by moving employees to remote or home offices.
- 6. Low-cost Access to Features and Services.** Advanced features used to come with a steep price tag, bundled together as part of the PBX system. VoIP telephone systems include many of these features (such as advanced call distribution) free of charge. Other advanced functionality is available on an affordable basis through hosted VoIP services, which sell access to features on an a la carte, as needed basis.

7. **Increased Productivity.** VoIP telephone systems have a profound impact on worker productivity. Advanced features, remote access, and voice-data integration add up to time savings and greater efficiency.
8. **Data Integration.** The integration of the voice and data system is a powerful driver of **operational efficiency**. For example, your business can take advantage of customer relationship management (CRM) software to streamline customer engagement and access to key data.
9. **Scalability.** IP communications systems can be instantly ramped up or scaled back according to current business needs. Hosted VoIP services offer the most flexibility, ensuring that businesses don't lose money through insufficient or excess communications capability.
10. **Customization and Flexibility.** VoIP business phone systems can be configured to meet your company's unique and evolving business requirements.

The Future of Internet Telephony

The future of VoIP is bright and it is now a reality, especially in fixed telephony, that generates benefits both for customers and service providers - most notably, reduced costs and improved communication through innovative services - even though it is not a solution that will make up the fall in fixed operator's core voice revenues [8]. On the mobile side, all is yet to come as expected, but it is likely that operators will also capitalize on VoIP to defend their competitive position in the future.

The annual growth rate of the Western European telecommunications Valerio Fallucca market is slowing, with growth forecast at around 2% over the next 3-4 years, Partner compared to growth levels of 8-9% p.a., seen prior to 2003, and rates of 3-4% p.a. in more recent years [8]. Some say the market has reached saturation, with near 100% mobile and fixed line penetration.

However, mobile phone services continue to grow, as does broadband penetration, and we expect these to be the growth drivers of the industry going forward. One of the key applications enabled by broadband is "Voice over IP" (VoIP), a solution that brings benefit for both service providers and customers. For service providers, VoIP enables greater traffic management efficiency, as the change from circuit switching to packet switching enables more efficient network capacity management. For customers, it provides call cost savings and access to brand new services, or services that were previously cost prohibitive, such as videoconferencing, "presence" services, number identification and switchboard for small companies, for example [8].

VoIP is not only call cost saving, but also access to value added services that enrich the communication experience. There are at least three VoIP access models [8]:

1. **Direct Access:** where the service provider owns the infrastructure and its offer includes a VoIP service. Examples can be found all over Europe (BT Broadband Talk in the UK, Telecom Italia Alice Voce in Italy, etc.). In this case the customer can use the new service either as a second line (if provided by the incumbent) or as a new line replacing the traditional one (if provided by an altnet, like Fastweb in Italy for example)
2. **Indirect access:** where the VoIP offer sits on top of an existing broadband connection and can be provided by an alternative service provider, like the offer from Vonage in the US, for example.
3. **The "soft client" model:** where users download software on the PC to access the service. Skype [14] is the most obvious example. In this, and the previous example, the customer is likely to maintain the legacy line agreement with the incumbent as well. VoIP is now a mainstream in the business environment. In Italy, for example, the number of companies using VoIP services has almost doubled, from 10% in 2003 to over 20% now. In addition, nearly 65% of Italian companies are evaluating the opportunity of switching to VoIP, to improve communications, reduce costs and be more competitive.

Whilst consumer take-up lags behind business take-up, this too is an area of strong potential growth. In 2004, 8% of Italian households were estimated users of VoIP services and analysts expect this number to reach one third of Italian families (over 6 million households) by 2010.

CONCLUSION AND RECOMMENDATION

The circuit switched telephone network service had proved effective since in use. Packet switched (Internet) telephone service has also met especially with the recent improvements in the technology, eliminating the various challenges such as the tackle against Quality of Service (QoS), adoption of security techniques ranging from software/ applications configuration to hardware, and many more.

In comparison, the internet telephony has proven has proven more cost effective over the switched telephone service, with many more affordable communication facilities provided with the presence of the internet service.

The rapid growth of the internet telephony over the circuit switched is an indication that the enterprise including other end users are switching to the packet switched (internet) telephone service due to its numerous benefits. Therefore, from the literature reviewed above, it can be concluded that the internet has taken over the telecommunication market and hence the telephone network of the world.

In the deployment of IP telephony, customers must address several considerations including quality of service, reliability, security, interoperability, ease of use and affordability so as to achieve the maximum benefits from this and next generation telephone network service.

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