Research Report

The Strategic Migration of Telephony into an Internet Protocol World – a South African Perspective

by

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"I, Pieter Adams, herewith declare that the language of this research report has been edited by Me. L Coetzer"

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Student's signature

Acknowledgements

"Thank You Heavenly Father YAHWE for Your amazing love, grace, health and protection, not only during the writing of this report, but for all time. Thank You for providing me with opportunities that many around the world might never experience. While I might stumble, You remain faithful. You are indeed the All Sufficient One, the Alpha and the Omega of life. "

To my wife Lizelle: Thanks Liefie for your support and love, and for looking after my wellbeing. You are my best friend and companion in life. I love you with all my heart.

To our baby who are still being formed by the Master: Daddy loves you and you are proof that an MBA can have many pleasant moments as well. See you soon!

To my study leader: Neels, thank you very much for the guidance and feedback. Sorry for all the technical jargon here and there.

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EXECUTIVE SUMMARY

Internet Protocol Telephony (IPT), also known as Voice over Internet Protocol (VoIP), has evolved from a niche technology to one that is adopted fairly well in developed countries. The aim of this research report was to determine whether IPT will also be a success in the Republic of South Africa, which is one of many developing countries. The technology was analysed and it was found that cost reduction, increased productivity and enhanced applications were the most valuable benefits the technology could offer. Particular interesting impediments of the technology were discovered and it was found that there existed both hard issues like security and quality problems, as well as softer issues like internal politics, that could hinder the global success of the technology. The adoption rate of South Africa was compared to that of industrial countries and it was found that South African organisations overall posed a wait-and-see attitude towards IPT. Various implementation models were discussed and it was found that a hybrid approach would be the most viable option for local organisations. The South African environment were analysed and it was discovered that the biggest obstacle for success in South Africa was the regulatory environment. But it was also found that the environment would soon change and that competitors, including Black Economic Empowerment companies, should use the opportunities available. Social factors like HIV/AIDS and theft as well as economic factors like the exchange rate could hamper the competitiveness of local companies using IPT. IPT technology can only be a success in South Africa if it is intensely supported by Government, implemented in the correct manner and adopted aggressively by the local market.

CHAPTER 1: INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction

According to Thomson & Strickland (2003:172) companies today are forced into two demanding races:

- "The global race to build a market presence in many different national markets and to establish an attractive position among the global market leaders
- The technology race to benefit from today's technological and information age revolution and build the resource strengths and business capabilities to compete successfully in the industries and product markets of the future"

South African organisations are also competing in the global race as well as the technology race and should not relax in a zone of comfort. They should be aware of new technological developments and use them as best they could to compete in the local and global markets. A new technology, IP Telephony (IPT), has been struggling over the last couple of years to get off the ground and is making its way to be the enabler of many more unimaginable things to come. Internet Protocol Telephony (IPT) is one of the latest new technologies that are shaking all industries around the world and it must therefore be explored from a South African perspective.

According to Thompson *et al* (2003) a fundamental aspect of business is that Key Success Factors (KSF) are the rules that shape whether a company will be financially and competitively successful. Telecommunications is found in almost every organisation and therefore real-time communication between the different stakeholders is of extreme importance to the success of an organisation. Using the wrong technology for instance for a call centre will definitely influence the profitability and effectiveness of that call centre, when compared to its rivals. The impact of telecommunications on a business will vary, depending on the business category, as well as the industry being competed in. IPT can possibly also change the KSF of an industry, which will eventually change the rules that shape the environment of organisations.

The Next Generation Network (NGN) is the vision of all telecommunication companies for convergence between the modern digital Public Switched Communications Network (PSTN) and Internet Protocol (IP) Networks. The PSTN is

slowly but surely migrating to this NGN, which will eventually be a communications network providing universal service and universal access to all its users. IPT can be seen as the first service to be implemented into the NGN with other services following over time (Hanrahan 2000). IPT, which in turn uses Voice over Internet Protocol (VoIP) technology to emulate the traditional voice network over an IP network, is experiencing rapid growth in developed countries and will eventually knock on the front door of most organisations in South Africa in the near future.

1.2 Problem statement

1.2.1 Background to the problem

Cost savings, being the primary driver for this technology, is a factor that can provide organisations with a competitive advantage but it can also benefit the normal consumer. What other benefits can the technology produce? While much research was performed in overseas markets, a significant small amount of research was done on the South African market. Will IPT be a success story in Africa, especially South Africa or does South Africa have other unique problems or characteristics that will inhibit the transition of Time Division Multiplexed (TDM) voice calls to IPT? *(See Appendix A for a description of the two switching techniques*) Does South Africa need IPT or will traditional based communication fulfil the role of communications?

1.2.2 Importance of problem

IPT as a controversial technology in overseas markets has shown many successes but also failures. According to Lon McCauley, director of network services at IBM Global Services, “it’s widely accepted that everyone will convert to IPT - the only question is when” (Erlanger 2004:44). Large organisations in developed countries with budgets larger than that of the South African economy, can afford to experiment with new technology and to learn from their mistakes without putting the survival of their organisations at risk. South African organisations cannot afford to implement the wrong technology and successful strategies should be followed if organisations want to survive and gain a competitive advantage over their rivals. Suppliers are currently vigorously attacking the customer premises market in their quest for market share, and vulnerable organisations could fall prey to possible exaggerated sales talk. It is therefore important that the real benefits this technology can offer are

investigated and understood. Implementing IPT for the wrong reasons and in the wrong way could result in a similar disaster as that of the dotcom bubble.

Research in this field is important from a South African perspective because international renowned research groups mostly focused on developed countries and almost no public documents exist about IPT in developing countries like South Africa. Africa including South Africa has many different features that differentiate the environment in which technology must prosper. South African organisations should understand the NGN vision with regards to the communications industry, know where it is heading, learn about IPT technology, and if found to be of true value, be able to align this technology with their ICT strategies.

Today, overall ICT spending decisions are being driven by requirements to improve business performance, to support business continuity and to reduce costs. As a result, each technology initiative and implementation must be justified in order to demonstrate how it addresses broader business imperatives. ICT managers today must meet two seemingly conflicting objectives. First of all they have to manage their ICT infrastructure as a utility providing low cost and at the same time also provide high reliability. And then they must provide the functionality their company needs in order to achieve a competitive advantage and to generate revenue. In all of these endeavors IPT as a technology is worth considering because it can convey a number of benefits to the business and will definitely alter business strategies.

1.2.3 Research Objectives

The aim of this research report was to determine whether Internet Protocol Telephony (IPT) can be implemented successfully in the South African context. Research was done on the profile changes the technology could have on an organisation as well as the opportunities and threats within the external environment in which it must function. Literature reviewing was initially done to find to what extend similar research had been performed and then to focus on key areas where research was missing. To come to a conclusion of IPT's success with regards to South Africa, the following points are discussed:

- The possible benefits that IPT can offer to organisations and the critically evaluation thereof
- The impediments of IPT compared to legacy PBX systems
- IPT implementation options

- The adoption process of any new technology as well as a comparison between international adoption rate of IPT and the local adoption rate
- Characteristics of the South African environment that could affect, as well as be affected by the success of IPT as a communications technology

In the final chapter a conclusion is made whether IPT could be successful in South Africa.

1.3 Research Plan/Design

1.3.1 Research methodology

Due to the vast amount of documents available on IPT internationally, the primary research methodology used for this research report was done through a non-empirical study of documentation available mostly in the public domain. Information was collected from the Internet, whitepapers, the latest news reports on IPT, journals and books. Technical forums and presentations within the telecommunications industry were attended in order to get a grip on what suppliers were proposing to customers and to determine shortcomings on the technology itself. Focus groups like the ITU-D were approached to investigate what had already been done in Africa and what issues were still outstanding.

1.3.2 Limitations of study

Although the initial intention of the research was to compare characteristics of Africa with the rest of the world, insufficient information was available and therefore the study primarily focused on South Africa. Much technical documentation was available on this subject and therefore the study focused more on the impact of IPT on the South African context. In certain instances it was necessary to elaborate on some technical issues in order for the reader to understand the technology. Relevant information on IPT was available in reports from various research groups at huge expenses; therefore this study mostly used information available in the public domain.

1.3.3 Assumptions

- IPT in this document refers to VoIP and vice versa as the term is used interchangeably in literature
- IPT will be the disruptive technology
- IPT will be the dominant packet switching technology in years to come
- IPT can enable change in an organisation's business strategies
- Business processes can be altered by IPT
- Africa is different from the rest of the world
- South Africa is different from other African countries although it is still a developing country

1.4 Terminology

1.4.1 Definitions

Circuit-switching

"A communications paradigm in which a dedicated communication path is established between the sender and receiver along which all packets travel. The telephone system is an example of a circuit switched network. Also called connection-oriented" (Webnox 2004:1).

Convergence

"It refers to the coming together of data, voice and video, i.e. the ability to carry all media types on one network. This is what IP enables. A converged network does not see any difference between voice and other media types; once digitized, voice is just another data stream" (Emmerson 2001:3).

H.323

"An International Telecommunications Union (ITU) interoperability protocol that enables cross-communication of multimedia products and applications over packet-based networks. Under H.323, multimedia products that are offered by one vendor can work with those of another, regardless of hardware compatibility. The standard bypasses long-distance charges" (Microsoft 2004:1).

Internet Protocol Telephony

"General term for the technologies that use IP's packet-switched connections to exchange voice, fax, and other forms of information that have traditionally been carried over the dedicated circuit-switched connections of the public switched telephone network (PSTN)" (Whatis 2004:1).

IP PBX

"The server that provides call control and configuration management for an IP-based phone system" (Erlanger 2004c:1). Two types of IP PBX systems exist:

- Pure IP PBX: Two sub-configurations exist for pure IP PBX, i.e. LAN alone (only with IP handsets on the LAN side) or hybrid (IP telephones as well as normal telephones with circuit switching operation). The bulk of calls on pure IP PBX systems is packet-switched (BMI Techknowledge 2004)
- Enabled IP PBX: Normal circuit switching PBX with IP capability. The bulk of calls on enabled IP PBX systems are circuit-switched (BMI Techknowledge 2004)

Next Generation Network

"A packet-based network able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unrestricted access by users to different service providers. It supports generalized mobility, which will allow consistent and ubiquitous provision of services to users" (ITU 2004:1).

Packet Switching

"A communications paradigm in which packets (messages or fragments of messages) are individually routed between nodes, with no previously established communication path. Packets are routed to their destination through the most expedient route (as determined by some routing algorithm). Not all packets travelling between the same two hosts, even those from a single message, will necessarily follow the same route. The destination computer reassembles the packets into their appropriate sequence. Packet switching is used to optimise the use of the bandwidth available in a network and to minimise the latency. X.25 is an international standard packet switching network" (Webnox 2004:1).

Public Switched Telecommunications Network (PSTN)

"The Public Switched Telecommunications Network refers to the telecommunications systems which are installed or otherwise provided, maintained and operated by a Licensee for the purpose of providing the public switched telecommunications services and fixed - mobile services" (Republic of South Africa 2001:4).

Time Division Multiplexing (TDM)

Time Division Multiplexing refers to a switching "technique where information from multiple channels is allocated bandwidth on a fixed, repetitive time slot within a higher-rate signal" (Artesyn Communication Products 1999:10). For a more detailed discussion on TDM, please refer to Appendix A.

Virtual Private Network

"Nodes on a public network, such as the Internet, that communicate among themselves using encryption technology so that their messages are as safe from being intercepted and understood by unauthorized users as if the nodes were connected by private lines. A Wide Area Network (WAN) formed of Permanent Virtual Circuits (PVCs) on another network, especially a network using technologies such as Asynchronous Transfer Mode (ATM) or frame relay" (Microsoft 2004:1).

Voice over Internet Protocol (VoIP)

"The use of IP for transmitting voice communications. VoIP delivers digitized audio in packet form and can be used to transmit over intranets, extranets, and the Internet. It is essentially an inexpensive alternative to traditional telephone communication over the circuit-switched Public Switched Telephone Network (PSTN). VoIP covers computer-to-computer, computer-to-telephone, and telephone-based communications" (Microsoft 2004:1). "VoIP is a broader category than IP PBX, involving the transmission of voice in IP packet form. It includes enterprise telephone systems, Service Provider (SP) backbones, SP edge voice applications, SP voice/data services, enterprise transmission from one site to another and consumer VoIP" (BMI Techknowledge 2004:66).

1.4.2 Acronyms

ACD	Automatic Call Distribution	**ADSL**	Asynchronous Digital Subscriber Line
ATM	Asynchronous Transfer Mode	**BEE**	Black Economic Empowerment
CAPEX	Capital Expenditure	**CEO**	Chief Executive Officer
CIO	Chief Information Officer	**CITI**	Cape Information Technology Initiative
CRM	Customer Relationship Management	**CTAM**	Constat's Technology Adoption Model
ERP	Enterprise Resource Planning	**FCC**	Federal Communications Commission
FWC	First World Country	**ICASA**	Independent Communications Authority of South Africa
IEC	International Engineering Consortium	**IEEE**	Institute of Electrical and Electronic Engineering
IETF	Internet Engineering Task Force	**IPT**	Internet Protocol Telephony
ISP	Internet Service Provider	**ICT**	Information and Communications Technology
ITU	International Telecommunications Union	**ITU-D**	International Telecommunications Union – Development

KBPS	Kilo Bits Per Second	**KSF**	Key Success Factors
KW	Knowledge Worker	**LAN**	Local Area Network
LDC	Least Developed Country	**MGCP**	Media Gateway Control Protocol
NGN	Next Generation Network	**OPEX**	Operational Expenditure
PBX	Private Branch Exchange	**PC**	Personal Computer
PIN	Personal Identification Number	**PSTN**	Public Switched Telecommunications Network
PVC	Permanent Virtual Circuit	**QoS**	Quality of Service
ROI	Return On Investment	**SA**	South Africa
SAVA	SA VANS Association	**SCM**	Supply Chain Management
SIP	Session Initiation Protocol	**SLA**	Service Level Agreement
SMME	Small, Medium and Micro Enterprises	**SNO**	Second Network Operator
TDM	Time Division Multiplexing	**USA**	United States of America
USAL	Under-Serviced Area Licensee	**VANS**	Value-Added Network Services
VoIP	Voice over Internet Protocol	**VSAT**	Very Small Aperture Terminal
WAN	Wide Area Network	**WTDC**	World Telecommunications Development Conference

2gIP Second Generation IPT

1.5 Overview of chapters

Chapter 2 – IP telephony and its benefits

Decision-makers can either make or break the success of a technology in some way due to their power of adopting a technology. Because corporate decision-makers are not always technology experts, they might fall prey to sales talk. This chapter discusses how IPT can be beneficial to a business and the end consumer and how it can make an organisation more efficient. Claimed benefits from various manufacturers are critically evaluated.

Chapter 3 – Impediments and challenges of IPT

This chapter compares legacy PBX systems with modern IPT technology. Reported failures by large corporations and shortcomings on things like e.g. security, are highlighted and discussed.

Chapter 4 – IPT Implementation options

Several strategies are formed for the implementation of the technology in developed countries and this chapter categorizes the different options. It introduces best practices for implementation of IPT and highlights most of the factors that have to be taken into consideration. The chapter also discusses why strategic decision-making instead of tactical ones is needed.

Chapter 5 – The adoption of the technology

This chapter focuses on the South African market and compares it to the international market. It describes the factors that influence the adoption process of a new technology and compares the international adoption rate with the local adoption rate.

Chapter 6 – The South African environment

This chapter, in combination with chapter four, describes how IPT can change the external environment and causes change on an organisation from the external environment. It describes how South Africa, being a developing country, has much to offer to the world. The environment created for instance by the regulator, i.e. ICASA, is different from that in the USA and Europe. What characteristics of SA can impact the overall success of the technology? What possibilities exist with the use of

IPT? Does South Africa need IPT if the greater need from a social perspective is job creation and BEE targets? These kinds of questions are being answered in this chapter.

Chapter 7 - Conclusion

The final chapter discusses the strategic fit of IPT in South Africa. Conclusions are made and it summarises all facts, arguments, findings and recommendations that have been presented in this research study.

CHAPTER 2: IP TELEPHONY AND ITS BENEFITS

2.1 Introduction

Corporate decision-makers have a huge input to the success of new technology. If a technology has proved to fulfil a need in the market and managements are convinced of the benefits it can offer to their organisations, it will be adopted and survive, otherwise it will be thrown away and labelled as just another learning experiment.

The communications industry is busy changing up to the point where organisations can choose from more than ten IP PBX systems and nearly as many service providers who offer hosted IPT solutions. With so many choices available, decision-makers need to understand their own requirements, the pros and cons of IPT in general, and the distinctions among the various solutions before deciding how to implement IPT, if at all (Wolter 2004). Corporate decision-makers are not always technology experts and might fall prey to sales talk if they are uninformed about IPT. Decision-makers should therefore understand the vision of telecommunication providers and the evolution communications are currently going through internationally. The claimed benefits IPT can convey to any business must be categorized and also critically investigated.

2.2 Aim

This chapter describes IPT as a technology and focuses mainly on the strength of the technology. It discusses how IPT can be beneficial to a business in general, to the end consumer and how it can make an organisation more efficient. Claimed benefits from various telecommunication suppliers will be critically evaluated.

2.3 Scope

In order to emphasize the aim of this chapter, the following topics will be discussed:

- The Internet Protocol World
- The drive from the Next Generation Network
- The drive from the customer market
- IP Telephony explained
- The benefits of IP Telephony

2.4 The Internet Protocol World

In order to understand the strong move towards Internet Protocol Telephony (IPT) it is necessary to understand the communications evolution. What is the IP world all about? IP is ubiquitous. Every personal computer produced today supports IP. IP is used in corporate Local Area Networks (LANs) and Wide Area Networks (WANs), dial-up Internet access, etc. (Collins 2001). IP is a packet-based protocol, which means that data traffic is broken into small data packets that are sent individually to their destination (Collins 2001). There is a difference between IP networks and the Internet. An IP network is one in which data packets are routed through the network, using the Internet Protocol. The Internet on the other hand is a world-wide set of interconnected networks using the IP routing protocol and providing a characteristic set of services such as e-mail, web browsing and file transfer, to name a few (Hanrahan 2000).

The last decade of the twentieth century has seen the Internet evolve from a resource sharing and file transfer medium for a few universities and government departments into a communications phenomenon of unimaginable proportion and power. IP has accordingly become the actual standard for transferring bits of data from one place to another, whether across the Internet or through private networks (NEC 2004).

The global communications market is going through a major paradigm shift from circuit-switched technology to an IP packet-based world (see Appendix A for a more detailed discussion). There seems to be a drive from both telecommunication companies and the business world. This “convergence” revolution also known as the NGN vision fuelled by the development of several new technologies, merges traditional voice communications with the Internet and similar data networks. As a result, a new age is on the brink where there will be no physical connection between two people and voice becomes “data packets” transmitted over a network (CITEL 2001).

The impact of the Internet and IP in recent years has been enormous and now the tremors of this impact are starting to be felt in the office voice environment. IP has been implemented on LANs and global backbone networks, but most organisations still employ PBXs for voice communications, because they are either not convinced

by the benefits of IPT or there are other barriers that inhibit the technology (Emmerson 2001).

So why is IP an attractive choice for voice transport? There are many reasons, including the following (Collins 2001:7):

- Lower equipment cost
- Integration of voice and data applications
- Lower bandwidth requirements
- The widespread availability of IP

As a result, this first decade of the twenty-first century is going to be exciting and the transformation and amalgamation of all types of human communications systems into a converged global communications network based on IP, are here (NEC 2004). Corporate decision-makers need to understand this revolution in order to stay competitive.

2.5 Drive from the Next Generation Network

Telecommunication companies globally have a vision called the Next Generation Network (NGN). It is the vision for convergence between the modern digital Public Switched Telecommunications Network (PSTN) and IP networks as discussed above (Hanrahan 2000). This convergence is the process of interconnection of traditional switched circuit networks (the PSTN and mobile networks) and packet-switched networks based on IP for routing.

The long-term goal of incumbent telecommunication operators is to migrate progressively towards the NGN by phasing out circuit-switched transmission and PSTN exchanges. They want to save on cost and start to interconnect to VoIP carriers in the backbone to lower the cost of international interconnection, thus helping them to compete more effectively with next-generation carriers and each other (Winogradoff 2002). However, the considerable investment they have already made in the PSTN switches causes this process to be stretched over a long period. “While the rise of the NGN is likely to be rapid, the phasing out of the PSTN will be slow” (Hanrahan 2000:2). This, in part, explains why the revolution to VoIP has been dragging on for so long.

The NGN is also an approach of new entrants and incumbent telecommunication companies to roll out cost effective infrastructure in order to obtain market share. To South Africans the question can arise: what is the role of NGN technology in South Africa? To provide universal telecommunications, information service and universal access to services to underserved communities, can be a good response (Hanrahan 2000).

The rationale for using an IP based transport network is the reduced cost of switching relative to PSTN exchanges. For the consumer, access to the PSTN is at present the major cost factor in the Internet experience and if the incumbent operator can reduce this in some way, the cost reduction can be forwarded to the consumer. Access technologies that will be rolled-out as evidence of the NGN vision is Asynchronous Digital Subscriber Loops (ADSL) and digital radio loop systems, for example. Overall the cost movement of access to the NGN is not clear and cost is likely to continue to be a factor in providing services to consumers. The NGN will be built on IP, where voice will be the most important application. Add in the dramatically different cost structure of IP and you have telecom's next revolution (Hanrahan 2000).

2.6 Drive from the customer market

Organisations need to provide reliable, secure, effective, cost-efficient and consistent communications for all their employees in order to insure maximum operational efficiency. While many organisations in developed countries have been doing well in providing these communication capabilities to their "head office" employees, they have not been able to connect their distributed remote locations effectively, due to the restrictiveness and inflexibility of Time Division Multiplexed (TDM) telephony. Organisations want to be more mobile. Organisations want to move their employees closer to their customers and equip them with better personal communications services in the most economical way (Rosenberg & Zimmer 2003).

Organisations demand global, distributed and increasingly unified communication and they want to simplify their operational communication infrastructure. They want to save on telecommunication costs. According to Woabank (in Gillan 2002) competitors like Internet Service Providers (ISPs) want to compete with network operators for market share and they want technology that can give them the leading edge.

The factors driving the adoption of IPT in the world from the customer market can be grouped as technical, cultural and economic in nature. From a technical perspective, packet switching technology is more seamlessly scalable and more cost effective than older circuit-switched technology. It also enables sophisticated converged applications, which are difficult and costly in a traditional telephony environment (CITEL 2001).

Social factors and government regulation in developed countries encourage the method of working from home and this, along with increased travel and mobility, has generated the need for remote teleworking and anytime, anywhere connectivity. The economics of outsourcing services and the need for remote related applications like "reach me" services and unified messaging are encouraging IP Centrex offerings, which will be discussed later (CITEL 2001).

As a result of all of these demands from the market, IPT has been designed as a next generation technology. Many telecommunications tenders from large organisations now also specify IPT as a mandatory requirement because they are interested in IPT for reasons such as cost, productivity, infrastructure rationalization, centralization of management, extra phone capacity and new functionality (Fujitsu 2003).

2.7 IP telephony technology explained

Now that it is clear that the telecommunications world is moving to IP in their quest for a Next Generation Network and the market wants this technology, the question arises: what is this IPT exactly? IPT today is often used in broad terms to cover all forms of IP packet-switched voice transmission. There exists therefore confusion between IP telephony, Internet telephony and VoIP (Winogradoff 2002).

VoIP is the underlying technology behind IP telephony. VoIP enables real-time transmission of voice communication as data, over an IP network. Beyond IP telephony, VoIP also has other applications like an Instant Messaging programme (Schoolar 2003).

IP telephony refers to the delivery of telephony features over a dedicated (private) IP network instead of circuit-switched networks. IP telephony uses VoIP technology to emulate the traditional voice network over an IP network (Schoolar 2003). It is the

general term for the technologies that use the IP's packet-switched connections to exchange voice, fax, and other forms of information that have traditionally been carried over the dedicated circuit-switched connections of the PSTN (Whatis 2004). Overall it has the same functionality as the PSTN (Schoolar 2003).

IPT is not just a matter of converting voice signals to data bits, although that is part of the process. Also involved are the call set-up messages and the networking information (transparent to the end user) that makes possible the convenience and ease-of-use offered by networked telephony systems (NEC 2004). Whereas legacy PBX systems use proprietary, non-interoperable signalling on proprietary hardware platforms between its handsets and the PBX system, IPT mostly uses standard signalling protocols enabled over open standard, high bandwidth, Ethernet, local and wide area networks (Flynn, Samuels, Watson & Wolf 2003:4).

Internet telephony, on the other hand, refers exclusively to the scenario where voice traffic is sent over the public Internet. Some say that Internet telephony is a struggling niche business that still is quality challenged. With precipitously dropping prices for higher-quality calls, the future according to some does not bode well for this IPT segment (Winogradoff 2002). Others believe that Internet telephony is the future of telephoning due to its huge cost savings to the consumer.

2.7.1 The basic components

The basic components of any IPT system differ from supplier to supplier but generally include the following:

i. **Gateways**

Network gateways provide network access to TDM PBXs, the PSTN and other public networks. It refers to a device that converts voice calls from circuit switching to packet switching networks and vice versa. Its purpose is to break the voice signal into packets and send it to the desired destination IP address and vice versa (Hill Associates 2003).

ii. **Clients**

Clients refer to analogue or digital phones, IP telephones, IPT and multimedia soft clients for computers and other portable devices. Clients needed for Internet telephony, for example, are Microsoft's Netmeeting or KaZaA's Skype application (Hill Associates 2003).

iii. Communication Servers

Communication servers deliver IPT and other services (Hill Associates 2003).

iv. Application Servers

These devices provide services like conferencing, unified messaging, and customer contact applications (Hill Associates 2003).

v. Protocols

IPT implementations typically use two different types of protocols. One to set up and terminate calls, the other to transport the voice (Hill Associates 2003).

vi. Routed backbones

The central component of an IPT network is a routed backbone. Routers must support the lower layer switching, special routing protocols, the ability to communicate and the QoS (Hill Associates 2003).

Other components of an IPT solution include things like the codecs, cabling, connectors and some form of reliable power source like Uninterrupted Power Supply (UPS) units.

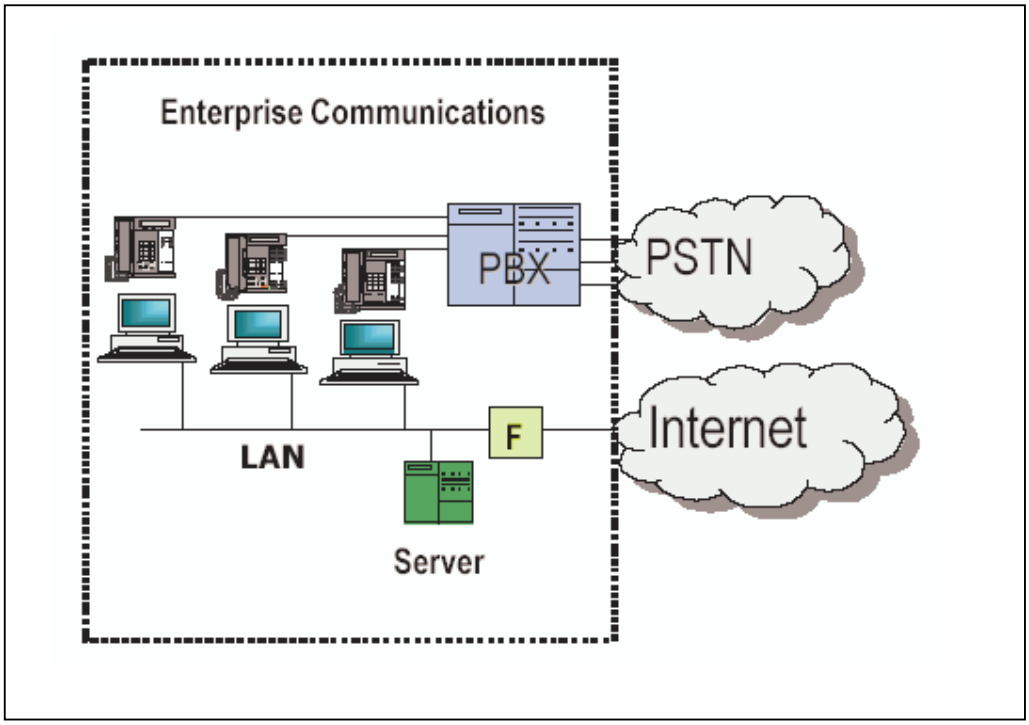
2.7.2 The convergence of two networks

Communications convergence will impact most profoundly on the business sector and therefore the business sector must grasp the basics of convergence. To appreciate the significance of this new technology it is important to understand business communications networks as they exist today. Currently, a typical company has two completely separate communications networks: one to handle voice communications and one to handle data communications (CITEL 2001).

The voice communications network consists of a PBX system that connects the telephones within the business to each other and to the outside world for purposes of making voice calls. PBXs communicate with their attached digital business telephones via proprietary protocols, which are unique to each type of PBX system. It is these unique proprietary protocols that enable PBXs to support the advanced telephony features that are available on digital business telephones (CITEL 2001).

The data communications network on the other hand consists of a LAN, which connects the company's computers to each other and to the Internet for purposes of sharing files, web pages, and e-mail (CITEL 2001). These two networks have traditionally been designed to handle different types of tasks using very different technologies. Separate manufacturers and technical experts usually support each network and the networks are connected to the outside world in a different way. In many developed countries the PBX connects to exchange lines from a telephone company like Telkom SA while the LAN connects to an Internet connection from an Internet Service Provider (ISP). "So typically a business will purchase and maintain two sets of equipment from two different manufacturers through two different resellers and pay connection cost and maintenance fees to two different kinds of carriers. Obviously this is innately inefficient" (CITEL 2001:2).

Figure 2.1 - Typical communications infrastructure – two separate voice and data networks



Source: (CITEL 2001:2)

With the improvement in technology, voice communications can now be handled as just another application on the LAN eliminating the need for two separate networks, suppliers and support systems (CITEL 2001).

2.7.3 Different types of IPT PBX technology

The following table provides a short description of the different types of approaches that manufacturers followed when they designed IPT equipment (See Appendix B for a list of IPT manufacturers).

Table 2.1 - PBX technology types

PBX technology	Description
IP PBX	Software on server connects to LAN; all handsets connect to LAN; calls travel over the LAN. Major vendors: Cisco and Siemens
LAN PBX	Dedicated hardware box connects to the PSTN and LAN; all handsets connect to the LAN; calls travel across the LAN. Major vendor: 3COM
Multi-function Converged Branch Exchange	PC-based PBX bundled with LAN functionality. Major vendors: MIA/Samsung, Alcatel, Mitel
PC based PBX	PBX and software, calls still circuit-switched. Major vendors: Alcatel, NEC
Hybrid PBX (IP-enabled PBX)	Traditional circuit-switched PBX with IP plug-in. Major vendors: Most TDM PBX vendors like Philips, Ericsson, Siemens, Nortel, etc.

Source: (BMI Techknowledge 2004:10)

Decision-makers should be aware of the different PBX technologies when the vendors approach them.

2.8 Benefits of IP Telephony

At an international conference, Voicecon 2004, it has been demonstrated that more businesses in developed countries are seriously considering IPT, but the benefits of the technology remain difficult to justify using traditional bottom line analysis (Hochmuth and Greene 2004a:1). Brian Riggs, an analyst from Current Analysis who attended the conference, says there isn't a compelling reason right now to scrap a PBX and to install an IP PBX, unless it's a brand new facility (Hochmuth *et al*

2004a:52). Winogradoff (2002) also mentions that for the enterprises market, quality concerns and lack of compelling benefits for the most part still inhibit IPT adoption to a significant degree. But the benefits do exist in reality and the next few paragraphs will explore these benefits of IPT in more detail.

2.8.1 Cost savings

According to Forrester Research, 32% of organisations in developed countries are considering IPT as one of the ways to minimize their telecommunication expenditure (Fujitsu 2003). Before 2005, almost all IPT projects will need to be justified through cost savings, as few organisations will be able to transform new IPT capabilities into business value (0.7 probability) (Rolfe 2003). What are the cost savings organisations can benefit from IPT?

The obvious starting point is toll bypass. Voice communication between branches of the same organisation can be achieved by using their private network for both data and voice (Fujitsu 2003). This has been the early selling point for IPT vendors and it was expected that organisations could lower their voice and fax communications costs through IP networking between multiple sites. Converged IP services allow a company to bypass toll PSTN charges by sending the data traffic onto the corporate WAN. This bypass has promised substantial savings on international calls and in areas where regional call charges were high. BMI Techknowlegde (2004) reported that the declining trend in long distance charges has eroded this benefit offered by toll bypass.

"The technology can save money by combining access lines, reducing long distance costs and reducing the expense of reconfiguring PBXs when employees move their office" (Hochmuth *et al* 2004a:52). Voice and fax traffic that use the traditional communications infrastructure rely on a PSTN and thus are subject to tariffs that can be substantial in non-competitive environments like South Africa's. In a legacy environment, a small office typically has a small PBX with a primary rate ISDN or analogue tie lines to connect to the PSTN. In developed countries, home office users are generally equipped with two lines: one for voice and one for data, to provide narrow-band access and voice connectivity to the head office. The remote user would then call the central office (local exchange) periodically to retrieve voice messages. This repeated setup resulted in multiple costs for all access lines. With IPT this can be eliminated. Hardware connection costs are also higher when

supporting separate voice systems and data networks (Bingham, Strauss & Edwards 2003:3).

Organisations can save money by transmitting internal voice and fax calls in the spare bandwidth of leased lines and therefore they do not have to lease additional lines for the voice calls (GAO Research 2004). A converged network allows an organisation to use a common infrastructure and cable plan for both voice and data. This convergence lowers hardware connection costs as well as the costs to deploy new IPT equipment (Bingham *et al* 2003:4).

Organisations in developed countries often provide calling cards to mobile workers so that they can make cheaper calls when travelling. This approach can save organisations money, but IPT can allow more savings if mobile workers use soft phones instead. A soft phone is an application installed on a computer that allows the user to use the microphone, speaker and mouse or keyboard of the computer to speak to another party without the need of a telephone. By using soft phones, mobile and remote workers can send and receive calls through their IP Virtual Private Network (VPN) service. "In some cases further savings can be achieved by making international calls through the system or to have a PBX in a low-cost long distance country call back to a traveller in a higher cost country" (Bingham *et al* 2003:3). This is a paradigm shift in how organisations think about the utilization of their telecommunications.

Traditional Automatic Call Distribution (ACD) and PBX hardware are unnecessary in an IPT solution along with the associated acquisition, power, space, integration, and maintenance contract costs. Cost savings can also be achieved by the compression of data alone leading to more efficient use of the data lines. Traditional voice requires 64KBPS for circuit-switched voice vis-à-vis 10-30KBPS for packet-switched voice with nominal compression for IPT. This means that up to four times the number of calls can be transmitted over the same amount of bandwidth using IPT (Flynn *et al* 2003:6). Any saving on bandwidth will result in lower costs to an organisation.

"Centralized IPT servers make telephony features and functions accessible worldwide without having to replicate the complete infrastructure at every office location or incur major trunk costs for remote site connectivity as in the TDM world" (Rosenberg *et al* 2003:ii). Such technology centralization also supports cost-efficient remote administration, technical support, and self-service provisioning to minimize

the need for expensive ICT employment at all enterprise locations. This approach will work for employees on site, at remote branch locations, mobile workers and home-based teleworkers (Rosenberg *et al* 2003).

While some also claim cost savings in IPT can be achieved by promises of lower total cost of ownership and increased ROI, BMI TechKnowledge states that IP phones and infrastructure do not yet provide clear cost savings or ROI compared to traditional analogue and digital PBXs (Van Rensburg 2002). Evidence is also mentioned by Hochmuth *et al* (2004a) who reported that many customers said they were still finding it difficult to make the case that this technology would save money. Organisations who have adopted IPT say that there will not be savings when replacing TDM PBX systems with IP PBX systems to reduce long distance or administration costs, because most calls (+/- 80%) that originate inside the company are to people outside. Companies don't phone internally that much, relative to calls made to people outside the organisation (Hochmuth *et al* 2004a). Steven Taylor, principle at Distributed Network Associates Traditional, is also of the opinion that voice services in an organisation are so inexpensive that potential savings are minimal (Hochmuth *et al* 2004a).

InfoTech Primary Research (2003) reports that IPT has lowered the cost of domestic calls in developed countries between company sites and reduced the cost of premise networks and their administration and management. Early adopter organisations also report a reduction in communications administration and management staffing over time as they converged separate voice and data networks into a single corporate infrastructure. The most dramatic saving that adopters have reported was received in the area of Moves, Adds and Changes (MACs), which refers to the fee that has to be paid to the network operator/service provider for any extension number, speed dial number changes, etc. It is reported that organisations could lower their Operating Expenditure (OPEX) with this benefit.

Nortel (2004c) identifies the following benefits of a converged network:

- Lower operating expenditure (OPEX) and capital expenditure (CAPEX) through protocol and network convergence
- Reduction in phone cards for teleworkers
- Lower cost due to MACs by moving the desktops to IPT

Overall the majority of organisations are still hesitating to implement IPT because many of the cost savings that vendors have promised have not realized. Early in IPT's life cycle, it has been told that routing voice calls over the data network would produce significant savings in long-distance calls, but then carriers in developed countries dropped their long-distance rates and gone were most of the savings (Erlanger 2004).

Residential customers can undoubtedly also save huge amounts of money by connecting computers to computers and by using ordinary telephones to connect to Internet Telephony Service Providers (ITSPs), which use IP to provide inexpensive voice connections through combinations of the Internet, leased lines, and the PSTN. Using IPT saves money because it is more efficient than ordinary Plain Old Telephone Service (POTS) and because it avoids most of the tariffs telephone companies are subject to, especially in the monopolistic international telephone service market like South Africa (GAO Research 2004.) International voice calls from South Africa are still very expensive if compared to voice via the public Internet, i.e. Internet telephony. Making a 10 minute call from South Africa to New York via the normal PSTN will cost R33.30 during standard time and R30.17 during Callmore time. For the same call companies specializing in Internet telephony like Net2phone and Dialpad would charge R3.18 and R2.54 respectively (using an R/$ exchange rate of R6.50). It is clear that Internet telephony is very cheaper than traditional calls made via the PSTN and this is also the one and only benefit related to Internet telephony.

2.8.2 Increased productivity

Some report that the real value of IPT does not lie in savings on toll bypass on long-distance calls but rather on an increase in productivity. An improvement of 2% on productivity is said to have much greater value than savings on telephone calls (Howard Mellet Communications 2002). According to experts, it is estimated that 67% of any employee's time is used productively (Bucci 2004). The most important goal for most companies undertaking a network convergence process therefore can be to make their employees more productive by allowing them to be fully connected, both inside and outside the office and giving them a wider range of powerful communications tools (IDC 2003).

Some of the claims made on productivity improvement on Siemens equipment can be seen below:

- "Organisations deploying the Siemens HiPath MobileOffice solution increased employee productivity by an average 10%...." (Bingham *et al* 2003:2)
- "HiPath customers also realized an average 5,5% increase in user productivity" (Bingham *et al* 2003:2)
- "HiPath customers also realized an average 18% in teleworker productivity" (Bingham *et al* 2003:2)
- "Business deploying the Siemens HiPath ProCenter suite into the contact centre increased agent/supervisor productivity by an average of 15%..." (Bingham *et al* 2003:2)

In Bucci's (2004) article on the productivity benefit of IPT it is made clear that the affected employees here are employees who rely greatly on communications, who are primarily knowledge workers. According to Peter Drucker a knowledge worker is an employee who creates value from intellectual rather than physical skills. They solve problems, manage new initiatives, improve processes etc. According to the International Society for Performance Improvement, knowledge workers engage in four basic functions each day of which the output cannot be measured easily, i.e.:

- Reading
- Writing
- Communicating
- Planning

What is true is that the more time knowledge workers can spend on these functions, the better. According to Goldratt (1992) productivity is anything an employee does that will bring the organisation closer to its goal where the goal is to make money, now as well as in the future. In other words the goal is to make a sustainable profit. If decision-makers want to make the organisation more productive, this productivity improvement must help the organisation to be more profitable, otherwise it is a waste. No one, however, can be 100% productive all the time (Bucci 2004).

Let's do a simple calculation to determine if productivity improvements can lead to cost savings. Productivity improvements are claimed to be directly related to cost savings. Let's assume that an average worker is productive 60% of a working day (8

hours), which equates to 4.8 hours (0.6 x 8 hours). If technology could improve productivity by 4%, it will improve the productive hours from 4.8 hours/day to 5 hours/day (an improvement of 12 minutes/day). If an average worker in South Africa earns R30/hour, it means a saving of R6/hour. Multiplying this with the amount of employees in an organisation and assuming a mix of 35% knowledge workers in an organisation, will quickly display that productivity improvement can lead to cost savings for an organisation.

The argument now is that most workers in South Africa get paid a salary each month. They get paid for the productive as well as the unproductive time, which does not really mean a saving in terms of Rand value to the organisation. In those circumstances where workers are not employed with fixed salaries each month, but rather get paid as contract workers (per/hour), savings will definitely be evident.

According to Avaya CEO, Don Petersen, the real value of converged networks is allowing workers to produce more with new applications that convergence enables (Hochmuth *et al* 2004a:52). So the productivity benefit received by IPT must be linked to the application benefit that will be discussed in the next paragraph. One question can be asked: if workers produce more, is that necessarily good for the organisation? Arguable this is not always the case.

Hochmuth *et al* (2004a) also supports this argument when he finds that with all the mentioned claims on productivity, organisations with larger, more diverse workforces still say the productivity and business payoffs of IP-based convergence applications are not as apparent. According to Edward Jackson from Cardinal Heath, they themselves have such a diverse group of users on different platforms that it's hard to find one single application that will make everyone more productive (Hochmuth *et al* 2004a).

Two questions can now be asked:

- How did the organisations who reported productivity increases expressed as a percentage, measure these productivity increases?
- Is the productivity benefit that an organisation can achieve worth the price it has to pay for the IPT solution?

How then can organisations get productivity improvements that will benefit them? Rather look at productivity improvements only from a knowledge worker's point of

view. If business managers can improve their productivity it will mean projects get finished sooner, which means projects meet budgets or sales goals and money is saved. What drains the productivity of the knowledge workers in an organisation? A few of them are (Bucci 2004):

- Long and ineffective meetings
- Searching for information
- Communicating with others

If a technology can improve any of the above, it means productivity improvement for the knowledge workers. Looking at IPT systems, they eliminate constraints imposed by location. With soft phones installed on laptop computers, mobile employees can enjoy all the benefits as if being located within the corporate telephone system. Employees can be issued with either standard IP telephones or special home IP telephones when the organisation decides to allow the employees to work from home. This way they receive and make calls as if they were in the office, while retaining all other PC related features. They also have the same mobility whether inside their own organisation, visiting other companies, sitting in conference rooms, or even waiting somewhere, as long as there exists a local wireless LAN for them to connect with (Bingham *et al* 2003:4).

Employees gain from the convergence of voice and data traffic onto one network and by doing this they work more effectively (Dimension Data 2003). These benefits are made possible by new ways of using the telephone in combination with the PC and with directories (Bingham *et al* 2003:4). Meetings can be conducted from the desktop and can include participants from the same office building, but also others on the other side of the world. Meeting documents can also be readily available during the meeting (Bucci 2004).

According to research only one out of every ten business calls reach the called party on the first attempt. This is due to the fact the knowledge workers are not in their office most of the time. A study showed that office workers are at their desk only 50% of the time. IPT will allow people to be reached more often and will make knowledge workers more reachable (Bucci 2004).

2.8.3 New and enhanced applications

While the potential cost savings are what usually sells IPT, the exciting features and the ease with which they can be managed are what keeps users happy (Wolter 2004). Some claim that the long-term value of IPT lies in the new and enhanced business applications that it can support (Hochmuth *et al* 2004a). According to the CIO of Prudential Northwest Properties, Sean McRae, the biggest payoff for his organisation when implementing IPT was applications that allowed agents to be more accessible and have better access to messaging and other data resources (Hochmuth *et al* 2004a).

Instead of being a separate silo before, voice is on the verge of becoming just another network application that can integrate with other real-time applications like instant messaging, presence and voice conferencing, to enhance collaboration between geographically isolated work groups. IPT has the potential to integrate with ERP and other enterprise applications to speed up approvals that used to stop business processes (Erlanger 2004).

With newer applications there must also be productivity improvements, i.e. efficiency, as mentioned previously, otherwise organisations will not reap any benefits at all from IPT. The applications benefit is therefore important but many sales people will only focus on all the “nice to have” applications of IPT to impress organisations. Decision-makers should know about the various applications that will be introduced by IPT. Here are a few that were identified from research:

- Presence and availability management
- Voicemail system
- On-demand conferencing
- Multiparty video conferencing
- White boarding
- Document sharing
- Distance learning
- Phone directories
- Screen popping
- Voice web browsing
- Unified messaging
- Presence conferencing and collaboration
- Teleworking

- Mobility
- Modular messaging

Presence and availability management are among the new applications emerging for IP PBX systems. Presence management allows the telephone system to display to managers the locations of employees and whether they are available, on leave, on lunch, travelling, etc. One way to track employee presence and availability is with corporate or personal databases, which can hold information about scheduled holidays. Some approaches utilize an employee's PC or telephone usage to determine the individual's presence in the office. IPT systems may even display the location of the employee (Bingham *et al* 2003).

Another application provides links to voicemail systems that show the date a greeting was recorded and activated. Users often create internal or external greetings that refer to future business trips, but they might forget to change the "old" greeting when they are back in the office. This feature of IPT helps to avoid such problems (Bingham *et al* 2003). Another improvement on voice mail is that e-mail can be read to you through the phone while you are on the road (Hill Associates 2003).

"Applications and features that are still being developed for the market include on-demand conferencing, multiparty video conferencing and collaboration capabilities like white boarding and document sharing" (Mier 2003:46).

The click-to-dial future was one of the earliest applications of IPT to display the benefits of the integration of IPT and directories. Even compared to four digits used for internal calls or calls over a Virtual Private Network (VPN), a single click is undoubtedly more efficient. New applications make dialling faster. The caller does not have to navigate to a personal or corporate directory, but instead all recently placed and received calls are shown on the telephone display or as a Web page on the PC telephony client. In addition to the fact that it is more efficient to dial with IPT, errors with the setup of teleconferences are minimized and graphical interfaces to voicemail systems are provided. One application, for example, allows users to automatically time, code, and bill incoming and outgoing calls (Bingham *et al* 2003).

IPT offers exciting new added values in the long term. Such value added opportunities include: IP multicast conferencing and telephony distance learning applications, phone directories and screen popping via IP, and "voice web browsing"

where the caller can interact with a web page by speaking commands to the computer. Web-enabled applications like PeopleSoft, SAP, Oracle and Siebel in future will be easily integrated with the communication systems and by adding speech-to-text and text-to-speech capabilities, employees and customers will eventually speak directly to applications and data, greatly enhancing the way business is conducted (Integrated Research 2004b).

BMI Techknowledge (2004) is of the opinion that the "killer application", which will provide strategic advantages to organisations hasn't made its appearance yet, while others believe that it already did and that the success of the latest applications launched may put to rest the issue of whether IPT indeed has a "killer application". Researchers argue that "it may turn out to be not a single application, but the right mix of applications that will deliver clear productivity gains and ROI, which propels us into an IPT future" (Mier 2003:46). It is agreed that both users and vendors have a long way to go on the IPT applications learning curve. "Much work remains to be done, as there are relatively few applications that are unique to IPT" (Sulkin 2004).

The strategic advantage of IPT lies with the new applications, which must still be developed. Until these applications make their appearance, many organisations with TDM equipment will continue to delay the implementation of VoIP strategies (BMI Techknowledge Group 2004).

2.8.4 Mobility

IP allows a mobile worker to log onto the organisation's network in any office around the world and after that person has been authenticated by the network security system, an IP address will be assigned. E-mail would then be delivered to that physical location and in the same way IPT allows voice calls to follow a user because users are not bound to a physical location. So by using IPT, physical changes and mobility limitations are no longer an issue. As long as employees can connect to the organisation's network, they can move to another office or another country and still have communications. They still will have an extension number, which is linked to their profile, and that in turn is linked to the IP address that is generated when they log on. IPT therefore allows greater mobility (Emmerson 2001).

This mobility benefit also opens the door for more effective call centres. Time zones can be used to extend call centre hours and because a virtual call centre can be

setup, it will allow call centres to operate 24 hours/7 days a week. Employees located in time zones where it is normal business hours, will be able to assist customers from remote locations in different time zones where it is already after hours. Organisations will then be able to save money on overtime and use countries with lower labour hour rates to assist with their call centres. This brings up once again the issue of cost savings.

In the healthcare environment where medical staff, i.e. doctors, nurses, etc. are moving all around the facility between different patients, IPT combined with WiFi technology can provide them with great mobility (BMI Techknowledge 2004).

2.8.5 More control over resources

IPT allows organisations to manage voice the same way as data. A network manager can physically sit anywhere on the WAN or even dial in from a remote location and monitor exactly what is going on in the network and make any necessary changes. This had been impossible with most regular PBX systems and when at all possible, it had been very expensive. Any configuration changes had to be made on site and employees had to be dispatched to many remote sites. By converging voice with data it also means the creation of a single database that can store all aspects of an employee's profile (Emmerson 2001:9).

According to Dimension Data (2003) the benefits of implementing an IPT solution include a reduction in the enterprise's telephony costs by centralising its network management. Legacy system administration is time-consuming. Some legacy administration tools are still command oriented and do not allow scheduling or batching of administrative tasks. These limitations add significant time that system administrations have to spend in order to get the job done. New IP and converged systems typically reduce administration time because of the higher percentage of easier-to-use, object-oriented administration tools, which accelerate reconfigurations (Bingham *et al* 2003).

Template-based administration minimizes the number of configuration steps required to install a telephone for example. Installing, changing, and removing users are among the most burdensome management requirements of any telephone system. It obviously depends on the size of the organisation at stake. In typical telephone systems, the physical line to each employee is associated with a number, which an

employee can't always keep when changing offices. If the employee brings the old number to a new location in the organisation's network, a manual entry has to be made in the system by the administrator who has linked that extension with the number (Bingham *et al* 2003).

IP telephones enable users to perform plug-and-play IP desktop implementation and administer their own moves. A phone can easily be disconnected, moved to another location and plugged into the network without the need for a technician to move the telephone. The IPT system automatically recognizes the IP telephone, wherever its location may be. This process allows support teams to work on more strategic and value-added projects. As a result the size of the support team can be smaller, which again means cost reduction (Bingham *et al* 2003:3).

Centralising network management through integrated software applications delivers economies of scale and can improve ICT processes such as network diagnostics, troubleshooting and problem resolution (Fujitsu 2003).

2.8.6 Better LAN utilization

With IP and converged communications platforms, voice, data, and video operate cost-effectively over the same network. "Depending upon the company's requirements, this convergence impacts the LAN infrastructure and increases its capacity utilization overall" (Bingham *et al* 2003:4). IPT therefore allows for better LAN utilization.

2.8.7 Leverage of existing IP data networks investments

Compared to deployment of a separate dedicated voice network, costly telecommunications connections will be eliminated with the use of one network for voice and data. "Organisations need not support two separate networks anymore to bring voice and data into a call centre or to a remote office for example". With IPT an organisation can use the ICT hardware already bought and only expand the network with additional hardware to allow for telephony over the data network (Flynn *et al* 2003:6).

2.8.8 Improved leverage of expert staff

Many organisations today need to do more with less. Organisations have highly skilled employees that are deployed throughout the world and yet they might not be utilized completely. IPT can make greater use of these critical resources in field locations and readily integrate them into a common virtual team. Wherever people might be located, they can still function effectively as remote knowledge workers who appear as though they are onsite with the rest of their team (Flynn *et al* 2003). The single infrastructure required also results in lower system administration and employee costs (Bingham *et al* 2003).

2.8.9 Bandwidth efficiency

Circuit switching uses bandwidth inefficient. 40% of any conversation consists of silence, which means that a huge amount of bandwidth is not used effectively. Although "pair gain" compression techniques try to have more conversation on the same infrastructure, the fixed bandwidth approach of circuit switching is inefficient (Fujitsu 2003).

Bandwidth is expensive and because a circuit-switched telephony call takes up 64 KBPS while an IPT call takes up only +/- 10-20 KBPS, bandwidth is utilized more efficiently with packet switching. Resources are only used when information is transmitted and voice conversation can be intermingled with the data traffic. This is again linked to cost savings for the organisations.

2.8.10 More flexibility and control

The convergence of voice and data will result in a more flexible and scalable system. By uniting voice and data onto the one platform, increased flexibility, responsiveness and control to achieve the business vision can be enabled. In a traditional environment, organisations often deploy four or more networks to link their isolated locations. They have separate voice and data networks within a location (PBX and LAN networks) as well as separate voice and data networks between locations (tie lines and WAN networks). "This approach can lead to inflexible and inefficient use of network capacity, as well as adding cost and overlap in support and management" (Telstra 2004:1).

The convergence of voice and data on a unified IP network can be seen as an efficient way of utilizing network capacity, as well as unleashing the flexibility and functionality of the ICT world on a traditional telephony environment. This approach can help to minimise the complexity of risk management, capacity planning, internal billing and reporting (Telstra 2004). Converged networks allow for more flexibility and control of the network.

2.8.11 Better customer satisfaction

IPT systems can be integrated with Customer Relationship Management (CRM) platforms. When customers call a call centre for instance and identify themselves through an Interactive Voice Response (IVR) system by means of their account number and PIN code, these details can then be passed to the CRM system. By the time the call reaches an agent, that agent will correctly identify the customer and have all the customer's details in front of him/her. This can improve both the productivity of the agents as well as customer satisfaction levels.

Another application of IPT where the customer satisfaction can be improved is where a customer can click on a link on an organisation's Web page that will initiate an Internet Telephony call to that organisation's call centre. An agent at that call centre can then guide the customer to a specific Web page during the course of the conversation (Fujitsu 2003).

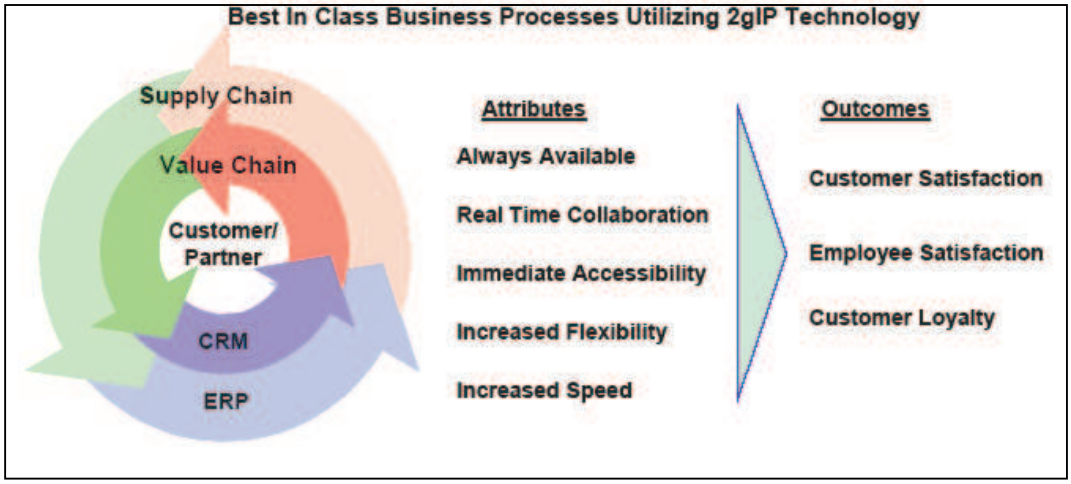
2.9 Second Generation IPT

The second step into IP globalization is the second generation of IPT, also known as 2gIP. 2gIP provides improved communications, coordination, accessibility, and collaboration across the enterprise. It is marked by improved or enhanced applications. It enhances mobility through improved integration into enterprise communications. The benefits of the 2gIP environment especially impact an organisation's supply and value chains. *Figure 2.2* shows how improved business processes can lead to benefits for customers, supplier and employees (InfoTech Primary Research 2003).

BMI Techknowledge (2004) states that the "killer application" that will provide strategic advantages instead of tactical advantages will make its appearance in enterprise applications most closely related to modern business processes. IPT with its open standards and fewer proprietary platforms can free the minds of innovators

to design new strategic applications. Voice-enabled CRM software for various vendors is expected to be launched in 2004. Major vendors of ERP systems will start to add voice functionality as IPT systems become more prevalent. Voice-enabled SCM software is also a contestant as it can offer more efficient and informative experiences to end-users.

Figure 2.2 - Business processes utilizing 2gIP technology



Source: (InfoTech Primary Research 2003:3)

2.10 Conclusion

The aim of this chapter was to critically investigate the claimed benefits from various telecommunication suppliers. The conclusion that can be made on the cost savings for organisations is that there are many indirect places where cost reduction can be achieved through IPT. The general cost of the equipment needed for an IPT solution might be too expensive compared to legacy PBX systems, which can decrease the cost saving benefit. IPT calls made over a private network are perceived as “free” but actually they are not. IPT has met or exceeded performance requirements, but the area of cost savings and ROI has been one of the most attractive market adoption drivers.

It is essential that decision-makers understand the possible value proposition of IPT. Some might say that it is an investment in a communications infrastructure that can increase productivity and create a foundation for more value-added applications. Others might feel that there is no solid value proposition. What is true is that IPT can offer benefits to an organisation in many ways.

Convincing benefits are discovered by listening to early adopters in developed countries who have already implemented IPT and who can provide developing countries with clues and wisdom about the effects of the technology on their organisations. Advantages provided by IPT include:

- Cost reduction
- Increased productivity
- New and enhanced applications
- Better mobility to employees
- More control over resources
- Better utilization of the LAN/WAN
- Better leverage of existing IP investments
- Improved leverage of expert staff
- Bandwidth efficiency
- More flexibility and control
- Better customer satisfaction

After years of hype and unfulfilled promises, IPT has at last evolved as a true option for many organisations. IPT can be utilized very effectively as long as it is done for the right reasons and in the right way. One benefit leads to another and eventually adds up to a giant balloon of benefits, which are important to the success of any organisation whether locally or abroad.

CHAPTER 3: IMPEDIMENTS AND CHALLENGES OF IPT

3.1 Introduction

Like any other technology, IPT must also display a negative side, how insignificant it even might seem, that can result in threats to an organisation. Therefore, as part of the profile formulation process of IPT technology, the weaknesses of IPT must also be explored. Technical issues as well as customer response issues might hinder the overall implementation of the technology into the market environment.

3.2 Aim

This chapter will investigate the inhibiters (weaknesses) of IPT with all of the negative implications to the organisation, if any. This chapter aims to help the researcher to come to a conclusion whether the benefits of IPT outnumber the challenges or the other way around. By the end of chapter four, the profile of the technology should have been described in such a way that the business manager should be able to identify IPT according to its benefits and challenges and decide whether IPT as a technology can be successful in a lucrative environment.

3.3 Scope

In order to give emphasis to the aim of this chapter, the following impediments and challenges will be discussed:

Hard issues:

- Security
- Quality of Service and voice quality
- Bandwidth consumption
- Cost
- Reliability/availability
- Interoperability
- Manageability
- Power
- Features
- Emergency calls

Soft issues:

- Regulation
- Management issues
- Resistance to change
- Vendor lock-in
- Lack of expertise
- Internal politics

3.4 Hard issues

3.4.1 Security

As IPT moves towards integration with core business systems, organisations will become more aware of the security risks involved when implementing voice and data on the same network. An organisation's threats to vulnerabilities increase as the reach of the network increases (Nortel 2004). The most common security vulnerabilities can be seen in *Table 3.1*.

Table 3.1 - Security vulnerabilities

Type	Description
1. IP Spoofing	It refers to the insertion of an IP address of an unauthorized user into the transmission stream of an authorized user to get access and to hijack the communication session
2. Network Sniffing	Using software, designed to analyse a network and to identify bottlenecks, to find usernames and passwords instead
3. Denial of Service	The network is flooded by infected computers in such a way that regular traffic is either slowed or completely interrupted
4. Bucket brigade attacks	Messages between a server and client PC is intercepted and modified
5. Backdoor entries	This refers to a secret way of gaining access to a programme or online service
6. Masquerading	The hacker poses as a valid administrator to access a network

7. Eavesdropping	Every packet on the network is captured and packets belonging to a certain conversation are combined again to get the original conversation.

Source: (Nortel 2004)

ICT personnel already have their hands full in order to keep the security on the network at a high level and now other types of applications are added onto the network. Organisations must be aware of all the threat types mentioned and must be aware of IPT's problems. Because voice and data are now shared on the same network it opens up new ethical, financial and regulatory pressures. "….experts say IP telephony users must be on guard" (Hochmuth 2002:1). This was the conclusion that was made after a virus had attacked a leading IPT manufacturer's equipment. The Nimda virus hit the Cisco IPT of Carnival Cruises in 2001 and made many suppliers and customers globally aware of the threat that IPT could pose to their organisations. Even after that awareness process and the entire added security enhancement over the following months, Cisco has yet again warned of a vulnerability that exists in its IPT solution in 2004 (Hochmuth 2004b). Researchers of META Group have found that many existing IPT products and projects demonstrate "an alarming lack of security measures" (Foreshew 2004:1)

As companies start to replace legacy PBXs systems with IPT equipment, a variety of new security issues have already been revealed so far. These threats occur because the equipment is connected to the LAN/WAN, which are in turn connected to the Internet through firewalls. Many of the operating systems used in IPT equipment are build on public operating systems and commonly hacked software. The products of companies like 3COM, Avaya, Alcatel, Nortel and Cisco are also susceptible to denial-of-service or hacker attacks because they are build on the standard IP stack. Another concern is that most of the vendors also use Microsoft's Internet Information Server, which is constantly being patched for security holes (Hochmuth 2002).

UK's National Infrastructure Coordination Centre (2004) has recently released findings that equipment from many IPT vendors who utilize the H.323 protocol standard contains flaws that can be exploited by attackers (See Appendix C for more info). The vulnerabilities can leave products open to Denial of Service and buffer-overflow attacks, as well as the insertion of malicious code into the equipment. The CERT Coordination Centre has reported in 2004 that many organisations are vulnerable due to these flaws in their equipment and only some of the vendors have

responded to the accusations by either agreeing or not. Appendix C shows a list of vendors that were identified with vulnerabilities.

All of these security issues, if not dealt with, will eventually lead to loss of revenue and productivity and data theft (Foreshew 2004). Although all of these new types of problems are experienced on IPT solutions, previously TDM systems also had their problems like the possibility of eavesdropping, telephone misuse, denial of service and toll fraud (Shore 2004). So it is only a matter of how corporate decision-makers deal with this issue and what precautions they take.

While businesses need to consider issues such as voice quality and call features when planning to migrate to IPT, basic security of the IP PBX and phones should not be overlooked. If businesses manage their IPT solutions with the same due diligence as any other secure or mission-critical application, security should not be a problem to their organisations (Hochmuth 2002).

3.4.2 Quality of Service (QoS) and voice quality

Hamilton (2003) is of the opinion that the most important impediment for IPT currently is the quality of the voice calls that is being experienced on an IPT network. Voice calls require consistent real-time flow of packets from one device to another in order for humans to understand and interpret the information being transferred. Traditional data networks have not been designed to guarantee that information would flow along the network in continuous streams with predictable point-to-point delivery time, which is a requirement for IPT. If for example one looks at e-mail, the information doesn't need to reach the other person in real-time and a few delays between the blocks of data would be acceptable. Customers rightfully require clear and undistorted voice calls and it does not help to argue with them that the human brain can comprehend speech even when there is a significant amount of distortion. Any deterioration in the quality will be perceived as disruptive on an organisation and customers will not tolerate such service (Gillan 2002). End users are accustomed to PSTN quality and will not settle for less, even with added functionality (CITEL 2001).

To support IPT, a network must be able to guarantee delivery of information within a predictable and acceptable amount of time, which is usually about 100 milliseconds. QoS technology is what enables data networks to provide this predictable end-to-end transmission. It is not new to the telecommunications industry and therefore QoS

enabled IP networks are already in immense use within service provider networks, especially for international communication links (CITEL 2001). The two most severe components of QoS, i.e. latency and lost packets, are closely related. Latency refers to the time it takes for a packet of data to get from one designated point to another (Whatis 2004). An IP network may lose some packets, and other packets may arrive too late at the destination to use to reconstruct the speech, which results in unsatisfactory speech quality.

“Latency, packet loss, and jitter render IP telephony unusable” (Hamilton 2003:3). Experts like Hamilton (2003) are of the opinion that IPT still has many quality problems, which makes it unusable while others like Flynn *et al* (2003) and Erlanger (2004a) report an opposite stance. It has been reported lately that when a network loses a packet, IPT products have intelligence to "reconstruct" the information in it in a similar way a compact disk player would smooth over scratches. IPT algorithms produce transitions that are less distracting than silence or gaps in speech quality, but too many lost packets will degrade voice quality to an unacceptable standard. An agreed maximum level of lost packets for PSTN quality service is 10% (GAO Research 2004.).

One thing for certain is that if an organisation hasn’t implemented QoS before IPT, it will experience packet delay, packet loss and jitter. This will cause speech break-up, speech clipping and all sorts of clicks and funny sounds (Nortel 2004a). It is reported that QoS is not widely used in the LANs of most organisations, the primary reason being the complexity and cost thereof. In order for an organisation to implement QoS it typically means that all the ICT hardware like hubs, routers and switches must be replaced (GAO Research 2004.).

Gillan (2002) reports that link over-utilization is the major QoS culprit, because if the link used to carry VoIP is over-utilized, then voice traffic will be degraded. An over-utilized network will cause delay, packet loss and jitter. There must be a balance between the data and voice traffic and this balance will vary at different time intervals. To get this balance it sometimes will mean that the number of simultaneous phone calls will have to be limited in order to guarantee bandwidth for the data. Network designers must make sure that the network is not over-utilized.

The process of adding QoS to an organisation’s LAN is not guaranteed, because of the layout and design of the existing LAN infrastructure and the age of the equipment

being used. Most LANs are custom designed and by adding QoS to support IPT it requires the service provider to also become a LAN consultant. Skilled technicians must be sent to customer sites to conduct site surveys and design a QoS upgrade plan for the LAN (CITEL 2001).

Bandwidth alone is not enough to guarantee performance of the LAN. Voice and video packets need priority over the data packets in the network. IPT network management software will enable network managers to evaluate QoS policies and also manage the complexity that QoS brings to the network infrastructure.

Winogradoff (2002) and Erlanger (2004a) report that while quality problems might have been a problem a few years ago, it is not a problem anymore. IPT quality over well-engineered networks is equal to PSTN and even better than traditional voice systems. Corporate decision-makers should therefore not worry about the quality of the voice calls if the necessary care and engineering take place during the network preparatory process, which will be discussed later. For Internet Telephony, quality will still be an impediment for the next few years as it goes along with network congestion (Corrocher 2002).

3.4.3 Bandwidth consumption

IPT, with links dependent on the Internet, is referred to as Internet telephony and quality problems experienced can be linked to the available bandwidth. If everyone started to use the Internet for voice calls, the cumulative effect would be that there might not be enough IP bandwidth. Most of the time, poor voice quality is caused by Internet congestion, which today is much more of a problem in developing nations. Such nations often have very little bandwidth going in or out, compared with the more advanced networks of Asia and Europe (Wolter 2004).

Although bandwidth is an impediment for Internet Telephony, the whole idea of cost savings by using an organisation's data infrastructure for voice is also an impediment to some decision-makers. According to Neil Richard, Gartner analyst, there is no such thing as free bandwidth. One simply has unused bandwidth and if IPT is implemented in that bandwidth along with other applications, the bandwidth cost increases incrementally and the expected cost savings will disappear (Vecchiatto 2004b).

3.4.4 Cost

CITEL (2001) reports that desktop telephones represent 65% of the voice network investment in a typical PBX deployment. The cost of IPT equipment is very expensive if compared to normal TDM equipment. This is partly because an IP telephone can be thought of as a traditional business telephone plus half a computer. The device appears and operates like any other business telephone, but connects to a LAN like a computer. It normally contains a microprocessor with a TCP/IP stack, DHCP support, simple FTP, and other elements required to "log on" to the LAN, which makes it very expensive.

The average price of an IP telephone is about $300 per unit, with the high end models selling for more than $600 (Wolter 2004). Research shows that in 2001 there were over three hundred million existing digital business telephones installed around the world and that the base is still growing (CITEL 2001). Organisations have invested huge sums of money in their current PBX voice networks and subsequently moving to a fully converged network sometimes involves a complete replacement of the PBX system, which would effectively be a write-off of this investment. Even though a converged network will reap cost savings as discussed in chapter 2, many companies will still delay the converting process to IPT until their existing system investments have been fully depreciated. The high cost of IPT equipment also means that only a few organisations will reap the financial benefits of the technology.

Not only is the cost of the equipment an impediment for IPT, but also the cost savings that were promised that have not realized yet. There must first be demonstrable cost savings over the total of capital (CAPEX) and operating (OPEX) expenditure, before IPT can really be seen as a cost saver (BMI Techknowledge 2004).

3.4.5 Reliability/availability

Business people will know from experience that data networks are not as reliable as voice networks because they must have experienced network downtime or computer halting errors somewhere in their business. Because IPT systems rely on computer technologies, which are typically more unstable than technologies used in the PSTN, IPT can be seen as less reliable than traditional voice systems. Organisations require their telephone system to be immediately available and they must have uninterrupted

service in order to conduct business. Therefore most executives are unwilling to put voice communications at risk in order to have cost savings (Gillan 2002).

Reliability is something that must be measured over a period of a few years in order to make a conclusion whether the technology used is reliable enough. Predictive models exist that can help with the prediction of the availability of the equipment, based on the design and component failure or repair rates. Most vendors claim that their equipment is very reliable. If the hardware is then so reliable that it can be calculated why do networks fail? According to Hughes Software Systems (2001) the primary reason for downtime is due to application software.

While some might view the unreliability of the software to be the problem, others feel differently. The fundamental component of IPT, i.e. the protocol, could also be the problem. Gillan (2002) feels that IPT is not reliable enough and the IP protocol is the culprit. Most organisations use IPv4, which does not have good support for guaranteed routing. Gillan (2002:56) is of the opinion that until the next-generation of the IP protocol, IPv6, is implemented widely, IPT will not be a critical corporate technology contender without the use of hybrid solutions that combine IP with other more reliable protocols, such as ATM. "The technology will continually improve and eventually get to the point where reliability is not a problem, but for now it remains a barrier" (The Yankee Group 2004:10).

3.4.6 Interoperability

Khalilian (2003) is of meaning that the biggest challenge for organisations deploying IPT is interoperability problems. Interoperability problems have damaged IPT's reputation and organisations have labelled it as another risk factor. At the core of interoperability problems is the way vendors implement two IPT standards, i.e. Session Initiation Protocol and H.323.

H.323 on the one hand is an "International Telecommunication Union (ITU) standard, originally designed to promote compatibility in video conferencing across disparate IP networks. Service providers have also used H.323 for Internet telephony because it addresses call control and management, as well as gateway administration of media traffic, bandwidth, and user participation. The standard represents a very large protocol suite and thus requires extensive memory. H.323 is more rigid in its

implementation but provides better session control and management" (Leavitt 2004:1).

Session Initiation Protocol (SIP) on the other hand is an "Internet Engineering Task Force (IETF) signalling protocol for initiating, modifying, or terminating an interactive user session that includes multimedia elements such as voice, video, or gaming. SIP handles communications requests from clients, which can be sent via various transport protocols, and responses from servers. After identifying the participating systems, SIP determines a session's communication media and media parameters, as well as the called party's interest in participating. SIP also enables sessions involving services such as call forwarding, caller authentication, Internet conferencing, and instant messaging. SIP has been designed to be relatively simple and flexible and to enable application programmability and easy feature-set extension" (Leavitt 2004:1).

What it basically comes down to is that H.323 and SIP systems aren't directly compatible, which offers tremendous interoperability problems to organisations. Further to the problem of interoperability is that in one standard there exist so many modified or extended versions. Audin (2004) reports that vendors may talk about "open" systems, but in reality the IPT systems are only open as long as the implementer follows the approach of the specific vendor.

The emergence of SIP is an enabler of the second generation IPT (2gIP). SIP has been adopted and supported by many manufacturers, but SIP-enabled applications did not reveal themselves (InfoTech Primary Research 2003). The Internet Engineering Task Force (IETF) is now also supporting Megaco, which is yet another protocol, and as a result of these changes nobody knows for sure what the dominant IPT protocol will be in a few years time (BMI Techknowledge 2004).

This interoperability problem is a challenge for IPT providers globally (Hughes Software Systems 2001). The majority of vendors however, have started to adopt open standard-based protocols due to demand from the market and have started to move away from proprietary protocols to some extend, which means that interoperability problems are becoming less of an issue. Supported by bodies like the ITU and IETF, IPT have definitely matured, but interoperability will definitely not go away soon.

The second biggest impediment for IPT in 2003 was interoperability problems (Taylor 2003b). Once interoperability is not a problem anymore it is envisaged that IPT equipment will gradually start to become commodities, which will result in the cost of products declining.

3.4.7 Manageability

Hamilton (2003) reports that to have call quality similar to that of the PSTN, requires careful planning and thoughtful infrastructure preparation. But it also requires a management platform designed for IPT's unique, real-time performance requirements. Network managers need to monitor the infrastructure and call quality in real time, generate detailed reports, and manage the growth of the IPT infrastructure. The success of any IPT implementation depends on its management platform and by having an ineffective platform it can be seen as another hindrance for IPT's success. Selecting the right management platform means fewer up-front risks, faster deployment, a shorter time-to-revenue, and rapid productivity enhancements.

3.4.8 Power

Power issues can be a hindrance to the success of IPT. Every IPT phone has to have a power source, which means one more thing to plug in at each desktop. If an organisation experiences a power failure, all of the IP phones will be down unless backup power exists for the site. Such a power failure can have huge cost implications to an organisation in terms of loss of productive output, loss of work-in-process and loss of revenue. For certain industries, like health care, there should not even be any power failures at all (Nortel 2004a). The legacy PSTN network operates on its own power so that if a site's power goes down, the phones at least work.

Power issues can become something of the past with the new Power over Ethernet standard, which will simplify this issue. With this standard each phone won't need its own power source anymore but will tap its power from the LAN infrastructure. To get such a capability, a company will have to install new LAN equipment, something most organisations won't be able to do right away (Wolter 2004).

Other options open to an organisation to address the issue of reliable power, include the options of battery or generator backup for the telephony system (Nortel 2004a).

While developers have been innovative enough to bridge the power problem with different options, the fact of the matter is that power problems must still be seen as an impediment of IPT in developing countries.

3.4.9 Features

IPT solutions originally lacked most of the features that existed in legacy TDM systems, which meant that organisations lost some of the features often used, just to get IPT. PBX features were designed and implemented over many years and customers very often use features like call forwarding, caller ID, speed dialling, call hold, auto attendant and so on. While a lack of features could have been a problem for IPT implementation, it doesn't seem to be a problem anymore. According to Erlanger (2004a) IPT solutions now support all the basic features. There may however be certain of the features used by an organisation, which they definitely will have to give up once they implement IPT.

While a lack of features could have been viewed as an impediment for IPT, Howard Mellet Communications (2002) is of the opinion that IPT is not about duplicating all the PBX features on IP anyway. It is about the innovation and the creativity of new features. Surveys showed that most employees of a company anyway never use the majority of features a traditional PBX offers, because they're not easy to use. With IP systems, many advanced features are more accessible and easier to use (Wolter 2004).

3.4.10 Emergency calls

Many states within the USA require that business telephone systems have the functionality to provide the exact location of a caller when a call to 911 is made. This is called E-911 compliance. Circuit-switched telephone systems can easily report the location by associating the origination point of a call with a specific system port. IPT system vendors currently have a unique challenge to identify the location of an emergency caller and this is an impediment for IPT's success.

3.5 Soft issues

3.5.1 Regulation

Policymakers, service providers and equipment manufacturers in developed countries agree that IPT requires some sort of regulation to ensure that IPT provides the quality of service demanded from their service provider (Shoreline 2004). Regulation must help the market to grow and it must create a fair, competitive environment. When structuring IPT regulations, the regulator of the United States of America, the Federal Communications Commission (FCC) (similar to function as ICASA in South Africa) said that it wanted to ensure that the IPT market continued to grow, but in a way that would be free from traditional monopoly regulations. Senator Johan Sununu in February 2004 said "the laws that are on the books now don't deal in a clear way with IPT technology" (Gross 2004:1).

In the American market, havoc has been created over the last few years where new IPT service providers provided voice communication but did not need to pay the taxes that traditional service providers had to pay. As a result regulation was needed, but not in such a way that IPT would loose its cost benefit to customers. Sununu accordingly introduced the Sununu bill, also called the VOIP Regulatory Freedom Act, as one of the first regulations of IPT. He said that “there are some people who would like to rewrite the 1996 Telecom Act but must understand that this (Sununu) bill is not a piece of legislation that's designed to rewrite decades and decades and decades of telecom law. It's a piece of legislation that's designed to ensure that this particular area of IP services is dealt with in a forward-looking way, that we don't try to take an archaic or outdated framework and try to jam it on what is a tremendous and promising technology" (Gross 2004:1).

Regulation issues will definitely be one of the major impediments of IPT for the next few years. Here in South Africa regulation issues have been an impediment for IPT and this will be discussed in chapter six.

3.5.2 Management issues

IPT has challenges for both managers and followers. The IP world is optimistic about IPT, while the legacy telephone community is perceived as sceptical and this is reflected in the approach of these two groups (Audin 2004). Voice and data have

traditionally been managed by different people and in different ways. As a result voice and data technicians within a single company typically operated in different cultures with separate divisions and structures. With IPT these cultures must be managed under one umbrella and that is extremely difficult to do. Managers, who already went through the exercise, tell that it requires huge cultural changes, which may hammer operational efficiencies if managed incorrectly (Hamblen 2004).

3.5.3 Resistance to change

To replace the existing terminals in an organisation will most definitely affect every user in the organisation. People are familiar with their handsets and accustomed to their normal way of doing things like using the phone. They will unquestionably resist change, even if it's only something simple like changing the telephone. Corporate decision-makers must know how to deal with this issue. Replacing handsets also entails retraining for all users, whether formal or informal, which incurs additional 'lost' time and expenses (CITEL 2001). Resistance to change can be seen as a challenge for IPT's success.

3.5.4 Vendor lock-in

Vendor lock-in refers to the contractual long-term obligations between a supplier and its customer. The speed of technological change makes vendor lock-in a major concern for any potential IPT buyer. Research has discovered that corporate decision-makers have trouble with two aspects of vendor lock-in (Gillan 2002:29):

- "The possibility that a better IPT solution can reach the market shortly after an investment has been made in a particular vendor's product. If that investment is substantial, it is generally impractical to scrap it and switch to the better approach.
- The fact that the selection of one vendor's approach to convergence may cause lock-in that extends far beyond the IPT solution itself, forcing a long-term commitment to that vendor's overall networking architecture"

A lot of organisations have already experienced this with desktop applications and data network hardware, where use of a particular operating system or routing technology has narrowed their choices in many other areas, such as applications and management tools. No decision-maker wants the IPT implementation to result in a similar limitation of long-term choices. Technology managers thus have legitimate

concerns about committing their companies to any proprietary architecture (Gillan 2002:30). Vendor lock-in can be seen as an impediment for IPT.

3.5.5 Lack of expertise

Communication support personnel have been dealing with a quite wide range of new technologies in a relative short amount of time. The addition of IPT to this technology base does not pose well for these already overburdened staff, which creates a need for more expertise. These experts do however come with a price tag and managers must be able to deal with this issue. Overburdened people will need the motivation and support from management, otherwise performance can decline and staff might abscond from the pressure at work. This can result in a snowball effect with even less expertise available (Gillan 2002).

3.5.6 Internal politics

Some decision-makers think that VoIP stands for "Voice over Internal Politics" (The Yankee Group 2004). Unfortunately, convergence can potentially disrupt the roles and structures of company technology staff and result in internal politics. Who must go? Who must stay? Whose network is the converged network? As things stand now, data applications are the responsibility of an ICT team, while voice communications fall under the protection of a telecommunications group. Convergence undermines these distinctions and roles. Decision-makers may be edgy about implementing convergence technology, whether consciously or subconsciously, because it threatens their own territory or the territory of someone with whom they really do not want to fight.

3.6 Conclusion

This chapter investigated the impediments of IPT with all of the negative implications it could have on the organisation. The weaknesses with regards to Internet telephony were also highlighted. This chapter aimed to help the researcher to come to a conclusion whether the benefits of IPT outnumber the challenges of IPT or the other way around. The impediments for the success of the technology itself were found to be:

- Security
- Quality of Service and voice quality

- Bandwidth consumption
- Cost
- Reliability/availability
- Interoperability
- Manageability
- Power
- Features
- Emergency calls
- Regulation
- Management issues
- Resistance to change
- Vendor lock-in
- Lack of expertise
- Internal politics

16 impediments and challenges were identified compared to the 11 benefits proposed by IPT vendors, which doesn't look that convincing and which throws the balance towards a negative opinion about IPT. But not all of these points must be seen as impediments to IPT's success in an organisation and the different weaknesses can be categorized into bigger groups which will bring down the amount of weaknesses. The secret lies in benefits that have not realized yet and which are still only possibilities that will reveal themselves in the next few years. Productivity improvements for example, cannot be counted as only one benefit but should be seen as a group of benefits. A "killer application" can reveal itself and who knows what other benefits it can bring to an organisation.

Some of the impediments can be overcome and might not even be impediments if the implementation is properly planned. But things like security, voice quality, interoperability problems and cost of equipment won't just disappear overnight and is expected to be a challenge for the next few years to come. "In today's digital economy, customer service and operational efficiencies are two of the most critical aspects of business" (Howard Mellet Communications 2002:1). Therefore the QoS delivered by the IPT system is critical to meet customer satisfaction targets. The reported lack of voice quality in IPT systems can be one of the greatest impediments for IPT but it can be overcome.

Knight (2004) discovered that experts on the topic of IPT understand the weaknesses of the technology in detail and have a fear that inertia, arising from conflicting economic interests within the standard setting bodies, will prevent meaningful improvements from being made. According to him they do believe in IP and know that technical fixes and extensions to the standards will solve most of the outstanding issues.

Converged networks are complex and need good security and performance. New security vulnerabilities will continue to be discovered over time and all organisations will unanimously have to fight the treat of security issues. As far as the other impediments are concerned, some like Jorge Blanco, vice president of marketing at Avaya, might feel that "the early issues of voice quality, quality of service, scalability, migration, features and functionality in enterprise IP phone systems have pretty much been solved" (Erlanger 2004:1).

IPT vendors should face reality and admit that the value proposition of IPT is not that convincing yet if one compares all the benefits with the impediments. IPT customers in return should be more opportunistic about the technology and understand the benefits the technology can offer to their business once it has matured and the "lucrative environment" exists. IPT can be successful and can bring about strategic benefits to an organisation.

CHAPTER 4: IPT IMPLEMENTATION OPTIONS

4.1 Introduction

Chapter two described the strengths of IPT and the weaknesses of the technology were highlighted in chapter three. Possible models for implementing the technology must now be investigated to understand the different factors involved, because if the technology is implemented in the wrong way, additional impediments might be introduced. It is then also necessary to understand the logical steps that suppliers developed from their experience in developed countries in order to implement the technology.

4.2 Aim

This chapter will investigate the best practices for implementing IPT technology. The strategies that were formed for the implementation of the technology in developed countries will be categorized to determine whether it is also applicable to our local context. The most important factors in the implementation process will also be highlighted and this chapter will discuss why strategic decision making instead of tactical ones is needed.

4.3 Scope

In order to reach the aim of this chapter, the following points will be discussed:

- Why strategic and not tactical decision-making?
- Implementation options
- Best practices for implementation
- Other factors to remember in the decision-making process

4.4 Why strategic and not tactical decision-making?

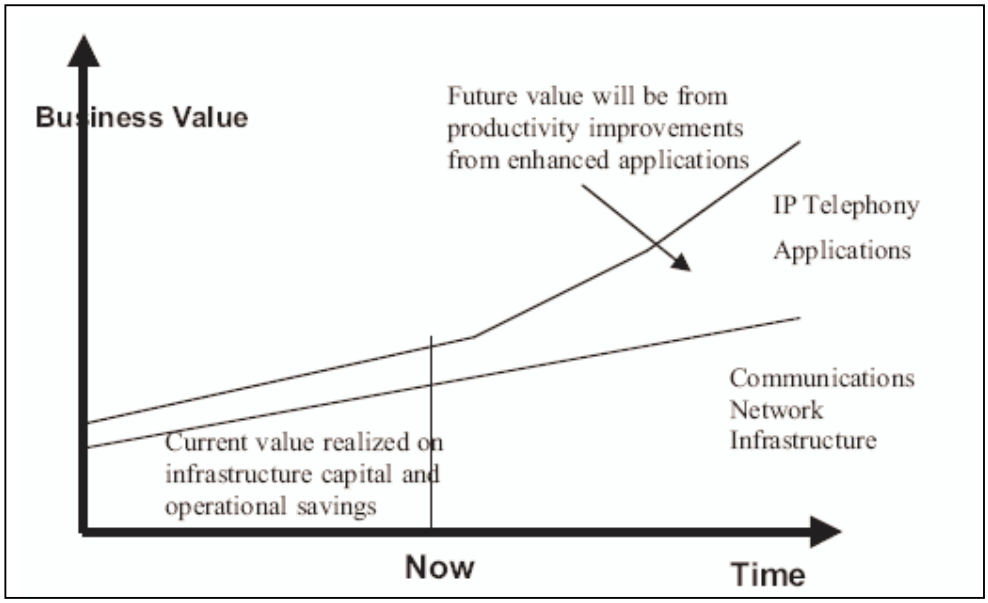
"The productivity gains and competitive benefits that are realized through an integrated network of voice, video, data and applications quickly changes a tactical decision that an enterprise makes to a strategic decision that helps the enterprise run its business better and improve its customer service" (Nortel 2004b:4). ICT is today becoming a strategic part of an organisation and decisions are based on business drivers and not popular technology. IPT decisions should not be different and it should be contemporary. If an organisation waits too long to implement IPT it will

find itself in a competitive disadvantage within the next few years (The Yankee Group 2004).

It is true that technology is the fastest depreciating asset in a company and therefore decision making in organisations can be more tactical in focus (Whittle 2003). Tactical decisions are mostly based on ROI, e.g. "does the benefit delivered by the technology measurably outweigh the costs involved in delivering it?" (Whittle 2003:7). If not, then don't implement. An ICT department is said to be largely tactical focused if the primary emphasis of the department is to provide only a basic set of services at the lowest possible unit cost. Decision-making is focused on "nice to have" things like toll bypass savings and a single converged network for convenience. If the ICT department also has a strong mandate to assist the organisation to reach its objectives, then its decision-making can be seen as strategic focused. IPT is not just a tactical ROI-based decision but a strategic decision as it will also involve commitment and risk (Winogradoff 2002).

A strategic stance towards IPT will be displayed by an organisation if business processes are redefined in order to get the real benefits (Taylor 2003a). *Figure 4.1* shows that decision makers must think of IPT over the longer term. Productivity improvements will only be realized later on when new unimaginable applications will be developed.

Figure 4.1 - Enterprise communications value timeline



Source: (The Yankee Group 2004:1)

Benefits of an IP-based infrastructure can only be achieved through skilful planning, implementation and execution. By not doing this, an organisation can place unnecessary financial burdens upon itself instead of reaping the benefits of the technology (O'Halloran 2003). The modern commercial environment continues to place increased pressure on an organisation to increase efficiency, flexibility and responsiveness. A fundamental requirement in delivering such benefits is a robust, reliable and flexible ICT infrastructure that will not place cost burdens on the business. It must support fundamental improvements to productivity and customer service. IPT is claimed to be one such a productivity improvement technology (O'Halloran 2003).

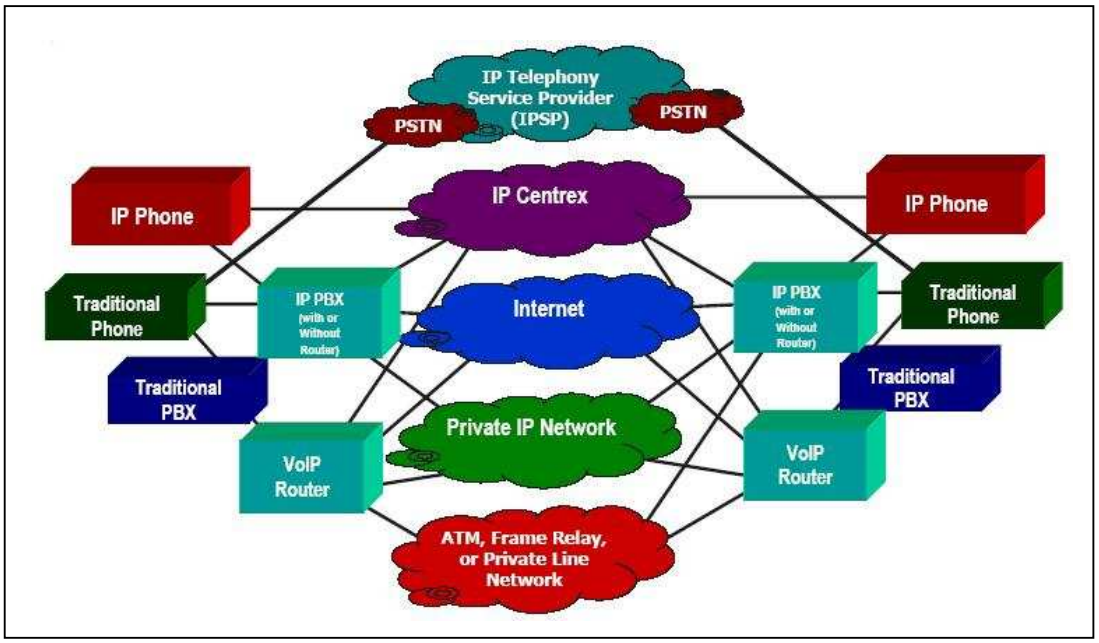
An organisation's internal design elements like its structure and culture can influence the success of an ICT technology. Cultural aspects referred to are things like risk taking attitude, whether teamwork or individual work is valued, whether bigger is better and so on. As a result ICT can also contribute to dramatic changes in an organisation's structure (Silver *et al* 1995).

An ICT system like IPT must "fit" its context (the organisation, its strategy and it business processes). Effective ICT implementation depends on the balance that is achieved by re-engineering. Reengineering aims to accomplish radical improvements by complete redesign of business processes supported and enabled by the use of ICT. A misfit will subsequently result in a high failure rate.

4.5 Implementation options

IPT can be implemented in several ways as shown in *Figure 4.1*. IPT can refer to voice communications over the Internet, a private IP network, the IP network of a carrier or through an IPT Service Provider (IPSP). Nortel (2004c) is of the opinion that the key to success when moving to a converged network is to see the process as an evolution of the existing network. Basically there are three major options that can be followed when implementing IPT in the enterprise market. One of the options is an evolutionary approach (also known as a hybrid option), the other a revolutionary approach (also known as the forklift approach) and the third option is a hosted IPT service, called IP Centrex.

Figure 4.2 - IPT network architecture



Source: (Hettick & Taylor 2004:4)

4.5.1 Option 1 – Evolutionary approach (hybrid)

How can the benefits of IPT be achieved without over-capitalizing? The most popular scenario for IPT implementation is a hybrid deployment that installs IPT where it costs the least and produces the most benefits and to leave the TDM systems in place otherwise (Erlanger 2004). Not only is this most cost effective approach, it also reduces the risk of IPT implementation and expedites the implementation process (Fujitsu 2003). A hybrid system allows an organisation to "stick a toe in the water without getting completely wet" (Wolter 2004:1).

Central to the whole hybrid approach to IPT is the IP enabled PBX. This PBX operates as both a TDM PBX and a server for IPT calls (Fujitsu 2003). Large manufacturers like Avaya, Mitel Networks Corp, Siemens, Alcatel and Nortel Networks, offer a number of upgrade scenarios that ease into the new technology. The six largest vendors of hybrid systems are: Nortel, Siemens, Avaya, Alcatel, Ericsson and Cisco (Walton 2003). These solutions vary in cost, depending on the original equipment and the number of extensions served (Wolter 2004).

CITEL Technologies, which is a rather small company, develops software that enables some of the most popular analogue phones to communicate with an IP PBX of another manufacturer like 3Com, for example. This can minimize the costs

associated with buying new IP phones, or at least allow an organisation to purchase and implement IPT slowly (Wolter 2004). When following this evolutionary approach the migration can be done in the following stages (Fujitsu 2003):

- Proof of concept stage
- Pilot projects
- Full IP telephony

Stage 1 - Proof of concept

During this phase the capabilities of IPT and infrastructure provisioning requirements are tested. The current types of systems are tested for interoperability and so on (Fujitsu 2003).

Stage 2 - Pilot project

This stage involves deploying IPT to parts of the organisation where the benefits can be monitored. This can include the migration of certain branch offices and teleworkers. Problems identified during the pilot project can then be rectified without paralyzing the whole organisation (Fujitsu 2003).

Stage 3 – Full IP telephony

Logically this would then be the phase where the whole organisation moves to IPT (Fujitsu 2003).

This hybrid approach will allow organisations to take advantage of IPT without disproportionate costs. By leveraging existing equipment, organisations will be able to achieve higher ROI without sacrificing the functionality and stability of legacy TDM PBXs. It is recommended that this is the best option for businesses that are satisfied with their current, traditional PBXs or don't have the budget to buy whole new IPT systems.

4.5.2 Option 2 – Revolutionary approach (Greenfield)

Organisations that will build new offices from scratch or are expanding tremendously should use this option. This is also known as the “forklift approach”, when the complete network is redone and as a result it is also the most expensive option (Nortel 2004b). The key advantage of this option is that an organisation owns and has full control over its voice system. In many cases this provides a great deal of flexibility to customize communications applications to meet specific needs.

The main potential downside of this option is the management of complexity of an IP PBX. Either a knowledgeable ICT employee or a consultant must be employed to deploy and manage it (Wolter 2004). "Many early adopters who have attempted revolutionary upgrades to IPT have discovered their networks were not adequately provisioned for the change. The result is unreliability, downtime and business instability as urgent upgrades are carried out" (Fujitsu 2003:14).

It is estimated that the initial cost of an IPT solution might be 10 to 20% higher than for a traditional PBX, but those costs are usually recouped within a few months if the purchaser can take advantage of the savings on long-distance calls. Organisations starting from scratch can also save money if one looks at the wiring issue. Only one set of cables is needed when it comes to wiring a new building (Wolter 2004).

Companies that provide complete IPT solutions include (Wolter 2004):

- Alcatel (www.alcatel.com)
- AltiGen Communications (www.altigen.com)
- Anta Systems (www.antasystems.com)
- Artisoft (www.artisoft.com)
- Avaya (www.avaya.com)
- Bizfon (www.bizfon.com)
- Cisco (www.cisco.com)
- Comdial (www.comdial.com)
- EADS Telecom (www.eadstelecom-na.com)
- FacetCorp (www.facetcorp.com)
- Interactive Intelligence (www.inin.com)
- Nortel (www.nortel.com)
- ShoreTel solution (www.shoretel.com)
- Siemens (www.siemens.com)
- Swyx Solutions (www.swyx.com)
- Toshiba (www.toshiba.com/taistsd/pages/prd_voip_ipctxdk.html)
- Vertical Networks (www.vertical.com)
- Zultys Technologies (www.zultys.com).

It is anticipated that companies with a significant installed base of TDM PBXs are unlikely to forklift it all out to make space for IPT equipment unless there are enough benefits to do so.

4.5.3 Option 3 – IP Centrex solution

With this option, the telephone system basically consists of software running at the Service Provider's network operations centre. It functions exactly as an on-site PBX, the only difference being the fact that no voice equipment is present at the organisation's premises. This option is a relatively new concept, which has only been offered in the USA over the last five years. The major inhibitor of adoption of this option in the USA is the fact that people don't know that it is available (Wolter 2004).

The providers of this option for large organisations in the USA and Canada include (Wolter 2004):

- Covad/GoBeam (www.covad.com, www.gobeam.com)
- ICG Communications, Inc. (www.icgcomm.com)
- SBC (www.sbc.com)
- Telus (www.telus.com)
- AT&T Wireless (www.att.com)
- Verizon Wireless (www.verizon.com)

The following companies focus on hosted options for small businesses:

- Covad/GoBeam (www.covad.com, www.gobeam.com)
- Packet8 (www.packet8.com)
- Voicepulse
- Vonage

The key advantage of a hosted service is that it relieves an organisation of the responsibility of setting up and maintaining an IPT system. Other benefits include the following (Roger 2003:15):

- It cuts out the need for significant capital investment, which minimizes the risk.
- It reduces the resources required to manage the solution
- The organisation can benefit from the supplier's expertise and ICT resources, which can be difficult and expensive to provide in-house
- The organisation has the benefit of growing and changing the network end-to-end as the business demands
- The service provider can provide assistance with network planning for applications for example

- The service provider can provide proactive management to monitor, maintain, fix, and measure network performance
- Guaranteed times are provided for new installation and time to repair via Service Level Agreements

With this option Service Level Agreements will be an important part of the agreement with the service provider, because they must provide the performance levels agreed upon.

4.5.4 Comparing IP PBX with IP Centrex

Decision-makers will have to choose between the different options available for implementation. The different options have pros and cons and two of the options, i.e. IP PBX and IP Centrex, are compared in Table 4.1.

Table 4.1 - IP PBX versus IP Centrex

IP PBX		IP Centrex	
Advantages	Challenges	Advantages	Challenges
More control over migration, upgrades and features	Requires capital expenditure to implement	Requires few resources and skills	Immaturity of services and service providers
Single point of responsibility for service levels	Requires skilled resources to build and support	Easier to implement	Service provider blaming in-house ICT employees
In-house IPT and application integration	Must plan for flexibility and business recovery planning	Lower capital costs, even none at all	Service provider controls migration/upgrades/features
		Service provider provides flexibility and business recovery planning	Reliant on service provider to facilitate application integration

Source: (Shoreline 2004:1)

Whatever option an organisation selects, costs must be planned out over time, since this will not be an overnight process (IDC 2003).

4.5.5 The best choice

There is currently a debate over whether a hybrid solution or a pure IPT system is the better, but the choice at the end will be unique to each organisation and every decision-maker will have to perform the correct amount of due diligence to determine which option is best. A solution must be selected that fits the specific business' environment and that can meet the organisation's goals. There is no best solution for all organisations. "The important criteria is that a variety of choices be available to the enterprise to provide a solution that can deliver all the benefits of IP telephony while offering investment protection and a product that will not put the business at risk" (The Yankee Group 2004:9).

4.5.6 Internet telephony options

Looking only at Internet telephony, Corrocher (2002) explains that there are three types of configurations:

- PC-to-PC
- Phone-to-PC and PC-to-phone
- Phone-to-phone

For the PC-to-PC configuration, two computers are linked via the Internet and voice packets are transmitted between them. For the phone-to-PC and PC-to-phone configuration a gateway must be set up to link the Internet with the PSTN and a connection is made to another gateway at the remote side. "Outgoing calls from a PC to a phone are simpler than calls travelling in the opposite direction, because it is relatively easy for an Internet application to find a phone number and the IP address of the gateway, while it is impractical to require the PSTN users to dial first the telephone number of a gateway and then the numeric IP address of the called party" (Corrocher 2002:527). The third configuration, phone-to-phone, the called party as well as the calling party's phone is connected to gateways which converts the digital signals to analogue signals and routes the call through the local PSTN (Corrocher 2002).

4.6 Best practices for implementation

IPT cannot be successfully implemented without a well-formulated strategy, which is implemented, evaluated and controlled in the correct manner. "Despite the future value proposition, companies should not hastily deploy IPT" (The Yankee Group 2004:1). Organisations must employ strategic planning as a way to progress towards their desired goals and to give them direction. They must allocate resources and finances. They must formulate and implement a strategy continuously as it is an on-going, never-ending, integrated process that requires continued reassessment and reformation (Wikipedia 2004). Implementation of IPT must be done in a similar way with the Situation Target Path (STP) process: Where is the organisation right now? How did the organisation get here? Where does the organisation want to be? How can the organisation get there?

4.6.1 The need

In an article of Hochmuth *et al* (2004a:52) it is mentioned that one of the people who attended the Voicon conference 2004, John Kealey, who is a manager for Canada's IT Services Division, has made the remark that it comes down to business needs. If an organisation needs to offer new services that only IP supports, it must implement IP telephony, otherwise not. Where does the organisation want to be? Key to successful choosing of technology is to only think in terms of the particular organisation's problems and needs. Once the business goal is identified, map out the existing process and consider how it can be improved (Whittle 2003).

So why then will organisations need IPT? The Yankee Group (2004) mentions that organisations face the following challenges and this is where IPT will fit in:

- They must improve productivity with ICT
- They must increase revenues while lowering costs
- They must mobilize the workforce
- All communication platforms must be unified
- They must reduce complex administration of the ICT infrastructure

IPT will enable organisations to overcome these challenges. How do decision makers then determine if the organisation is ready to look at IPT? Erlanger (2004a) gives the following questions that decision-makers can ask themselves in order to determine whether it is time for IPT in their organisations:

- Is the organisation getting ready to upgrade the legacy phone system or is the contract due to be signed again?
- Does the organisation have many different types of TDM systems and services that incur a lot of overheads?
- Is the organisation moving offices or adding new branches?
- Can the organisation benefit from mobility communication to their sales and marketing people?
- Can the organisation benefit from virtual call centres?
- Do employees in the organisation change from office regularly?

4.6.2 Network Assessment

Network assessment is important for IPT planning and is mostly conducted by outside experts. According to Hettick & Taylor (2004) it is needed to make sure that the existing IP network can accommodate the added traffic that the voice part will put onto the existing IP network. Assessment of the network is important because the performance of IPT is not dependent so much on the equipment itself, but more on the environment in which it must perform. The goal of the process is to assess the data network's ability to deliver the required voice quality levels (Avaya 2004). What must be assessed, is the network's latency, jitter, utilization characteristics and the availability of key features such as QoS. To realize good voice quality Hewlett-Packard (2003) suggests the following minimum requirements:

- Packet loss: up to 3% between end points
- Delay: 80-180ms delay between end points
- Jitter: 20 ms or less between end points

Organisations can bypass the assessment part at a high cost and simply overprovision the network. It will work initially, but becomes a very risky option as the network usage increases (Concord Communications 2003).

It is estimated on a global level that 85% of today's data networks are not ready to support IPT services without any modification. It is therefore crucial to test the network thoroughly before, during and after deployment and to link the testing results with some sort of network management tools that monitors the performance of the network over a certain period. Software tools exist that can generate Web-ready reports to enable rapid information sharing and decision-making, which is a notable

advantage for time and budget-critical IPT deployments (Integrated Research 2004a).

Key areas to understand before formulating a strategy are (Nortel 2004b:14):

- "Infrastructure components and capabilities
  - What types of components exist in the network? What data components? What telephony components?
  - Does the organisation have components of multiple vendors or from a single one? Will interoperability problems be an issue?
  - What is the age of the equipment? Can it be upgraded to support IPT?
  - What is the performance possibility of the WAN?
- Infrastructure topology and traffic patterns
- Infrastructure design, capacity planning and scalability
- Infrastructure policy services
- Infrastructure management, operation, administration, maintenance and provisioning
- Business continuity policies and practices"

While the assessment process may vary from organisation to organisation, the typical process includes (Packeteer 2004:3):

- Capture a holistic view of the network
- Analyse bandwidth requirements
- Capacity planning
- Server performance
- Security issues
- Network's ability to meet voice quality standards
- Maintenance

If the assessment has found that the network is deficient, the assessment must also determine what improvements must be made. The assessment can also provide information on support planning and budgeting when it deals with future growth, traffic fluctuations, planned restructuring, acquisitions and divestitures. Additional assessments during implementation and afterwards can be very useful (Avaya 2004).

4.6.3 Option selection

If IPT is found to be needed it can be implemented in several ways including a revolutionized approach or in an evolutionary approach. Nortel (2004c) is of the opinion that the key of success when moving to a converged network, is to see the process as an evolution of the existing network.

The first step is to ask whether it is time for IPT in the specific organisation. The next step is to determine technology and business needs, and to measure those needs against current capabilities and infrastructure. Making the leap to having a more effective network is not always easy, particularly as both networks and networked applications have grown more complex (IDC 2003). To make the leap is very difficult and many organisations have their doubts about the unrealistic migration strategies proposed by vendors, which simply proposes a high risk, high-cost "forklift" upgrade that do not take into consideration business realities (Fujitsu 2003).

4.7 Other factors to remember in the decision-making process

"If IPT is not properly engineered and implemented, it can result in lost productivity, frustrated customers and curtailed revenue" (Nortel 2004a:2). This paragraph will highlight additional factors necessary to take into consideration in the decision-making process.

4.7.1 The Alignment of ICT with the business

Forming a strategy to implement IPT should include solutions that can help the ICT department to (Packeteer 2004):

- Gain visibility of the network and applications
- Apply control
- Accelerate performance
- Show bottom line ROI

Gain visibility of the network and applications

According to research conducted by Network World magazine and Packeteer (2004), more than 75% of all ICT managers do not have adequate visibility of the WAN in their organisations and as a result thereof, organisations do not know about all the applications running on their network. ICT departments must get visibility of their network.

Apply control

It should be possible to determine where the bottlenecks in the network are and to know what other applications will also compete for bandwidth? SAP will not be the only business-critical application anymore and IPT will compete for bandwidth. According to Packeteer (2004) many ICT organisations are still unsure of the importance of IPT to their organisations. IPT will become the most critical application for an organisation because its performance will impact every user at every location in the organisation. QoS issues like bandwidth, latency, jitter and packet loss as discussed earlier must be properly addressed to ensure optimal and reliable performance for all knowledge workers (Packeteer 2004).

Accelerate performance

Compression techniques eliminate repetitive bits of data to be transmitted over the network and have the benefit of reducing packet size, which in turn results in less bandwidth required for the applications themselves. Organisations must look at compression techniques.

Show bottom line ROI

Organisations must focus on money that they spend on ICT infrastructure and should save money by avoiding unnecessary WAN upgrades. They must have an IPT implementation plan and know when and what to upgrade.

But IPT forms part of an organisation's ICT and as a result it must be aligned with the business strategy. Convergence needs to be based on the corporate strategy to meet the business needs and to take advantage of the benefits while also managing the risk. "Technology should be the slave, not the master. It should help achieve your business priorities, not dictate them" (Hegarty 2003:6). The Yankee Group, which is a leading ICT research group, states that investment in ICT infrastructure that is not aligned with the business strategy will lead to competitive disadvantages. ICT alignment means that ICT departments must work closely with the various lines of an organisation to understand their performance objectives and priorities and to ensure that their own resources, operations and performance metrics are in harmony with strategic objectives of the whole organisation. Misalignment will definitely lead to cost implications (Packeteer 2004).

4.7.2 Security issues

During the move to a converged network it will be necessary to ensure that the real-time applications are secure and that the business assets are protected against malicious intent. Steps should safeguard the confidentiality, integrity and accuracy of network communications (Nortel 2004b).

One of the best ways for ICT professionals to secure an IPT LAN is to separate IPT from the data LAN. The 802.1Q capability of switches must be utilized in such a way that IPT is placed in a different virtual LAN. A firewall must then be placed in between the segments, so that wherever the segments must interact, for example messaging systems, the firewall should provide protection from attacks (Erlanger 2004). IPT vendors and customers, who already are familiar with IPT, recommend these steps to be taken to manage the security of an IPT solution (Hochmuth 2002):

- Separate IP PBXs on the LAN by installing the devices in different domains from other servers
- Isolate voice traffic onto a virtual LAN
- Limit the administration access to IP PBXs allowing only a few people to have access to the IPT server
- Limit the types of protocols that can access the IP PBX or IPT network when possible
- Encrypt voice traffic where possible. Do not send IP voice over an unmanaged or public network

Other tips that are given:

- Do not use PC-based IP phones because they are vulnerable to virus attacks and create a link between the data and voice segments (Bayerl 2004)
- Network address translation must be implemented between the segments with private address space for all IPT devices (Bayerl 2004)
- Rather use static IP addresses for all IP phones (Bayerl 2004)
- Always install the latest security patches for all voicemail and call-processing servers (Bayerl 2004)
- Have good virus protection (Bayerl 2004)
- Block access to H.323 services on devices that don't need to be exposed (CERT 2004)
- Limit access to only those machines that use H.323 for critical business functions (CERT 2004)

- Disable application-layer inspection of H.323 packets by Firewalls (CERT 2004)

4.7.3 Outsourcing or not

Part of the decision-making process is to determine which tasks are to be done in-house, and which to outsource. "The most expensive element of technology after upfront investment is support costs" (Whittle 2003:8). Decision-makers should determine the core skills of the organisation and where to focus the resources. It is reported that hiring an outside vendor can be cheaper and faster than hiring, training and managing internal employees (Avaya 2004).

4.7.4 Business continuity

Decision-makers need to assess the impact that the IPT move will have on the organisation. It will be necessary to evaluate whether employees will be able to carry out their day-to-day tasks. Training of the employees will be essential for the implementation, in order for employees to know how to use the new applications (Nortel 2004b).

Measures must be taken to ensure that the transition to a new converged network will be done in the most effective way and that the customers, employees, suppliers and partners all have access to the applications they need (Nortel 2004b). The principle of disaster recovery and redundancy must be used to ensure that the network provides essential functionality even if parts of the network are unreachable. Decision-makers must know what the normal traffic flow in the network looks like and must produce a plan of action to handle bursts of traffic on the network (Nortel 2004b).

4.7.5 Power

In order to provide communication and telephone service at all times, including emergencies, the IPT network infrastructure must be connected to an uninterruptible power supply source of some type.

4.7.6 HR issues

According to Erlanger (2004) it is the organisations that will get the voice and data employees to work together effectively, that will have the most successful IPT implementations. All the users of the technology should be considered. They must be trained, otherwise many hours will be wasted if the employees don't know how to use the technology.

4.7.7 Support of legacy equipment

Decision-makers must ensure that the IPT solution they want to invest in supports their legacy equipment like fax machines, modems and others at a reasonable cost.

4.7.8 Risks

It is important to consider the impact that any move to a converged network will have on the business continuity, organisational dynamics, security and scalability (Nortel 2004b). All the risks must be explored and decision makers should be aware of the risks and know what actions to take to reduce their impact.

4.7.9 Scalability

The number of IP devices will increase over a certain period if the phased approach is taken. This will mean that the decision-makers will have to look at capacities of the current equipment and the bandwidth of the current infrastructure (Nortel 2004b).

4.8 Conclusion

The aim of this chapter was firstly to determine the different implementation models and then to categorize them accordingly. It was found that organisations could either follow an evolutionary approach (hybrid), or a revolutionary approach (Greenfield) or thirdly an IP Centrex solution. In the next chapter where the market environment will be investigated, the popularity of the different models can be compared with each other and this will then also help to identify the most appropriate approach for South African organisations.

Business best practices and systems like ERP and CRM are being implemented by local organisations because of pressure from global competition. Many local companies compete with international organisations for market share and should be

as efficient and effective as their competitors and even better. Implementation of best practices with regards to IPT was investigated and it was found that an organisation should start by asking whether they need IPT or not. Convergence is happening whether organisations are ready for it or not. The process must be carefully planned out and supported by ongoing testing. Given that convergence provides a competitive advantage, most companies will find they need to pursue it. However, they must do so within the context of specific needs. If they need the technology, they must perform a network assessment to determine what network components they can use and which ones they need to replace. They must also decide whether they want to go for the hybrid, Greenfield or Centrex solution.

Various aspects to be aware of during the formulation and implementation of an IPT strategy were highlighted and included the following issues:

- The alignment of ICT with the business strategy
- Security issues
- Whether to outsource IPT implementation and maintenance or not
- Business continuity
- Power issues
- HR issues
- The support of legacy equipment
- Risks involved
- Scalability

None of these issues can be marked as not being applicable in the South African context. All of them are important to local organisations as well. IPT implementation decisions must shift from hype decisions to the solving of business problems. The value proposition must be of increased productivity rather than of the saving of costs. The implementation process op IPT will have to be carefully planned in logical steps and all the factors must be taken into consideration.

CHAPTER 5: THE ADOPTION OF THE TECHNOLOGY

5.1 Introduction

From a customer perspective there are two criteria that would facilitate a move towards another technology (Esselaar 2001):

- Greater cost efficiency
- Provision of services not possible with current technology

New technologies like IPT can either be adopted or not. Once it has been adopted, the new technology will go through several stages before it becomes a dominant force. Foster (in Esselaar 2001) mentioned the stages as:

1. Entry of competitor with a new product
2. Large contracts that makes this technology a force in the market
3. Substitution between current and newer technology
4. Product variants are produced and all niches are penetrated.

How old this reference might be, the process might still hold value. What is important is whether the technology is adopted in the market in order to sign the large contracts.

5.2 Aim

In chapter 2 it was concluded that IPT as a technology bodes well and that it could be beneficial to an organisation to gain a competitive edge. It was then compared to all the challenges it still faces. The value proposition of IPT is not that convincing yet. This chapter will try to proof this point and the market will be investigated. What do the customers say? The aim of this chapter is to determine whether the international market has adopted the technology well and then to compare it with the local adoption rate of IPT. The aim is also to identify the implementation option mostly adopted so far by local organisations.

5.3 Scope

In order to reach the aim of this chapter, the following points will be discussed:

- A theoretical adoption model (CTAM)
- The international trend of adoption
- The local trend of adoption

5.4 Constat's Technology Adoption Model (CTAM)

Constat (2001)* developed a technology adoption model to determine if a certain technology would be adopted in the market and what components of the environment would influence the adoption rate. After many years in the business they found that much of today's market research shouldn't be used in the wrong context. Today's research is driven by assumptions, which if correctly applied, will lead to market research that excels, but it also has a few problems. One problem for instance is that assumptions can be overestimated or underestimated. IPT market research might have left out some of the components of the model and this chapter will investigate this issue (Constat 2001).

The adoption of technology is not a simple research exercise, because it is very complex and a continuously evolving process. The Constat Technology Adoption Model (CTAM) is a very useful research tool to analyse a market environment, because it is more sensitive to all the elements involved in the adoption rate of a new technology. Although described along the boundaries of individuals, the model can also be applied to an organisation, because organisations looking at IPT are made up of individuals who must make the final decisions.

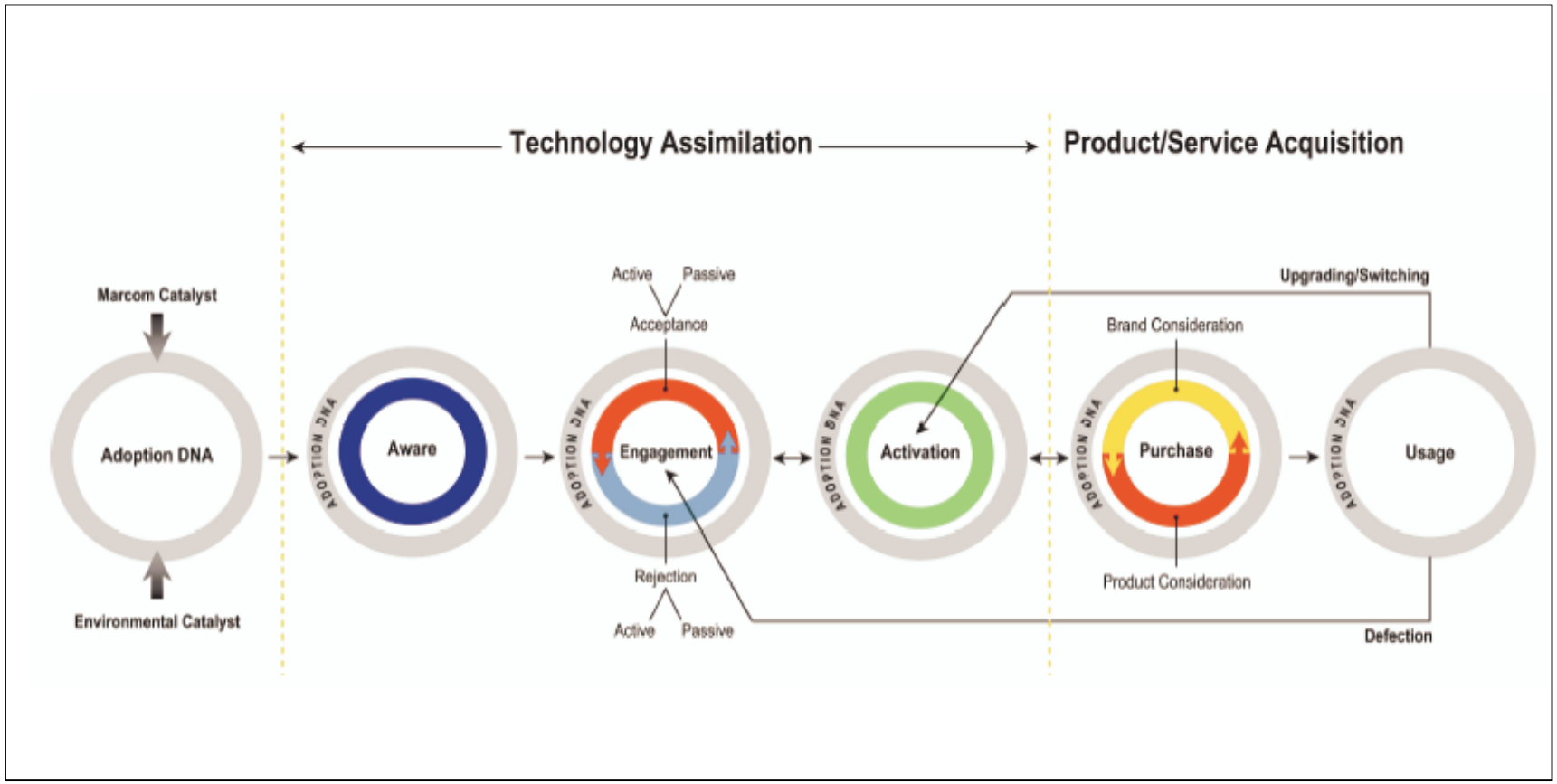
In order to discuss the market research issues of IPT, it is first necessary to describe the model as seen in *Figure* 5.1. The next few paragraphs aim to highlight all the issues that are important for the adoption process. What is important about this model is that it consists of three dimensions (Constat 2001):

- Adoption DNA
- Adoption Catalysts
- Technology Assimilation Process

Producers of technology and services must understand the adoption process from the perspective of the consumer. In all industries consumer input is of utmost importance to the development, positioning and marketing of new products and services (Constat 2001).

* Constat is a research company that does custom market research and consulting for the ICT marketplace and it has done research for customers like AT&T Wireless Services, Cisco Systems, Intel, Sprint Communications and Microsoft to name but a few.

Figure 5.1 - Constat's technology adoption model



Source: (Constat 2001:7)

The adoption process should not be seen as a linear movement through the different stages from left to right (*Figure 5.1*), but every organisation within the active market for a given technology will fit at a specific phase of the process and the phases are mutually exclusive (Constat 2001).

5.4.1 Adoption DNA

The first part of the model, Adoption DNA, can be broken down into knowledge-based belief structures, social system and characteristics, brand relationships and techno graphics as shown in *Figure 5.2*. "By determining the relative influences of each element, the extend to which each element will influence or interact with another, and the best way to simulate each element, we can better understand why, how and when certain individuals will adopt a new technology while others will not" (Constat 2001:5).

Knowledge-based belief structure

Knowledge-based beliefs are the individual's basic "cognitive and psychological frameworks, paradigms and stored beliefs and information" (Constat 2001:5). Past experience and information serve as a basis for future knowledge sets.

Social system and characteristics

This refers to the social milieu within which the individual/organisation operates (Constat 2001).

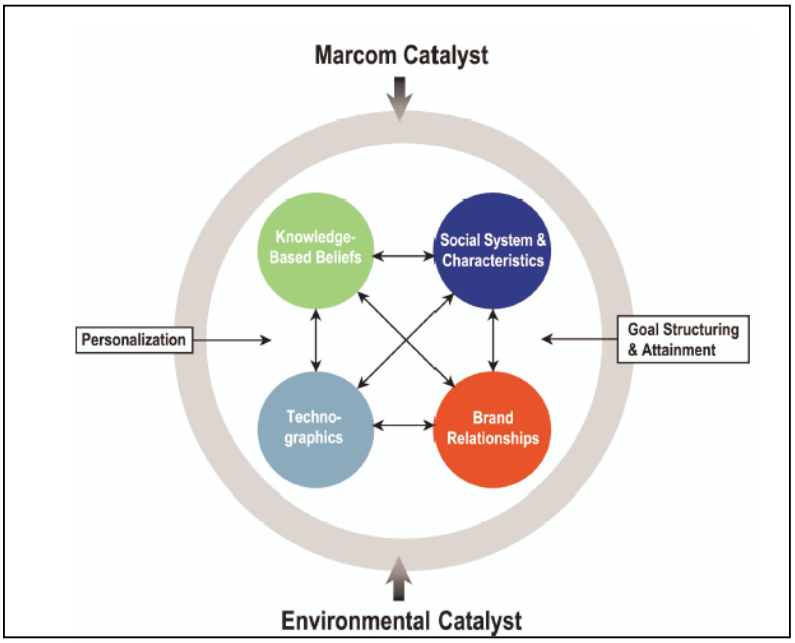
Brand relationships

A brand may become synonymous with a certain category and a brand preference is established earlier in the discovery phase of a technology. Examples where brand names dominate the technology are SAP with ERP systems, Microsoft with operating systems and Cisco with networking equipment. Brand relationships are very important for the adoption process and that is why it is important for technology companies to target an organisation in the early engagement process of the technology (Constat 2001).

Techno graphics

This refers to the extent to which people adopt a certain type of technology, use it and the likelihood of adopting subsequent technologies (Constat 2001).

Figure 5.2 - The Adoption DNA



Source: (Constat 2001:4)

Marcom Catalysts

Marcom Catalysts refers to the influences created by companies that create and market technology products and services, which include new features, brand positioning, advertising, changes in pricing, etc. (Constat 2001).

Environmental catalysts

Environmental catalysts refer to all the incentives outside the primary influence of the technology companies of which it has no control (Constat 2001).

In combination all of these components make up the Adoption DNA of the technology at stake. It should be taken into consideration in the whole adoption process of new technology.

5.4.2 Technology Assimilation

Evident in the CTAM are three distinct phases of technology assimilation, which are awareness, engagement and activation. The whole process is an assimilation process. According to the Cambridge Dictionary of American English assimilate means “to take in and make part of your basic knowledge….so that you can use it as your own”. It consists of the following phases (Constat 2001):

- Awareness phase

- Engagement phase
- Activation phase

The Awareness Phase

Before an organisation can adopt a technology, it must be aware of the technology. In this case it is IPT. Constat (2001) finds that the circumstance under which an organisation becomes aware of a new technology have a huge impact on the organisation's disposition towards the technology and likelihood of pursuing the technology further.

The Engagement Phase

During this phase decision-makers can form an opinion about the product and can decide whether they like it or not. It is confined to attitude alone. Based on the decision there are then four sub-categories (Constat 2001):

- Active acceptance – The technology can either meet their needs or improve their current status
- Passive acceptance – Decision-makers like the technology but there might be barriers that inhibit them from buying the technology. These organisations will stay here until an external catalyst activates their Adoption DNA in such a way that they continue they assimilation process
- Passive rejection – Decision-makers perceive that the technology does not meet a specific need or they cannot see themselves using it
- Active rejection – Decision-makers simply reject the whole technology

The Activation phase

During this phase potential adopters actively search for more information about the technology. It involves active behaviour from the decision-maker's side (Constat 2001).

Was South Africa involved in the development of IPT or is it simply a technology that was designed for a different market that sales people try to fit into the local market? The next few paragraphs will try to answer this question to some extend.

5.5 The international trend of adoption

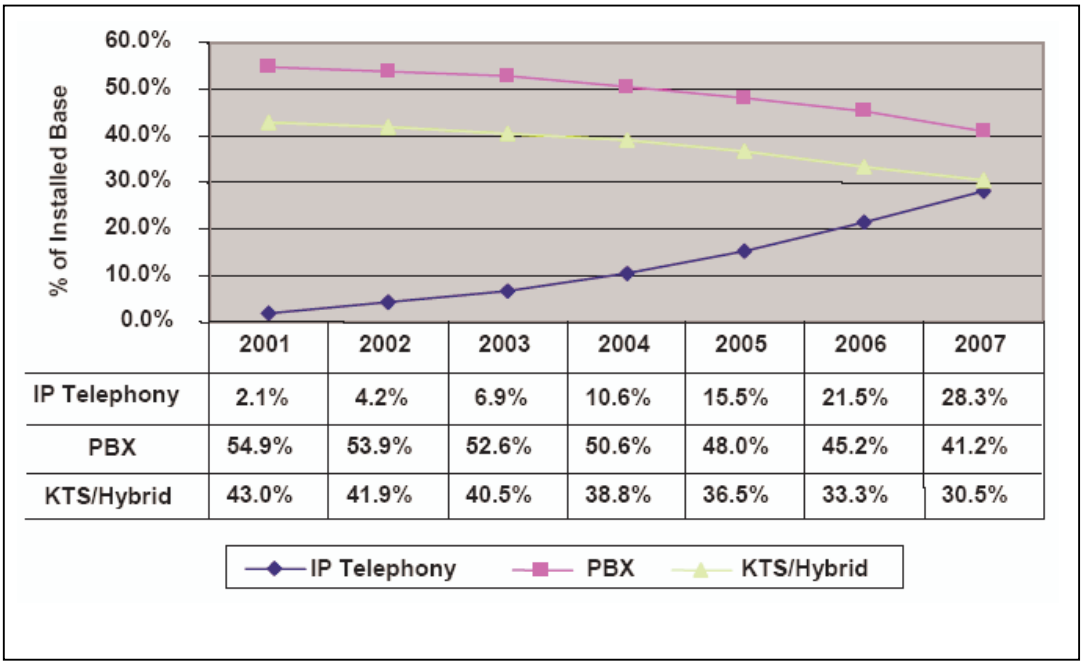
A few of the estimated adoption rates for IPT are:

- 10% of all voice traffic is currently being transmitted via VoIP/IPT (Ranch Networks 2004)
- Seven million IP phones will be in circulation by 2007 (Ranch Networks 2004)
- AT&T had IPT services available to the top 100 US markets at the end of quarter one, 2004 (Ranch Networks 2004)
- Global IP PBX will increase from $1.7 billion in 2002 to $7.9 billion in 2008 (BMI Techknowledge 2004)
- Gartner Group estimates global spending of IPT services to grow from $4.2 billion in 2002 to $21.1 billion by 2006 (Avaya 2004)

But who is right and who is wrong? If one looks at *Figure 5.3* that compares IPT with TDM and hybrid systems for developed countries, the graph clearly shows a predicted declining trend for the number of TDM PBX systems and a predicted incline in the number of IPT systems. Many of these graphs exist (e.g. *Figure 5.4)* in the media with different estimates, but what is common in all of them is that IPT will eventually replace TDM PBX systems. The problem is that uncertainty is present everywhere, even in the adoption process of IPT. In reality nobody knows for sure when IPT sales will overtake legacy PBX implementations.

IPT can be seen as a technology replacement for TDM systems, just like the transition form analog to digital that occurred during the ‘70s and ‘80s (Bucci 2004). The reality of selling IPT services to businesses has therefore become real.

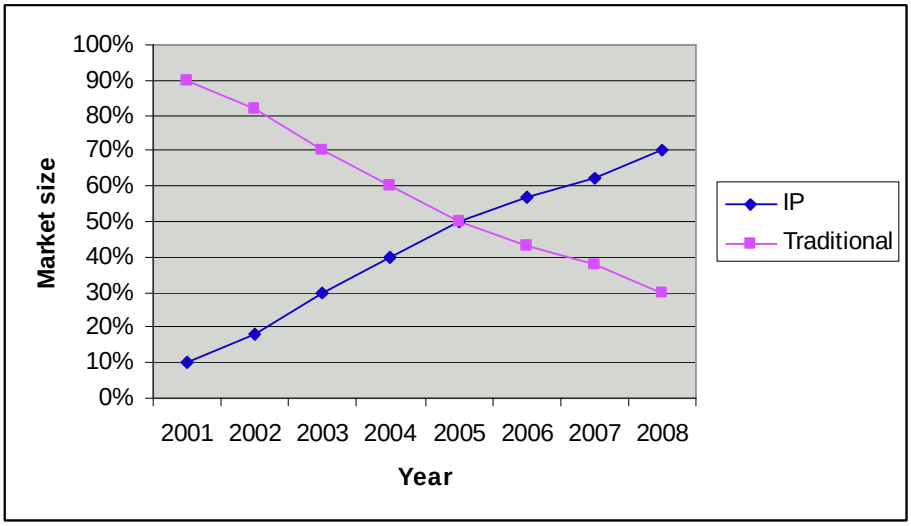
Figure 5.3 - Business voice communications systems installed base composition



	2001	2002	2003	2004	2005	2006	2007
IP Telephony	2.1%	4.2%	6.9%	10.6%	15.5%	21.5%	28.3%
PBX	54.9%	53.9%	52.6%	50.6%	48.0%	45.2%	41.2%
KTS/Hybrid	43.0%	41.9%	40.5%	38.8%	36.5%	33.3%	30.5%

Source: (InfoTech Primary Research 2003:1)

Figure 5.4 - IP replacing TDM in organisations



Source: (Adapted from Shoretel 2004)

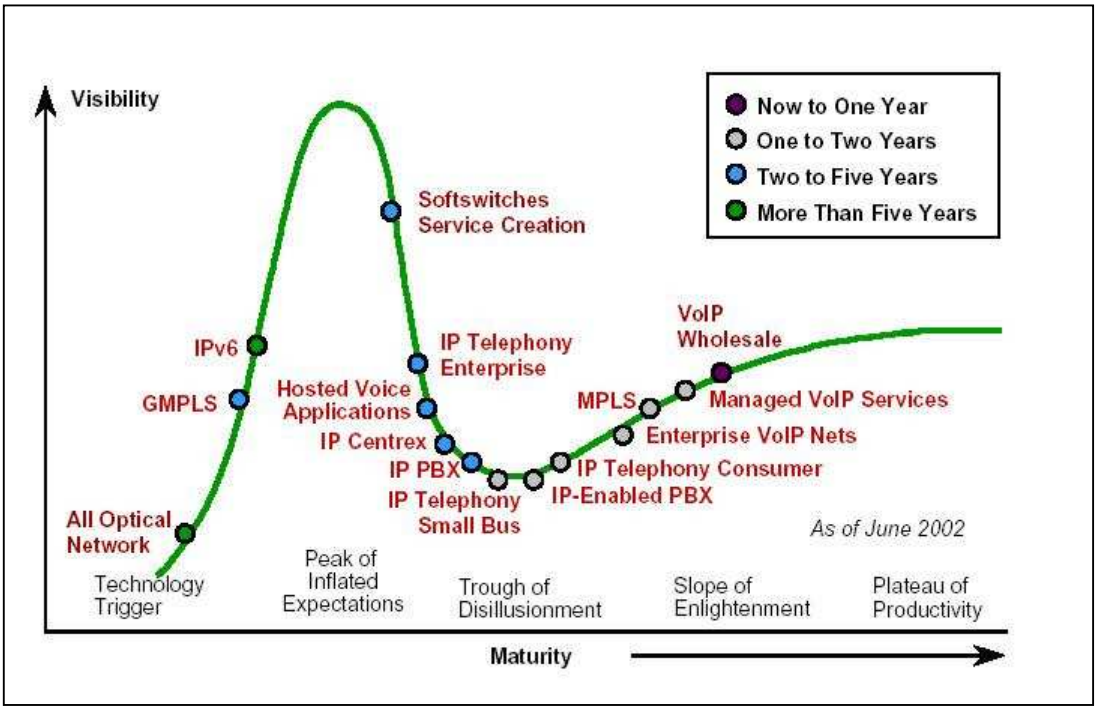
It seems like IPT has been adopted very well if one looks at these *Figures*. Wolter (2004) feels that after years of hype and unfulfilled promises, IPT has finally evolved as a true option for small and medium-size businesses. The technology of sending voice packets over data networks has been refined and has matured, offering a

number of benefits over traditional phone networks. The hype trend that he speaks of can be seen in *Figure 5.*5.

The first step in this process of IP globalization is called IPT, and it is already well under way. What is happening in the international market is that the adoption of IPT continues to ride the hype cycle although the peak of inflated expectations has been passed and IPT is becoming an important market segment. Evident in the hype curve are the similar "dotcom" peak of inflated expectations and the trough of disillusionment that followed, taking many companies to the process of bankruptcy (Winogradoff 2002).

"The telecommunications industry globally is moving away from the provision of facilities to customer and moving towards the provisioning of services independent of the network" (Esselaar 2001:90). That is why "hosted voice applications", "IP Centrex" and "managed VoIP services" can be found on the hype curve of *Figure* 5.5. IPT has been implemented to the end-customer and has improved so much that it is here to stay.

Figure 5.5 - The hype curve of IP telephony

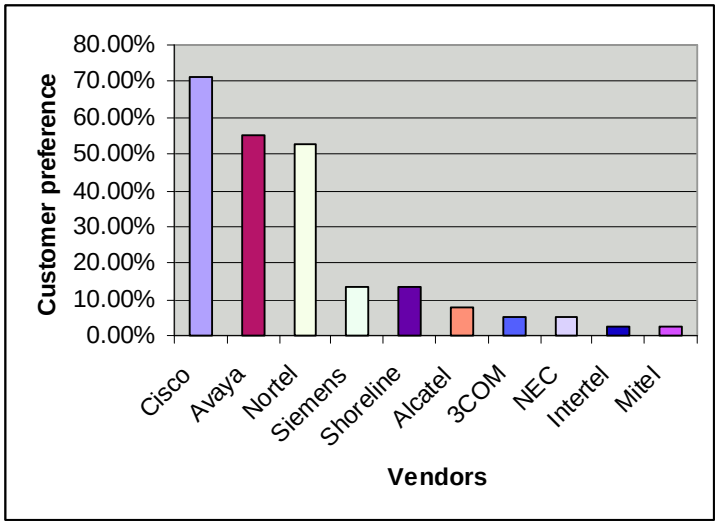


Source: (Winogradoff 2002:3)

According to Ofer Gneezy, CEO of iBasis, IPT can be divided into three main segments: international, domestic long distance and local access. Today the majority of VoIP traffic is in the international segment (ICT Development Agenda 2004). Globally IPT has been adopted quite drastically in developed countries and is therefore definitely past the awareness phase of the CTAM model. A position somewhere between active acceptance in the engagement phase, and the activation phase would be a good choice to categorize most large organisations in developed countries.

Nemertes Research in 2003 finds that organisations favour IPT vendors like Cisco and Avaya before others. Cisco has influenced decision-makers across the world in such a way that organisations now associate IPT with Cisco. The brand relationship theory of the adoption DNA of the CTAM is applicable to reality as many companies simply do not want anything but Cisco. *Figure 5.6* shows the trend of brand preference in the adoption process of IPT.

Figure 5.6 - IPT vendors that customers consider



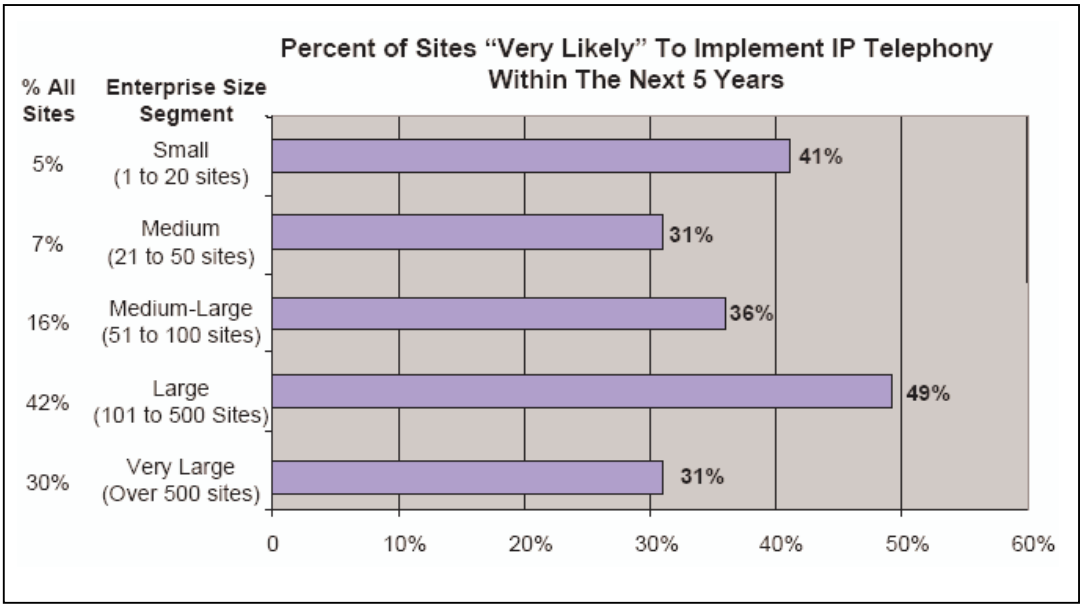
Source: (Adapted from Nemertes Research 2003:7)

By 2007, InfoTech Primary Research (2003) anticipates, IPT will constitute 30% of the entire installed base of voice communications systems. With this significant penetration rate it must also be mentioned that the anticipated minimum useful life of TDM and hybrid systems is five years and the average useful life is eight years. It will, however, take many years to clear out digital phones and circuit-switched technology from enterprise networks (BMI Techknowledge 2004).

The deviation between anticipated growth rate and real growth rate in the IPT market can be blamed on a few things like the worldwide economic slowdown and the early aggressive marketing by IPT vendors of an immature technology, which could have hampered the adoption rate. BMI Techknowledge (2004) reports that one of the problems in their opinion is that IPT has no large, easy-for-all-to-understand "killer application" and organisations are struggling to see strategic benefits with IPT.

Also of importance with regards to the adoption of IPT is the size of companies that have adopted this new technology. According to López-Acevedo (2002) the size of organisations is a widely recognized determinant of technology adoption. Larger organisations tend to support the high cost of new technology and the larger the size of organisations, the more technology it adopts. Smaller organisations tend to follow what the market leaders are doing and might follow a similar adoption rate. *Figure 5.7* shows the percentage of likelihood for the implementation of IPT in the next five years, which was gained from an empirical study on IPT.

Figure 5.7 - "Very Likely" implementation of IPT within the next five years

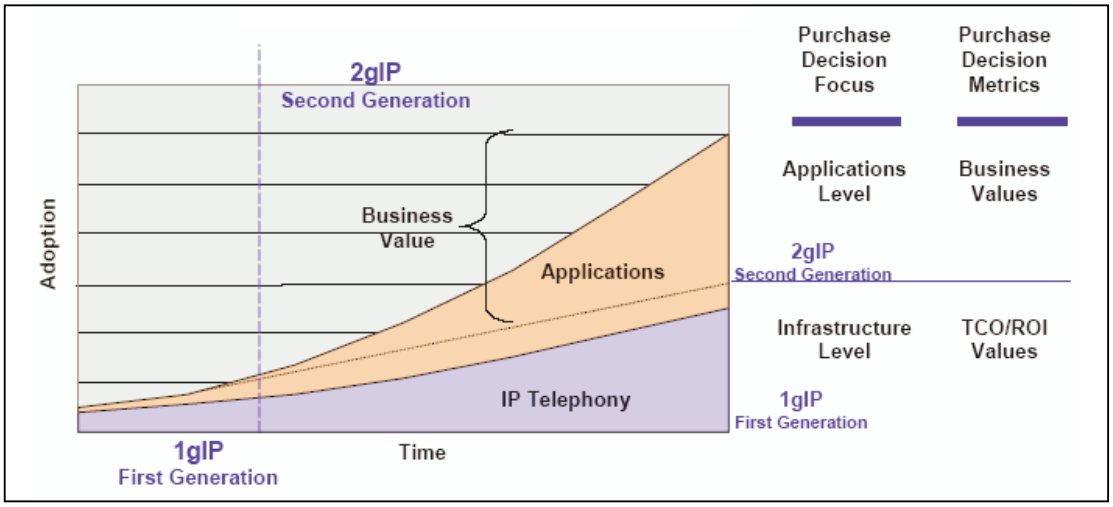


Source: (InfoTech Primary Research 2003:2)

IPT will definitely grow in the long run, but the time for implementation has not arrived yet for each and every organisation. It is anticipated that while many organisations globally have started to implement IPT, most of the remaining ones will adopt a why-fix-it-if-it-isn't-broken attitude (BMI Techknowlegde 2004).

Looking at the adoption rate of IPT one cannot help but to also notice that SIP is an enabler of new enhanced applications, which signals the presence of the second phase of IPT known as 2gIP. The second generation of IPT (2gIP) expands the value proposition of the first generation and adds real business value. Developed countries are past the first generation of IPT and are busy adopting the second generation known as 2gIP (InfoTech Primary Research 2003). *Figure 5.8* shows an increase in the business value of IPT over the long term. Purchasing decision will not be based on infrastructure anymore, but will start to focus on the applications levels. Purchase decision metrics will change from ROI to business values.

Figure 5.8 - The IPT and convergence evolution



Source: (InfoTech Primary Research 2003:3)

At this point along the TDM to IPT migration path the full promise of IPT has not yet been realized. There is a lack of integration of communications with business applications and processes. Many of these benefits of IPT are understood but the key trend is that the value proposition is formed around cost savings and not strategic benefits. Implementation decisions tend to focus on voice communications and not on improved productivity produced by enhanced communications, collaboration and accessibility (InfoTech Primary Research 2003).

Corrocher (2002), through empirical evidence, shows that consumers and businesses display quite different attitudes towards Internet telephony. Cost savings on international calls are the main driver for adoption by residential users, while the main drive for business users is something quite different. For business users the adoption of Internet telephony is related to cost efficiency of network management

and the possibility of supporting electronic commerce applications. Corrocher (2002) also finds that potential adopters of Internet telephony do not feel comfortable enough to switch to a different mode of communication particularly if it is perceived as unfamiliar and complex to their normal phoning habits. If adopted, residential users will however exchange voice quality for the price they pay.

5.6 The local trend of adoption

Research on the South African market is very limited. The adoption rate of IPT in South Africa is found to be slower than anticipated and is behind the rest of the world between one and two years (BMI Techknowledge 2004). Organisations in South Africa are aware that IPT is the technology of the future, but are still sceptical of adopting it.

BMI Techknowledge (2004) reports that local organisations have adopted a "wait-and-see" attitude, which can be the result of the following reasons:

- Decision-makers in South Africa also feel that the value proposition of IPT is not that convincing yet
- The local environment has restrictions different than other developed countries
- The quality of voice over converged networks are perceived as bad compared to PSTN quality
- Interoperability is seen as a problem due to different standards followed by different manufacturers and organisations are confused as to which equipment to implement. Uncertainty exists about the dominant IPT standard
- Bandwidth in South Africa is very limited
- Companies are "sweating" their existing assets and bleeding previous investments made on current TDM technology

Many organisations will rather implement digital PBXs that have the potential to be IP enabled and which can be migrated to IP when the time is right. Organisations feel that IPT must first proof itself before the adoption rate will increase (BMI Techknowlegde 2004).

Local regulatory restrictions can hinder the adoption rate but market forces are set to drive IPT into the market regardless of regulation issues, which will be discussed in the next chapter. Voice data of an IP network is difficult to monitor and open to exploitation. In South Africa it is expected that IPT will follow the same trends as other technologies like peer-to-peer networking and open source platforms, where these technologies have developed through market pressure that grew out of the reach of regulation (Rotter 2002).

Local sales of IPT equipment is not expected to increase soon but the average size of equipment in terms of ports is expected to increase as corporate organisations will start to adopt the technology and implement it (BMI Techknowlegde 2004). Highly skilled workers enhance a firm's absorptive capacity, and according to López-Acevedo (2002) it means that the likelihood of technology adoption increases with an organisation's skill base. Organisations that provide formal training to their employees are more likely to adopt technology.

5.7 Conclusion & recommendations

This chapter tried to proof the point that the value proposition of IPT was not that convincing yet. The aim of this chapter was to determine if the international market had adopted IPT in the same way as the local market to substantiate that point. As a result, the adoption rate of both the international market and the local market were investigated and it was found that they differ.

If one looks at the international adoption rate, it is clear that IPT will be the dominant communications technology for the coming years. Both large and small organisations have indicated that they plan to implement IPT within the next five years and sales of IPT have increased tremendously. Sales of TDM equipment will decline at a certain rate, which will eventually lead to the sales of IPT equipment to overtake TDM systems.

Information on the local trend of IPT adoption was found to be very limited and the best information currently can be found in the BMI Techknowledge (2004) report on the PBX market. Most South African organisations have taken a wait-and-see stance towards IPT and this can be an indication that they are not convinced by the value proposition proposed by IPT vendors. Organisations are overall very conservative with the implementation of IPT and they allow their TDM equipment to depreciate

further. The hybrid option discussed in the previous chapter will therefore be the most dominant implementation model for South Africa, while the Greenfield option can be expected to be implemented mostly by the Corporate Enterprises. The Centrex option at this stage is completely excluded, but might be a possibility for the incumbent and the SNO. This difference in the adoption process can be evidence that IPT was developed for developed countries with different needs and different environments.

In the next chapter the South African environment must be investigated to determine if the lack of a convincing value proposition is not due to something in the local environment that is different from the international environment.

CHAPTER 6: THE SOUTH AFRICAN ENVIRONMENT

6.1 Introduction

In chapters two and three the profile of IPT technology has been described. Both the strengths and weaknesses have been discussed and it was concluded that the profile of IPT is more slanted in favour of impediments but the real benefits will become evident in the near future. As part of the strategy formulation process, the external environment must also be analysed in order to find a synthesis. In the previous chapter the external environment was partly explained but it only focused on the local market. An organisation's external environment is defined by factors like the regulation, the technology deployment rate, the basis for competition, the growth rate of the industry, the relative power of buyers and sellers and the competitive structure of the industry (Silver, Markus & Beath 1995). In literature there exists plenty of technical documentation on IPT and most business-orientated documents only focus on developed countries. Few documents exist that focus on IPT in South Africa and as a result there are many unanswered questions.

The objective of IPT as a technology is to be the dominant choice of telephony in all countries and in all organisations across the world and to offer strategic advantages to organisations of the future. It is a technology that wants to share the data infrastructure of an organisation as an application and provide many benefits to organisations and consumers, one of them being lowered cost on communications. It is also an enabler of newer technologies and the trigger of many other unimaginable possibilities.

6.2 Aim

The aim of this chapter is to analyse the environment in which IPT as a technology will have to survive and grow locally. The South African environmental issues related to IPT will be discussed and analysed by doing a PESTE analysis. Major opportunities and threats of the environment will be debated and then it will be necessary to come to a conclusion as to whether the macro environmental issues in South Africa support the implementation of IPT or not.

6.3 Scope

The following components of the macro environment will be discussed:

- Political factors
  - Government regulation
  - Telkom SA
  - Second Network Operator
  - Sentech
  - Convergence Bill
  - Black Economic Empowerment
  - Competition Commission
- Economical factors
  - Bandwidth
  - Exchange rate
  - Cost of calls
- Social factors
  - Theft
  - Population growth
  - Career attitudes
  - HIV/AIDS
- Technological factors
  - Digital Divide
- Environmental factors

6.4 Political factors

6.4.1 Government regulation

Mark Rotter, communications analyst with BMI TechKnowledge in 2002 already said that: “the landscape of IPT is riddled with regulatory landmines”. This is because countries with more experience in regulation, better skills and finances have struggled and continue to struggle to implement access regulation successfully (Gillward & Kane 2003). South Africa was not excluded and regulatory issues were also a major constraint for companies who wanted to successfully compete against Telkom.

Generally speaking, the regulator of any country in the world has a few roles to play. Esselaar (2001) mentions that the regulatory environment plays two roles:

1. The promotion of competition
2. The introduction of new technologies

Regulation also plays an important role in shaping the environment and the incentives for investment. Regulated operators and potential investors have always included regulatory risk as a key factor when determining their investment strategies. Possibilities that they have identified for reducing this risk could include the following (Melody 2003:3):

- Strengthening the credibility of the Regulator
- Improving the efficiency of the Regulatory process
- Reducing barriers to participate
- Managing public resources to facilitate network rollout
- Clarifying rules where ambiguity and uncertainty exist

According to the Telecommunications Act of 1996 (no. 3 of 1996), Telkom "enjoys statutory exclusivity in respect of the provision of the Public Switched Telecommunications Network (PSTN) and Public Switched Telecommunication Services (PSTS) with the exception of Customer Premises Equipment (CPE) and VANS" (ICASA 2001:2). VANS can not use their infrastructure for voice transmission because the law currently states in paragraph 40.3 that: "no person who provides a value-added network service shall permit that service to be used for the carrying of voice until a date to be fixed by the Minister by notice in the Gazette" (South African Government 1996:1)

What about private networks? As far as private networks are concerned, the Telecommunications Act of 1996 (no. 3 1996) also states in paragraph 41.4 that: "A private telecommunication network shall not be restricted to the carrying of voice only or data only or to any other such limited use" (South African Government 1996:1). Buys (2004) made it clear that "VoIP may be used within an organisation through the use of private infrastructure…but it is illegal if the VoIP connectivity runs over a public road or connects two buildings owned by different companies." Therefore the only company that is currently allowed to use VoIP is Telkom. But, the Communications Minister, Dr. Ivy Matsepe-Casaburri has announced in August 2004 that the Second Network Operator (SNO) will be granted a license to provide public switched

telecommunication services in South Africa on 17 September 2004. It will therefore also be licensed to provide IPT solutions. Other players soon to be announced will be the Under-Serviced Area Licensees (USALs). USALs will be granted a license to have one Small, Medium and Micro Enterprise (SMME) per geographic area where less than 5% of the people in that area have connectivity to telecommunications services or facilities (Chetty, Tucker & Blake 2003).

But why are there still restrictions on the use of voice over an IP network? Telkom's exclusivity agreement of 1996 included IPT restrictions in order to protect its income while rolling out basic services in rural areas. Many people are unhappy with the current state of regulation the last couple of years. According to Mike van de Bergh, chairman of the SA VANS Association (SAVA), the exclusion of VANS from using VoIP in their operations is out of step with technology and flawed from a business point of view (De Wet 2001a). Also the Cape Information Technology Initiative (CITI) makes the remark that "banning VOIP is an attempt to swim against the tide of progress" (De Wet 2001b:1).

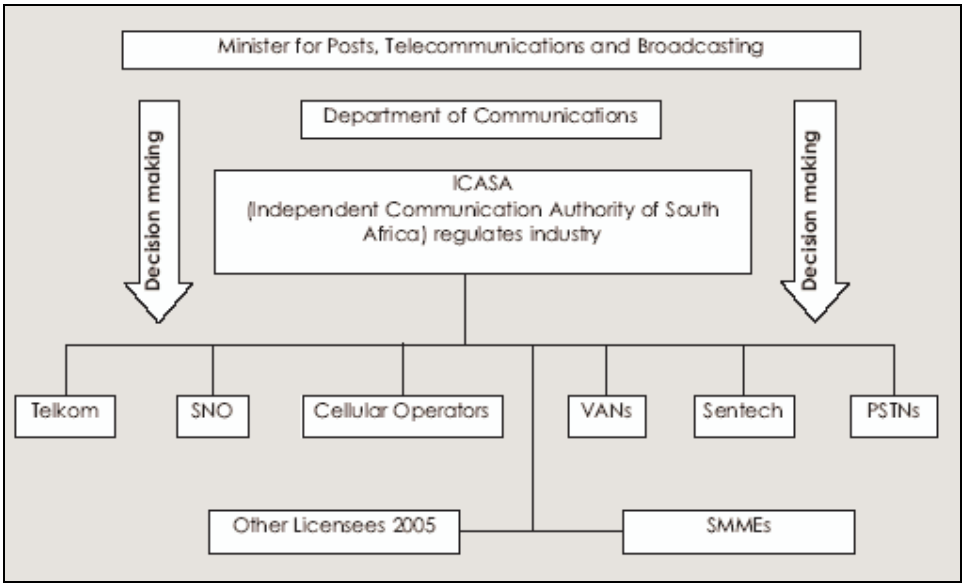
These are only some of the appeals made to Government. Because there seems to exist confusion about the role of the Department of Communications and the role of the Independent Communications Authority of South Africa (ICASA), their individual roles are investigated. The role of ICASA is stated as follows on their website (ICASA 2004):

- To make regulations and policies that govern broadcasting and telecommunications
- To issue licenses to providers of telecommunication services and broadcasters
- To monitor the environment and enforce compliance with rules, regulations and policies
- To hear and decide on disputes and complaints brought by industry or members of the public against licensees
- To plan, control and manage the frequency spectrum and
- To protect consumers from unfair business practices, poor quality services and harmful or inferior products

However, Ali (2003) reports that many see ICASA as a toothless body that will not be able to play an effective role in regulating the local communications industry.

According to Ali (2003) Governments, as guardians of the citizen's interest, have an obligation to ensure that their people have open access to reasonably priced communications. The Department of communications is therefore the backbone of all policy-making and policy review for the communications industry and therefore a tool in the hands of Government. The main objective of Government therefore is to use the Department of Communications to enable all South Africans to have access to both traditional media and ICT. The government believes that such access will improve the quality of life for millions of South Africa (Ali 2003). *Figure 6.1* shows the structure of telecommunications policy-making in South Africa.

Figure 6.1 - The structure for telecommunications policy making in South Africa



Source: (Ali 2003:119)

ICASA's powers are effectively limited by its position relative to the Department of Communications and the lack of resources. Given the position of Telkom in the current telecommunications environment as well as the regulation environment in which it must operate, these factors would determine the future shape of IPT in South Africa.

Regulation have an impact on the level of international Internet connectivity, the diffusion of Internet services and most of all the affordability of communications overall. So what can be done about the regulatory environment? Liberalization and privatization could transform the telecommunications market by developing the Internet infrastructure and the lowering of cost, but it will still not provide a solution to

the connectivity problem. Sarrocco (2002), like many other, reports that a more favourable regulatory environment would attract private domestic and foreign investment, which in turn could improve telecommunications infrastructure and the national Internet market in Africa. Deregulation can also help to promote a low-cost telecom environment and enable broader economic and societal benefits from technology integration (Bridges.org 2004).

Bridges.org (2004) reports that in numerous countries, deregulation has successfully brought down communication prices and made Internet connectivity more affordable which then encouraged people to use technology and foster economic growth. Monopolies in African countries are fairly common, which makes the communications environment fairly restricted and protected. But Sarrocco (2002) is of the opinion that although liberized regulation is undoubtedly needed, it alone will not solve the problem, especially where there is limited scope for market competition. Each country must adapt its telecommunication policies in order to promote expansion. Esselaar (2001) proposes that given VoIP's cost effectiveness, one of the methods open to government is the deregulation of VoIP in remote areas. SMMEs and cooperatives will undoubtedly be permitted to provide telecommunication services including VoIP for the specific purpose of advancing universal access in geographic areas with a teledensity of up to 5% from 7 May 2002.

McLeod (2004) is of the opinion that IPT is only a disruptive technology in competitive markets and IPT in South Africa promises to open up the market. When the industry can become deregulated, it will transform the telecom landscape completely. It will most definitely deprive fixed line operators of their voice revenue.

A recent court decision in the USA has found that IPT is not a telephone service but an Internet application and must therefore be unregulated. So what will it look like in an unregulated market? McLeod (2004) states that carriers like Telkom will risk cannibalizing their traditional voice revenues as they try to position themselves in an unregulated market, but they can take advantage of the fact that their broadband revenues can grow tremendously. Consumers will move from traditional telephony to IPT and make more use of broadband services.

So if both the customers and the carriers will benefit from the migration to an IP world, what is inhibiting it? McLeod (2004) is of the opinion that the reluctance to change to an unregulated market is that it has been shielded from market forces by

Government policy in order to protect Telkom's shareholders. Governments in Africa overall protect their telecommunications markets for the following reasons (Esselaar 2001:100):

- It is seen as a strategic asset to the government
- There is limited spectrum and it should be regulated
- Governments have responsibilities to their people to ensure their socio-economic upliftment by increasing teledensity

Telkom's monopoly ended 7 May 2002 and the following new players were added in different segments of IPT (ICT Development Agenda 2004):

- Sentech (international and long distance)
- SNO (local, long distance and international)
- SMMEs (local, although not operational yet)

In Africa, South Africa has probably gone the furthest with the liberalization of the telecommunications industry, at least in terms of policy. The same model could be replicated in other countries to harness IPT for faster and cheaper implementation of basic infrastructure (ICT Development Agenda 2004). Government knows that leadership must come from them and that is possibly why the Department of Communications has drafted the Convergence Bill. The reality of the Convergence Bill is that competitors like Internet Solutions, SA's biggest corporate-focused Internet Service Provider (ISP), feels that the bill still protects the rights of the incumbent operator. They feel that the best way to encourage competition in order to offer cheaper telephone calls is for Government to dispose of the restrictions that prohibits value-added network services like ISPs from offering IPT (McLeod 2004).

Gillwald and Kane (2003) propose the following options to Government within the current legislation:

- Remove the distinction between voice and data in a digital environment
- Permit the alternative provisioning of facilities, resale and direct connect by certain categories of network operators

"There is convincing evidence that countries which introduce effectively regulated private competition in information infrastructure provisioning see improved efficiency, lower prices and wider access" (Fink *et al* 2003:20).

Finally at the end of so many proposals to Government and Government understanding its own role in society, the liberized market is near. The Communications Minister, Dr. Matsepe-Casaburri, announced policy interventions effective from 1 February 2005 to speed up growth in the ICT sector, to remove constraints and to reduce costs, for instance by lifting restrictions on voice by VANS.

6.4.2 Telkom SA

Telkom currently "enjoys statutory exclusivity in respect of the provision of the Public Switched Telecommunications Network (PSTN) and Public Switched Telecommunication Services (PSTS) with the exception of Customer Premises Equipment (CPE) and VANS" (ICASA 2001:2)

Africa overall is underdeveloped and is geographically and culturally remote from the developed countries. Telkom can use the opportunities of IPT to not only compete locally, but also compete in a largely undeveloped market in Africa. It must try to become the unsurpassed player in Africa and explore internationally, using technologies like IPT. "….. using VoIP simply offers a more cost-effective means of carrying international traffic" (ICT Development Agenda 2004:1)(John & Buys 2003).

In 2001, Esselaar finds that many believe that Telkom cannot become internationally competitive if one looks at measures such as lines per employee and the time it takes for Telkom to attend to faults in the network. But if one investigates what Telkom has already done with regards to IPT, one would be surprised. In 2001 Telkom entered into agreements with ITXC (now known as Teleglobe), STWS and Dial Thru International to jointly provide VoIP services between South Africa and the USA (ICT Development Agenda 2004). Similar deals would allow Telkom to achieve the benefits of the technology, but the problem is that consumers feel that the cost benefit has not been transferred to them up to now.

The ability to communicate via the Internet poses a serious threat to traditional phone companies and it is estimated that US phone companies will lose about $900 million a year from 2001 (Taylor 2004). Telkom's business model will likewise be threatened by IPT. In 2002 Rotter reports that the major impact of IPT on Telkom would be a loss of revenue from international calling, both direct (loss of collection charges) and indirect (loss of settlement payments). All Telkom's competitors downstream are required to use Telkom's facilities, which can be seen as Governments objective of

protecting the revenue streams of Telkom. Some however are of the opinion that this has led to a whole range of anti-competitive complaints to ICASA and the Competition Commission as well as a reduction in investor confidence overall (Gillward & Kane 2003).

Telkom is positioning itself as the IPT hub of Africa if one looks at the high volume of incoming traffic that is already IP based. It will therefore also be the biggest player to promote the adoption process of IPT technology and must use it appropriately. The four most important forces that challenge Telkom are competitors, customers, technology and regulations (John & Buys 2003). Based on these forces one can then identify certain opportunities and threats. John & Buys (2003) identify the following opportunities for Telkom as shown in *Table* 6.1.

Table 6.1 - Opportunities and threats of Telkom SA

Opportunities	**Threats**
Other African countries lack telecommunication infrastructure	Deregulation of international telecommunication services and legal usage of VoIP in South Africa by VANS and other network operators
Demand for a better international call rate in Africa as a whole	PC-to-phone and PC-to-PC international calls via Internet, bypassing Telkom network
Leading political role of South Africa on the African continent and in the SADC region	Infrastructure sharing with the SNO
Increasing demand for voice connectivity in many African countries	Competitors are well-known role players in the international market
Steady growth of the international call traffic	Competitors with good financial backing could establish their businesses at a faster pace
Global trend towards deregulation and privatization of the telecommunication industry	Inconsistent workforce distribution within Telkom
Low teledensity on the African continent	The past mentality of being a sole telecommunication operator in South Africa is still prevalent in the minds of

Opportunities	Threats
	many Telkom employees
Established relationships with international telecom operators	Brain drain in South Africa
Global trend in the convergence of telecommunication and information industries	Political instabilities on the continent, social issues such as the AIDS epidemic, crime, natural disasters such as floods and storms could jeopardize the business expansion initiatives
Demand for voice and data integrated services	Regulatory constraints in certain countries do not allow entering into these markets
Demand for end-to-end managed service in the corporate environment	Maintaining the legacy networks
Increasing number of Internet users and ISPs	Lack of knowledgeable suppliers
Ever-increasing bandwidth demand for data	Inflation rate indirectly increases the service charges
Business expansion opportunities from the NEPAD	The private telecommunication networks in South Africa cause loss of income for Telkom business
	Managing staff numbers through retrenchments might affect the highly skilled workforce

Source: (John & Buys 2003:114)

It is clear from the table that because IPT is such an enabling technology it holds many opportunities for the incumbent. The prevailing changes to the regulation environment with regards to voice transmission over the Internet and private networks will, however, result in several subsequent threats that will start to manifest. If any regulatory changes should occur as promised by the Minister, it can result in major strategic changes on Telkom's side. If Telkom wants to implement IPT it will, according to John & Buys (2003), require highly skilled technical personnel who will need to get the technical know-how through proper training.

6.4.3 The Second Network Operator

Where is the competitive rivalry South Africa desperately needs? The biggest competitor for Telkom will be the SNO, which will be made up as follows: 30% owned by Transtel and Eskom, 19% by empowerment group Nexus Connexion Pty and SepCo for the rest of 51% (Gillwald & Kane 2003). In his research report Esselaar (2001) bases his findings on Porter's Five Forces model, and analyses the competitive VoIP environment as follows:

- The threat of a substitute product is VoIP
- The bargaining power lies with customers looking for cheaper phone calls
- Suppliers will have bargaining power because they can offer their products to the SNO and Telkom
- The threat will be that of other new entrants due to the regulatory environment

He finds that there is no rivalry because there are no competitors to Telkom. IPT represents opportunities for both Telkom and the SNO. The question posed by Esselaar (2001) is how Telkom and the SNO would respond to this opportunity given the complications of the regulatory environment. According to him domestic rivalry will most surely increase with the introduction of an SNO, but even if the telecommunications industries in South Africa change from a monopoly to a duopoly it will not be enough. Esselaar (2001) mentions that duopolies are traditionally not very competitive, because it makes no sense to compete on price when there is such limited choice available to the consumer. In his report he finds that IPT can only provide a short term advantage to the SNO, because technology overall is seen only as a short term advantage until competitors obtain it.

There exists a strong possibility that the SNO can leapfrog Telkom by using technologies like IPT due to its cost effectiveness. The SNO can bypass the huge investments traditionally needed to compete in the telecommunications industry if they want to go head on against Telkom. With such an approach they will then also open up the market for IPT and be the catalyst for the adoption process. The SNO license process has been complicated and unlikely to hold any prospects for improving access to facilities and interconnection, which is seen as key to competition, innovation and growth of the telecommunications sector overall (Gillwald *et al* 2003).

6.4.4 Sentech

A third international gateway is now also available by the granting in 2002 of the international carrier of carrier (carry telecommunication, voice and data traffic on behalf of other licensed operators) and multimedia license to Sentech (Gillwald & Kane 2003) (Ali 2003). Sentech aims to become a major player in the whole South African telecommunications market. If one looks at the fact that Sentech is also urging Government to speed up the passing of the Convergence Bill and to open up the market to more multimedia players, it can be assumed that they also plan to use IPT where possible. They definitely want the market to be open to more multimedia players without the Government specifying whether analogue or digital technology should be used (Loxton 2004).

6.4.5 The Convergence Bill

The Convergence Bill is the third major change to the telecommunications policy since the first participatory and advice-giving policy process has been initiated in the mid-nineties. The policy aims for balance between the provisioning of basic universal service to disadvantaged rural communities and high-level services to the business world with needs of a modern economy (Gillwald *et al* 2003). Masango (2004) reports that the Convergence Bill can in effect be seen as a replacement of the Telecommunications Act of 1996 as it will regulate the information and communications technology sector. Unlike previous processes that have gone to a Green or White Paper, this one is set to go straight into legislation mode and will be released to Parliament in the last quarter of 2004 (Masango 2004)(Department of Communications 2004). But is it still needed?

The goals of the Convergence Bill are (Gillwald *et al* 2003):

- The promotion of a pioneering and responsive sector through the development of broad and diverse service offerings
- A competitive manufacturing and supply sector
- The promotion of competition
- Overall promotion and stability in the telecommunications sector
- Encouragement of a diverse shareholder base through the promotion of SMMEs and historically disadvantaged groups and individuals
- Development of a strong consumer focus that takes into account the needs of local communities and disabled users

- Ensuring technical compliance and efficiency
- Facilitating the development of people within the sector

Emphasis has been placed on the fact that this opening of the market must not increase but rather reduce the current digital divide, which will be discussed later on. Gillwald & Kane (2003) mentioned that in order to prepare for a converged policy environment, all the networks in South Africa must be optimized. The lifting of restrictions can do this, in order to create an integrated information infrastructure required for a networked economy. Restrictions can be assumed to refer to IPT as well.

So the people of South Africa want to see the restrictions removed, but Masango (2004) reports that according to Adrian Scrase, the Chief Technical Officer of the European Telecoms Standards Institute, the Convergence Bill is not needed any more. The latest announcements made by the Minister of Communications to open up the industry in February 2005 will achieve the objectives mentioned anyway. According to Vecchiatto (2004) the CEO of Telkom SA, Sizwe Nxasana, feels the same and says that the Convergence Bill has been placed in serious doubt due to the announcements of the Minister of Communications. With or without the Convergence Bill, Internet Protocol Telephony will be implemented anyway.

6.4.6 Black Economic Empowerment

Black Economic Empowerment (BEE) is a controversial issue in South Africa. The major social objective of the telecommunications policy reform process is the empowerment of historically disadvantaged individuals and communities. This is then also the mandate of the regulator to reform the telecommunications sector in such a way as to include historically disadvantaged through the change of ownership in the sector. There is a mix of emotions as to whether the Government has really succeeded in this objective (Gillwald *et al* 2003).

If one looks at the Under-Service Area Licensees (Bokone Telecoms, Kingdom Communications, Thinta Thinta Telecoms and Ilizwe Telecoms), the new licenses will provide SMMEs a once in a lifetime opportunity (Masongo 2004). The policy decision to grant licenses to SMMEs and communities in under-serviced areas can contribute tremendously to the BEE of sector and national policy. The problem is that they need a successful funding model and have to minimize their costs as much

as possible. IPT is a cost effective technology, which can benefit the SMMEs. That is why these licensees are expected to offer telecoms services such as public payphones, VoIP, fixed mobile and distance calls (Masongo 2004). Gillwald *et al* (2003), however, are of the opinion that it might not be enough and bring the funding problem back to the policy and regulatory decision-makers to create conditions that will allow SMMEs to have effective business cases.

According to Caspary and O'Connor (in Akinsola 2003:17) SMMEs will face the following challenges when implementing IPT in rural areas:

- Remoteness, leading to high start-up and maintenance costs as well as a lack of electricity for the computers
- Lack of human capital, e.g. technicians for maintenance, which again raises the costs since the equipment must be build extremely robust
- The logistics of collecting the money from the customers
- Low earning capacity of the rural population

6.4.7 Competition Commission

In a dispute between ISPs, SAVA and Telkom, due to restrictions on the facilities Telkom provides to them, the Competition Commission has recommended to the Competition Tribunal that Telkom paid a fine of 10% of total turnover, over R3 billion, for anti-competitive behaviour (Gillwald, Kane & Esselaar 2004). This is only one of several claims against Telkom for so called anti-competitive behaviour.

As a result public perception lately is that Telkom uses its position to engage in anti-competitive behaviour. These allegations have however been tested before the relevant authority and Telkom could proof that it doesn't use its dominant position to behave anti-competitive. Telkom must comply with the Competition Act and the Telecommunications Act in order to compete competitively at all times.

If one looks at IPT as a technology, it can be argued that Telkom could have an unfair advantage against other competitors who want to compete in the IP PBX market. Telkom could provide a complete IPT solution by combining its VPN Supreme product (that will allow IP connectivity to the customer premises) with an IP PBX product. It might then have a possible unfair advantage to other competitors who only compete in the Customer Premises Equipment (CPE) market, as they do

not have an end-to-end integrated IP-VPN solution with Quality of Service product as Telkom has.

In order to decrease the amount of Competition Commission disputes that would go the same route, the source of the problem has been searched for. It is found that the lack of capacity to implement policy effectively has been identified as the root of the regulatory dispute problems (Gillwald *et al* 2004). If the regulatory environment becomes liberalized in the near future as announced, will it then be possible for South Africa to implement the new policies to control IPT effectively?

6.5 Economical factors

South Africa is undoubtedly the economic powerhouse of the African continent. Because the telecommunications sector is very important to the overall health of South Africa's economy it can be assumed that it is important to the whole of Africa. In 1992 the telecommunications sector represented 1.9% of the GDP of South Africa and in 2001, 5.8%. There has been increased activity and expansion in the sector and it might still be the most important sector of the economy (Gillwald *et al* 2003). Government knows this and will try to reap the benefits of the industry as far as possible by constructing legislation in such a way as to promote itself as a large shareholder.

Empirical evidence is available that shows that communication costs and infrastructure affect a country's participation in the international trade in goods and services (Fink, Mattoo & Neagu 2002). CITI, in a letter to the Minister of Trade and Industry in 2001 makes the remark that "if any technology is able to provide Africa with a pathway into the developed world economy it is the Internet, which brings Africa's citizens closer to the American, European and Asian Markets. VoIP and the lowered cost it can achieve stands to dramatically enhance the level of economic interaction between business people in SA and the developed markets" (De Wet 2001b:1). "..IP Telephony is already providing the foundation for dramatic cost and price reductions in other parts of the world that are essential to promote the e-economy" (Gillward & Kane 2003:57).

6.5.1 Bandwidth

TeleGeography Inc. (in Bridges.org 2004) reported that Luxemburg had more international bandwidth in 2002 than the whole of Africa. Bandwidth is a critical problem for developing countries and for the success of IPT in South Africa (Sarrocco 2002). By only looking at Internet telephony, the natural question to pose is whether South Africa will have enough bandwidth for so many users that will use the Internet instead of the PSTN for voice calls. Bandwidth limitation can also be linked to the Digital Divide and will be discussed in later paragraphs.

Higher bandwidth and the right "quality" of bandwidth is needed for IPT over the WAN, but due to the high cost of local bandwidth, companies rather go for the lower bandwidth capacity WAN. Bandwidth can be a problem for the sales growth of IPT equipment in South Africa, due to its high cost aspect. The high cost can then be argued as being there because of limited bandwidth locally. The introduction of the SNO will definitely increase the available bandwidth and based on the law of supply-demand, it must bring down the cost of bandwidth.

6.5.2 Exchange rate

A good exchange rate will definitely favour spending on imported equipment as most PBX equipment is imported. The problem is that the current exchange rate doesn't favour IPT in South Africa well, as the prices of IPT equipment will increase when the demand at this stage is very low. BMI TechKnowledge (2004) reports that local vendors are already operating at low profit margins and needs to make even larger investments in terms of equipment they must import. In order for them to survive they will have to start looking at cost-cutting measures, such as staff reductions in order to keep the prices low. This doesn't bode well for South Africa where the unemployment rate currently stands at an estimated 28.2% (Statistics South Africa 2003).

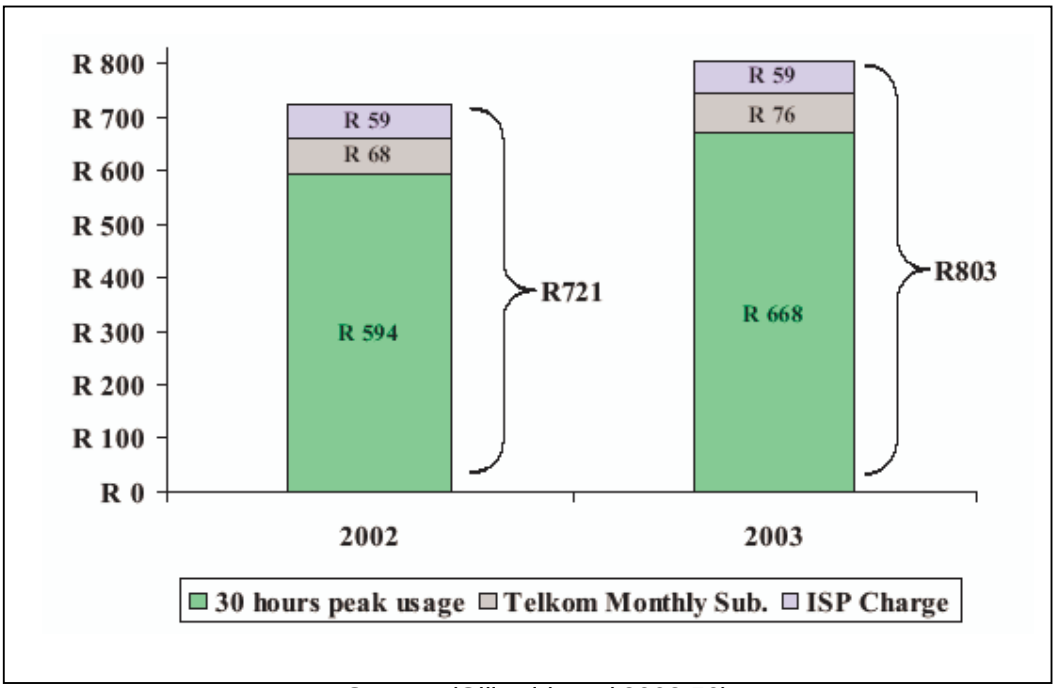
6.5.3 Cost of phone calls

The current cost of phone calls in South Africa is conceived as being very high. If one looks at South Africa, the number of residential users is +/- 56% of the total amount of telephone users compared to 75% in other middle-income countries. This small amount of local residential users might suggest that Telkom's tariffs are not affordable to potential residential users (Gillwald *et al* 2003).

With the large share of Government in Telkom, the high cost of calls could be seen as the protection of revenue streams of the PSTN in order to favour the Government as a shareholder also looking for value. But this is to the demise of the end user who has had to pay high prices for voice communication up to now. Research shows that the high cost of services and facilities of Telkom negatively impacts on the VANS and eventually on the growth of the Internet overall (Gillwald *et al* 2003).

According to ITU figures, South Africa was 13th in 1996 in the world in terms of Internet users and 26th in 2001, which means that it is falling behind the rest. This is again claimed on the high cost of Internet access and subsequently on the high cost of telecommunications. In South Africa almost 90% of the end costs to the user to connect to the Internet for 30 hours per week are direct PSTN expenses (Gillwald *et al* 2003). *Figure 6.2* shows what the price increase from 2002-2003 did for the monthly Internet connectivity charges for a user surfing the Internet for 30 hours during normal business hours.

Figure 6.2 - Effect of 2003 Telkom price increase on South Africa's Internet access basket



Source: (Gillwald *et al* 2003:50)

Telkom has denied recent allegations of high tariffs and says that Tarifica (2004) has been used to benchmark Telkom against network operators in other countries and it

was found that Telkom's tariffs are very competitive. Tarifica is recognized by the ITU and has benchmarked Telkom against countries like the UK, Germany, France, Sweden, Czech Republic, Poland, Mexico and Hungary. Telkom's local peak-time calling charges are found to be cheaper than those of many countries. Local off-peak call charges for a three-minute call are found to be the fourth cheapest of 26 countries surveyed. Telkom's residential and business rental charges are also found to be below the average of 26 countries surveyed (Tarifica 2004).

6.6 Social factors

"Telecommunications are influenced by, and in turn influence social and economic development of a community" (Sarrocco 2002:16). The function of communications in transforming society must never be miscalculated. The success of IPT in South Africa will also depend on social issues within the environment.

6.6.1 Theft

Telkom has suffered many losses because of theft and damage to its infrastructure in the last couple of years. Things like copper wire theft create an environment, which makes Telkom not internationally competitive (Esselaar 2001). These losses will definitely impact the prices of Telkom, the SNO and Under-Service Area Licensees and at the end the consumer can suffer.

Even if IPT as a new cost-saving technology will be used in the near future by all these operators, it will not be possible to charge the low internet telephony call rates if local theft statistics are so much higher than that of developed countries. Due to theft problems of infrastructure it is recommended that cable infrastructure should be used in combination with wireless technologies where possible. But if one looks at the Sentech case, one would find that bandwidth costs would start to become a problem again. Sentech has launched its MyWireless solution and shortly thereafter found that 6% of the users in South Africa occupies 50% of the network, which has led to throughput problems (Sentech 2004). If wireless solutions are going to be used in remote areas by the new USALs, similar problems can be experienced and in order to provide enough bandwidth, the cost of the service will be so much higher as initially intended. Government must enforce the law and help to bring down the telecommunications theft statistics. Theft, which can be seen as a social problem, will influence the success of IPT in South Africa.

6.6.2 Career attitudes

Esselaar (2001) mentions that as competitors like the SNO move into the market, they would all compete for the same skills base. If South Africa does not have enough trained telecommunications expertise, it will have to look outside its own borders. Government wants to create more jobs for the people of South Africa (McPhie 2004). It must therefore focus its ICT training in such a way that once the regulatory environment becomes liberalized and IPT is at the order of the day, there will be enough expertise in the field to support and make IPT a success. IPT can open up many new employment opportunities.

An example of South Africa's aim to create jobs is by enticing international call centres to the country. "These centres, common in places like India, provide outsourced services using high bandwidth connections and VoIP platforms. The centres provide telephone support services to developed countries from their bases in developing countries where labour is cheap, bringing cash to the local economies" (McPhie 2004:10).

6.6.3 HIV/AIDS

Bell, Devarajan and Gersbach (2003) reported that the net effect of AIDS on the growth rate of per-capita GDP in the short run is very modest. In the long-run however, the economic costs of AIDS are certain to be much higher, even devastating.

While HIV/AIDS will definitely have negative effects on the population growth rate and consequently on the economy of South Africa, it is also a social factor, which must be addressed properly by Government. Fink *et al* (2003) state that although the Digital Divide with its unequal per-capita access to ICT might be a challenge to Africa and South Africa, there are challenges that are more serious to the well being of people living in developing countries. One of them is the spreading of HIV/AIDS in large parts of the developing world, which poses a humanitarian crisis and has already affected the economic prospects of a number of nations.

According to the latest National HIV Survey, 12% of the 44.8 million people in South Africa are HIV positive and 600 new ones are infected every day. Four hundred thousand people with HIV will develop an AIDS-related illness in 2004, requiring anti-retroviral treatment. Government's focus therefore will be more on social issues than

on the liberalization of the regulatory environment and to promote IPT. The success, however, is where to find the balance of the voice of a humanitarian crisis and the voice of the business world screaming desperately for IPT implementation.

Bell *et al* (2003) mention that AIDS destroys human capital in a selective way, because it is primarily a disease obtained by young adults. If they become infected, their productivity becomes affected, because they become sick and weak. At a later stage they die although still in their prime and the human capital gets destroyed that way. Their employers loose their skills and must train a new person from scratch. This will also negatively impact on IPT as the skills, necessary to provide support of these new products, take many years to obtain.

6.7 Technological factors

IPT is highly requested by the business sector hoping to save on voice calls and to optimize their bandwidth usage. On the flip side a large portion of the population in South Africa doesn't even have basic voice services. Government therefore views universal access as the most pressing issue at this stage (Rotter 2002).

In terms of technology, South Africa is not a global player as such, but rather a major player within Africa and the developing world. South Africa, in some ways, has the advantage of not riding the wave of technological innovation, which allows the complete evaluation and realistic expectations of the technology before implementing it. South Africa can be seen as a technology follower and not a technology innovator. Technology in itself only provides short-term advantages anyway, as mentioned by Esselaar (2001).

This positional stance of South Africa to technology and in particular to IPT allows South Africa to skip the birth pains of IPT and implement it when it is ready. But waiting too long before implementation will also not be that good, as South African organisations want to compete with overseas markets and might be at a competitive disadvantage later on.

The telecommunications industry is an enabling industry, because it facilitates the flow of information and knowledge between individuals, groups and companies via the network (Esselaar 2001). IPT as a technology can decrease communication costs and this can increase the flow of knowledge.

6.7.1 Research and Development activity

Researchers like Esselaar (2001) have made South Africa aware of the major paradigm shift due to IPT and as a result major organisations are aware of IPT. South Africa has some of the best researchers and technological experts in the world and new ideas can come from South Africa. People like Mark Shuttleworth, who started the company Thawte, the first certification authority to sell SSL certificates, did it, why can't others do the same. The fact that a "killer application" of IPT, which is expected to provide strategic benefits to an organisation, still hasn't made its appearance yet as mentioned in chapter two, should signal South African scientists and engineers to grasp the opportunity and develop it for the world.

6.7.2 Digital divide

Esselaar (2001:73) mentions that countries with "ill-developed ICT industries experiences slower economic growth than countries with well-developed ICT industries". In order then to improve economic growth in South Africa, one could argue that the ICT industry must be developed tremendously. Unfortunately this is not the case for many African countries, which brings back the issue of the Digital Divide.

It is misconceived that the whole world has access to ICT and will benefit from all new ICT technologies like IPT. The Digital Divide in South Africa is extremely evident because, according to South African Web Usage Behaviour (in Singh 2004) 4.5% of the total population are information "haves" and 95% of the population are information "have-nots".

The Digital Divide simply means the division between those who have access to ICT and those who do not (Chetty *et al* 2003), but there are at least four possible interpretations of the Digital Divide (Fink *et al* 2003:16):

- A gap in **access** to use ICT measured by the number and spread of telephones or web-enabled computers
- A gap in the **ability** to use ICT measured by the skills base and the presence of numerous complimentary assets
- A gap in the **actual use** measured in terms of the minutes of telecommunications for various purposes, the number and time of users online, the number of Internet hosts and the level of electronic commerce

- A gap in the **impact of use** measured by the financial and electronic returns

Connectivity

"Initiatives such as the World Summit on the Information Society aspire to bridge the digital divide in order to reduce poverty and achieve the Millennium Development Goals, but this aim risks being undermined if basic telephone connectivity is not first made available" (Panos London 2004:1).

Internet access is a rare privilege in developing countries, which doesn't look that well for Internet telephony. In 2002 it was reported that two in each 1000 of the population in LDCs had access to the Internet compared to one in four citizens for major economies. World Wide Worx reported that 2.89 million South Africans had access to the Internet in 2001 and it was estimated that in 2002 this figure would have grown to only 3.1 million. It is also estimated that in 2006, 1 in every 10 people living in South Africa will have access to the Internet (Gillwald *et al* 2003). Relative to developed countries, this figure is still very small.

What is stopping the number of people with Internet access to increase? Several African countries were analysed in 2002 and it was found that they had connectivity problems and the Internet experience was not cheap. They had very little Point of Presence (PoPs), which meant that customers in remote areas had to make long distance domestic calls to the Internet. This made their Internet experience not only very slow, but also very expensive (Sarrocco 2002).

Computers

In 1995 it was reported that 28 people per 1000 of the South African population had Personal Computers and this figure grew to 69 people per 1000 of the population in 2001. Although growth was experienced, how does this compare with developed countries? In 2001, 625 people per 1000 of the population in the USA had Personal Computers and 366 in the United Kingdom. Clearly the amount of people in South Africa with PCs is very small and drastic improvement is needed to get to the same level of developed countries (World Bank 2003).

Bandwidth

The global bandwidth available for communications is increasing every year, but it is not evenly distributed across all countries in the world. In 2002 it was reported that there were more Internet users in New Zealand than in all 49 Least Developed

Countries combined. TeleGeography Inc. (in Bridges.org 2004) reported that Luxemburg had more international bandwidth in 2002 than the whole of Africa. Bandwidth is therefore a critical problem for LDCs and also for the success of IPT in South Africa (Sarrocco 2002).

So the cost of connecting to the Internet via ISPs is higher than in developed countries, there are fewer computers per 1000 people than in developed countries, there is less bandwidth available than in developed countries, which all contribute to a huge digital divide and South Africa is not excluded. As long as the cost of Internet access in South Africa is going to be relatively high, Internet penetration will be small and also Internet telephony.

S. Taylor (2004) confirms these findings when he reports that Russia had similar problems with the success of IPT and concludes that convergence also depends on the following factors:

- Ubiquitous and competitively priced broadband access
- The availability if Internet access
- Widespread use of computers
- Fully open competition

IPT with its low cost component can then be used to bridge the Digital Divide and the Department of Computer Science at the University of Cape Town is currently researching this topic using a Critical Action Research (CAR) approach. "The biggest obstacle to introducing IPT in locations where telephony density is below 3% is that emphasis will naturally be on increasing basic access and protecting existing public network investments rather than diverting scarce resources to the new technology" (Williamson 2002:32). The Digital Divide allows a disadvantage to people who do not have access to ICT. To conquer this divide, technology must be used to provide appropriate applications with locally relevant content.

6.8 Environmental factors

The ITU made it clear that IPT technology could also be used in remote areas where there is no fixed line access. It could therefore be combined with Wireless Data technology like WiFi to serve remote areas (Chetty *et al* 2003) and in that way the implementation of IPT could be done without polluting the environment.

6.9 Conclusion

The aim of this chapter was to analyse the environment in which IPT as a technology would have to survive and grow locally. The South African environmental issues related to IPT were discussed and analysed by means of a PESTE analysis. Major opportunities and threats of the environment were debated on political, economical, social, technological and environmental grounds.

The biggest obstacle of IPT's success was found to be regulatory issues, but that will soon change if one looks at the recent announcements by the Communications Minister as indicated. Government's intention of the Convergence bill will enable the industry to become more competitive and stir rivalry among competitors. Telkom, the SNO, Sentech and Under-Service Area Licensees can benefit from the technology and will be able to provide cheaper telecommunication services. At the end the consumer can benefit from lower telecommunication costs.

Because most of the IPT equipment will be imported from other countries, it is expected that the exchange rate will play a major role in the success of IPT. IPT can benefit the local economy and will allow for exciting career opportunities, which can affect the employment rate.

IPT success will depend on the following factors that S. Taylor (2004) confirms:

- Ubiquitous and competitively priced broadband access
- The availability if Internet access
- Widespread use of computers
- Fully open competition

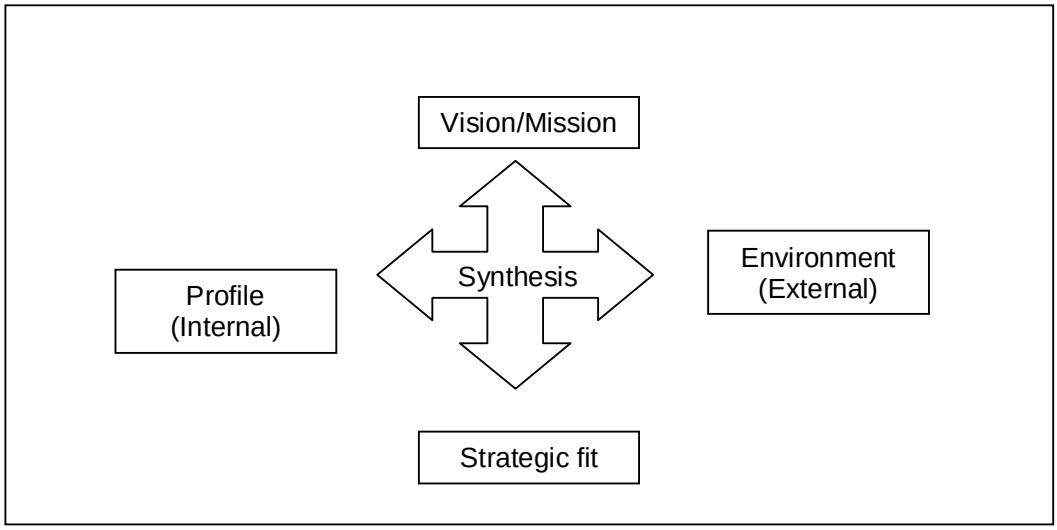
Since the "killer application" for IPT has not been developed yet, South African scientists and engineers can grasp the opportunity and become a major player in the development of these strategic applications.

CHAPTER 7: CONCLUSION

7.1 IPT's success in South Africa

The aim of this research report was to determine whether IPT can be successful in South Africa. To come to a conclusion a strategic "fit" must now be found between the profile of the technology and the external environment as described in the strategic "fit" model shown in *Figure 7.1*.

Figure 7.1 - Strategic fit model



Source: (Adapted from Pearce & Robinson 2001)

Before this strategic "fit" is done, let's first recap the findings since the beginning of this document. History is marked with many migrations that have forever changed the face of the earth and it was discovered that IPT is another migration, but one that would drastically change the way people communicate. The technology itself was investigated and certain benefits and challenges were identified that could impact the success of IPT.

It was discovered that the technology is not perfect yet, but wider adoption of open architecture and standard protocols hold the promise to unleash the creativity of solution providers to develop money-saving applications that will drive prosperity. A comparison between the benefits and the challenges of IPT that were identified can be seen in *Table* 7.1.

Table 7.1 - Benefits versus Impediments

Benefits	Impediments
Cost reduction	Security
Increased productivity	Quality of Service and voice quality
New and enhanced applications	Bandwidth consumption
Better mobility to employees	Cost
More control over resources	Reliability/availability
Better utilization of the LAN/WAN	Interoperability
Better leverage of existing IP investments	Manageability
Improved leverage of expert staff	Power
Bandwidth efficiency	Features
More flexibility and control	Emergency calls
	Regulation
	Management issues
	Resistance to change
	Vendor lock-in
	Lack of expertise
	Internal politics

At first it looked like there were more impediments and challenges for IPT than the actual benefits proposed by IPT vendors, but it was then discovered that the secret of IPT's success lies in benefits that have not realized yet and which are still only possibilities that will reveal themselves in the near future. It was discovered that IPT can be utilized very effectively as long as it is done for the right reasons and in the right way. One benefit might lead to another and eventually it can all add up to a giant balloon of benefits, which are important to the success of any organisation, whether locally or abroad. A "killer application" has not made its appearance yet and is still open to vendors to find. Some of the impediments identified can be overcome and might not even be impediments if the implementation is properly planned.

It was then found that organisations can either follow an evolutionary approach (hybrid), or a revolutionary approach (Greenfield) or thirdly an IP Centrex solution when they decide to implement IPT. Both hybrid and Greenfield implementation models hold value in South Africa and were already adopted by the local mark*et al*though very sluggish. Because the Centrex option is not available right now, it is

not possible to state whether it can be successful by only looking at the current information available. South Africa can however benefit from the Centrex option due to capital constraints facing most Small to Medium size Enterprises (SMEs), but only if it can be offered as a service by the incumbent operator and the SNO at competitive rates. Many local companies compete with international organisations for market share and should be as efficient and effective as their competitors and even better. Implementation's best practices with regards to IPT were investigated and it was found that an organisation must start by asking whether it needed IPT or not. The process must be carefully planned out and supported by ongoing testing. If the technology was found to be needed, a network assessment must be performed to determine what network components the organisation could use and which ones they needed to replace.

Various aspects to be aware of during the formulation and implementation of an IPT strategy were highlighted and included the following issues:

- The alignment of ICT with the business strategy
- Security issues
- Whether to outsource IPT implementation and maintenance or not
- Business continuity
- Power issues
- HR issues
- The support of legacy equipment
- Risks involved
- Scalability

Business best practices and systems like ERP and CRM are being implemented by local organisations because of pressure from global competition and it was then concluded that none of the needed requirements for IPT implementation differed for the local business environment. South African businesses also need IPT. The list must however not be seen as exhaustive, but it should be noted that the strategy to implement IPT will have to be done by taking into consideration many other aspects than just the equipment and costs. IPT implementation decisions must shift from hype decisions to the solving of business problems. The value proposition must be of increased productivity rather than only the saving of costs. The implementation process of IPT will have to be carefully planned in logical steps and all the factors must be taken into consideration.

With regards to Internet telephony it was found that there were three implementation configurations that could be used, i.e. PC-to-PC, phone-to-PC and PC-to-phone and then thirdly phone-to-phone. South Africa should start with the PC-to-PC configuration, because only regulatory restrictions and call costs prevented it from really taking off and not the architecture. The other two types of configurations can then be implemented in phases later on. Whether it will be as successful as proven in developed countries is uncertain due to facts like the Digital Divide and other social issues as discussed in chapter six.

If one looks at the adoption rate overseas, it is clear that IPT will be the dominant communications technology for the coming years. Both large and small organisations have indicated that they plan to implement IPT within the next few years and sales of IPT have started to increase tremendously. It is anticipated that a few large organisations will indeed start to invest in IPT in order to benefit from toll bypass, while the cost of international voice traffic is relatively high. Sales of TDM equipment will decline at a certain rate, which will eventually lead to the sales of IPT equipment to overtake TDM systems, but no one currently knows the exact year. It was discovered that most South African organisations have taken a wait-and-see stance towards IPT and this can be an indication that they are not convinced by the value proposition proposed by IPT vendors. Organisations are overall very conservative with the implementation of IPT and they allow their TDM equipment to depreciate further.

The biggest obstacle of IPT's success in South Africa was found to be regulatory issues, but it was concluded that the environment will soon change. The Communication's Minister, Dr. Ivy Matsepe-Casaburri announced that the SNO will be granted a license to operate on 17 September 2004 and she also said that VANS may provide voice transmission over any medium from 1 February 2004. The industry wants to see changes that will liberalize the market, because IPT is going to be a disruptive technology only when there is a competitive market. According to Ali (2003) the previous attempts by Government to introduce competition failed because it only resulted in an increase in penetration, especially mobile penetration, but prices to consumers have increased. These higher prices then become a restrictive factor of the prospective benefits that telecommunications regulation set out to achieve initially. It was found that Government's intention of the Convergence bill will enable the industry to become more competitive and stir rivalry among competitors. Telkom, the SNO, Sentech and Under-Service Area Licensees can benefit from the

technology and will be able to provide cheaper telecommunication services to the consumers.

Because most of the IPT equipment will be imported from other countries, it is expected that the exchange rate will play a major role in the success of IPT. IPT can benefit the local economy and will allow for exciting career opportunities, which can affect the employment rate. IPT's success in South Africa will depend on the following factors as mentioned by S. Taylor (2004), but also on others:

- Ubiquitous and competitively priced broadband access
- The availability if Internet access
- Widespread use of computers
- Fully open competition

Since the "killer application" for IPT has not been developed yet, South African scientists and engineers can possibly grasp the opportunity and become a major player in the development of these strategic applications. The benefits that can be achieved by having a converged network must be seen from within a strategic perspective rather than from a tactical perspective. Convergence needs to be a corporate strategy based on meeting business needs and organisations must take advantage of the benefits, but must also manage the risks that were identified. Organisations must ensure that they have the ability to be ready to move to IPT when the time is right. Convergence is happening whether organisations are ready for it or not and organisations will find that their competitors, partners, and customers will pursue it, and will show return on investment (ROI) in the near future. Given that convergence provides a competitive advantage, most companies will find they need to pursue it. Forethought, good planning and realistic expectations will make IPT operate successfully in South African organisations. IPT will bring various different methods of communication together that will enable people to communicate more effectively and efficiently. This evolution to IPT will allow people to choose when, how and where they wish to communicate. IPT is here and here to stay.

IPT can be successful in South Africa if the environment is going to change to a more liberalized environment. Enterprise operations, whether locally or abroad are dependent on efficient and effective communications between all levels of employees, internal customers and external customers.

"Communication is not revolutionary – it is always people talking on the phone with other people – but the underlying technology is new and people need some time to become familiar with it" (Corrocher 2002:543). Vecchiatto (2004:2) reported that according to Pieter Uys, COO of Vodacom, "it is not about technology, it is about what the customer wants". The South African public switched service providers, e.g. Telkom and the SNO, should remember this and not only see IPT as a threat to their business but also as an opportunity they have in providing basic communication. They should focus on the profitability of the technology, the increase in the efficiency and capabilities of the new service and they should focus on the maturity of the technology. These services should start with something that add value to users and which is not mission critical. It must be based on the current emerging platform. As the technology matures, the service providers can then run the current services on the new platform. Services based on IPT will be largely accepted by the market only when they are easy to use and accessible through appliances that are easy to operate, e.g. telephones (Sijben & Spergel 1998).

Ali (2003) anticipated that the evolution of South African telecommunications regulation would in the longer term result in deregulation of this sector. This anticipation is about to turn into reality if one looks at the recent announcement by the Communications Minister, Ivy Matsepe-Casaburri, on 2 September 2004. The Minister announced policy interventions effective from 1 February 2005 to speed up growth in the ICT sector, to remove constraints and to reduce costs, for instance by lifting restrictions on voice by VANS. IPT will then also be legal in South Africa (Finance24 2004a)(Finance24 2004b).

It can be expected that in South Africa there will be a long period where both IPT and the legacy network will co-exist, maybe much longer than in developed countries. South African Network Operators must therefore accommodate both early adopters of IPT and slow adopters and allow them to communicate with each other quite easily. Local Internet service providers have the infrastructure to accommodate the additional voice over the Internet and they will therefore be an alternative choice to customers. They will definitely reduce the revenue streams of Telkom and the SNO. The Network Operators should respond to this threat by also becoming Internet Service Providers. This will then allow them to undermine the competitive advantage of new entrants by further reduction of costs.

South Africa needs Internet Telephony Service Providers (ITSPs) like Net2phone and Dialpad as discussed in chapter 2. This will add more competition to the industry and positively influence the rivalry, to the benefit of the consumer.

As the technology affordability such as the costs of PCs were identified by Ali (2003) as a stumbling block for the mass-market adoption of e-commerce in South Africa, likewise the affordability could be a problem for the success of IPT in South Africa. The promotion of communications access in South Africa by using IPT can be beneficial to the growth of e-commerce and Internet in the rural areas as more consumers will start to use the Internet due to cheaper communication costs. This can then trigger fresh interest by local organisations to adopt e-commerce technology strategies (Ali, 2003).

Through all the different issues mentioned in this report, it can then be concluded that IPT can be successful in South Africa if it is supported by Government, implemented in the correct manner by the Service Providers and organisations and adopted aggressively by the local business and residential markets as intended. If one of these components is missing, South Africa will fall further behind developed countries.

7.2 Recommendations

7.2.1 Recommendations to organisations

"Every citizen should understand the social-economic development potential of new technologies, and call upon Government to drive the changes needed to allow their widespread use" (McPhie 2004:12). Despite the weak value proposition, companies should not deploy IP telephony hastily. IPT still needs a sound value proposition that transcends basic call savings. The value proposition should address every type of organisation and must impact organisations as a whole and not only the ICT department. IPT customers should however be more opportunistic about the technology and understand the benefits the technology can offer to their businesses once it has matured and the lucrative environment exists. IPT can be successful and can bring about strategic benefits to an organisation.

7.2.2 Recommendations to vendors

IPT vendors should face reality and admit that the value proposition of IPT is not that convincing yet. A few other recommendations open to IPT vendors are the following (Winogradoff 2002:4):

- Become more cognizant of the needs of the end customers. Customers are more capital and expense savings orientated lately, focused on core business, and consistently positioning against competitors and competitive offerings
- Eliminate proprietary interfaces, by helping to promote interoperable and consistent standards
- Focus on comprehensive solutions. Don't only sell products, but focus on developing IPT that can help to address key concerns of carriers
- Also focus on the management of systems. The converged network must be managed properly to maintain reliable voice quality while also supporting other business critical applications

7.2.3 Recommendations to Network Operators

IPT will accelerate balancing between domestic and international calls. It holds both threats and opportunities to the incumbent operator. Broadband links can provide always on Internet connectivity and are much more cost effective and flexible than the other options available for Internet connectivity. Effective deployment of Internet connectivity combined with IPT can provide a way to compete in the modern global economy (O'Halloran 2003). Telkom could have benefited from IPT under the current regulatory environment, because it was illegal for any other organisation to provide managed services due to the fact that it was illegal to break in AND out of the PSTN at the same time. This will however change soon as indicated and Telkom needs to amend its strategies. Because huge amounts of capital are available, Telkom is in a position to either accelerate or slow down the implementation of IPT. They must therefore take the leadership role and encourage the immediate development of robust and flexible IPT solutions.

7.2.4 Recommendations to the regulator

IPT will offer many difficult questions to regulators and ICASA is not excluded. Government cannot ignore the growth of technology and the fact that current regulatory attempts are unenforceable and impossible to police, because

Government simply does not have the technology or the resources to ensure that Internet telephony is not used illegally. They must therefore change the regulatory environment as they indicated. ICASA must promote rather than hamper the development and implementation of IPT as a viable alternative to circuit-switched telephony. They should not restrict IPT in such a way that it minimizes IPT's usefulness and ubiquity as currently the case. They must focus on the customers and help to provide more choice and more competitively priced service. This will then also encourage the Network Operators to implement IPT faster. If foreign IPT organisations specializing in Internet telephony could sign deals with local organisations it could add to the available bandwidth for South Africa and that could enable better quality access to consumers. "Unless the government aligns its intentions and actions it may undermine the country's position as a technology leader in Africa" (McPhie 2004:12).

7.3 Areas for further research

While much research was done on IPT technology itself, little empirical research was done for the implementation thereof on developing countries including South Africa. Where groups like ITU-D did research on developing countries like Egypt and Uganda, the research have become outdated and new research projects should be undertaken by these organisations. Given South Africa's uniqueness in things like its history, geographic location and its social challenges like HIV/AIDS, much more research should be done on:

- Empirical study to proof the findings of this paper, i.e. that IPT can be successful in South Africa
- The impact HIV/AIDS will have on the success of communication technologies of the future
- A general model that will include all the macro economical factors that could impact the success of IPT in any country
- The bridge that IPT can offer in order to overcome the digital divide

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Appendix A: Difference between circuit switching and packet switching

Time Division Multiplexing (TDM) is based on a circuit switching technique, whilst IPT is based on a packet switching technique within the communications network. "The PSTN uses circuit switching technology that has not changed in over a hundred years. When one party phones another, the call is set up by a series of switches. A PBX in one office might switch the call to a local exchange, which then switches it to a national exchange, from there it might go to an international exchange, and then proceed back down the link until it reaches another PBX and the called party. The PBX switches calls from phones to and from the public infrastructure and it also handle internal calls" (Emmerson 2001:5).

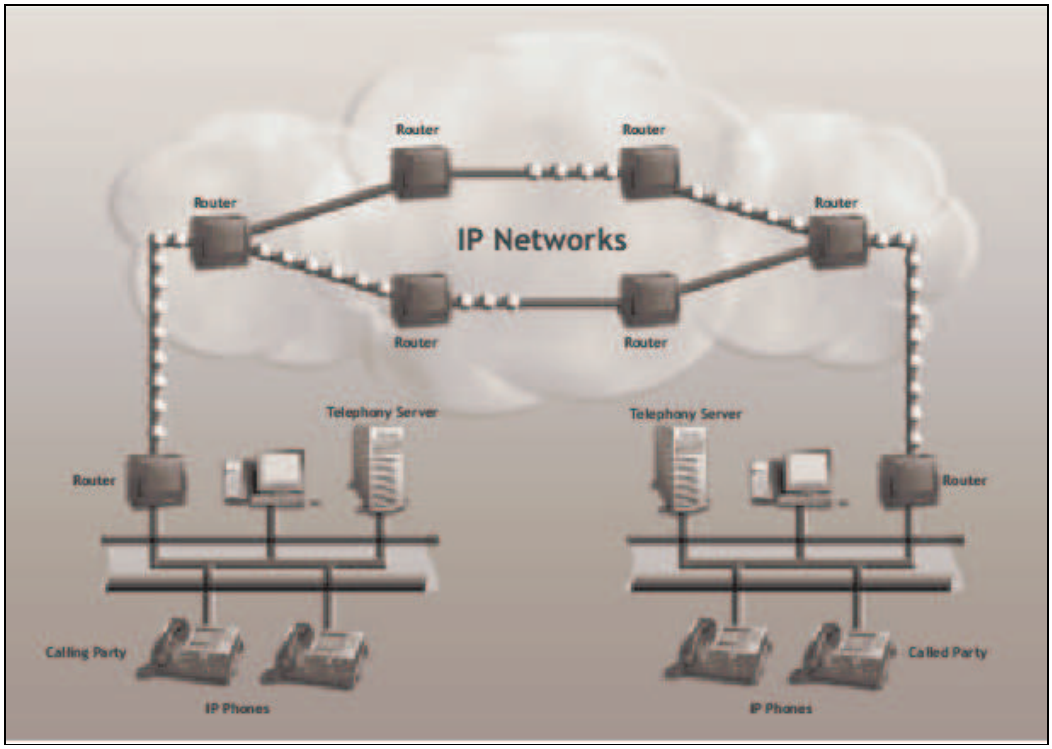
"Once this end-to-end link is established, it is used for the duration of the call. Any other party cannot employ this valuable communications resource until the call is terminated. That is why tariffs are also based on duration. This is something normally taken for granted and until IP and the Internet came along there did not seem to be any alternative, but this technology is very inefficient. Circuit switching ties up resources since the central exchanges and PBXs stay in the loop after the call has been set up and is only released when the call is terminated. In a circuit-switched Virtual Private Network (VPN) every location has a PBX and the carrier interconnect these switches. This process takes time and the resulting infrastructure is not flexible. Adding a new location may take months and retaining the same number when employees change to new locations is something of a logistical nightmare" (Emmerson 2001:5).

"Digitising an analogue voice signal and chopping it up in thousands of small packets of data might sound like an improbable technology and in some ways it is, but once voice becomes just another data type then virtually anything and everything can be done to the signal. There are a number of technical issues, but they have been addressed and the IP telephone technology is robust, particularly when running on corporate LANs and WANs. VoIP is therefore a technique that enables internal calls to bypass the public infrastructure and thereby minimise communications costs. This explains the term 'toll bypass'" (Emmerson 2001:6).

"In an IP environment the signals are not switched, they are 'routed' by a computer system. Once IP packets have been sent onto the route, then that part of the

network infrastructure becomes free to handle another call. The links between routers can also handle more than one call; in fact, they can handle many calls simultaneously since each packet of data has a unique identity. Thus, the need to base tariffs on call duration is eliminated since no resources are tied up unnecessarily" (Emmerson 2001:6).

Figure A.1 - A simplified IP communications network



Source: (Emmerson 2001:6)

"Calls between two parties are established by routing a flow of packets over an IP infrastructure. The telephony server identifies each packet, i.e. the address to which it is sent and its sequence. Packets can travel by different routes, as illustrated. For local PSTN calls and calls to non-IP based telephony systems (i.e. PBX's), gateways are employed to interface between the two environments" (Emmerson 2001:6).

Appendix B: IPT equipment manufacturers

3Com

”One of the first IP telephony players from the data side, 3Com offers IP telephone systems for small, medium, and large businesses. Its enterprise VCX V7000 product interoperates with legacy PBX’s and accepts legacy handsets for a gradual migration” (Erlanger 2004a:1).

Alcatel

”This second-tier player offers IP phone systems with support for legacy devices to enable a gradual migration to IP. Its OmniPCX Enterprise IP PBX features native SIP (Session Initiation Protocol) support and Web services interfaces to integrate voice into business applications” (Erlanger 2004a:1).

Avaya

"One of the biggest players in the legacy and IP telephony space, Avaya sells legacy, hybrid, and complete IP phone systems. Avaya’s Extension to Cellular feature rings incoming calls on desk and cell phones simultaneously and provides cell phones with office phone functionality” (Erlanger 2004a:1).

Cisco

”The principal IP telephony player from the data side, Cisco offers complete IP enabled phone systems that can bridge to existing phone systems and a variety of phone types including wireless and XML enabled handsets” (Erlanger 2004a:1).

Mitel

”A second-tier vendor that offers hybrid and complete IP phone systems, Mitel offers a unique Your Assistant app, which provides presence information and lets users manage all their communications from one interface. A YA Pro softphone offer multiparty videoconferencing” (Erlanger 2004a:1).

NEC

”This diverse tech giant offers phone systems with a modular architecture that supports legacy, hybrid, and completely IP-enabled phone systems” (Erlanger 2004a:1).

Nortel Networks

”One of the biggest players, Nortel offers legacy, hybrid, and complete IP enterprise phone systems to allow a gradual or complete migration to IP. Its Meet Me Conferencing application adds collaboration, presence, messaging, and video calling services and an i2050 Mobile Voice client runs on a PDA” (Erlanger 2004a:1).

PingTel

”This IP PBX supplier recently went open source with SIPxchange, a SIP-based, customizable IP telephony platform that runs on standard server hardware and includes WebEx, along with tools for integrating VoIP with enterprise applications” (Erlanger 2004a:1).

Siemens

”A major player in the legacy and IP space, Siemens offers hybrid and complete IP solutions for a gradual migration to IP. HiPath OpenScape is a suite of presence-aware conferencing applications and middleware that can be integrated with IBM, Microsoft, and SAP data application platforms” (Erlanger 2004a:1).

ShoreTel

”Formerly known as Shoreline, it offers all-IP phone systems using architecture of distributed, centrally managed IP voice switches. Switches can also accept Shoreline’s own analogue phones” (Erlanger 2004a:1).

Spectralink

”A key player in voice over Wi-Fi, SpectraLink offers wireless handsets for both legacy and IP phone systems through service, equipment, and application providers” (Erlanger 2004a:1).

Toshiba

”A provider of legacy, hybrid, and IP-based phone systems, Toshiba’s major products include the Strata CTX100 and CTX670 IP-ready PBX systems” (Erlanger 2004a:1).

Zultys

”This IP PBX vendor provides VoIP products that combine several functions in one box and work with third-party SIP handsets” (Erlanger 2004a:1).

Appendix C: H.323 vulnerabilities

Table C.1 - IPT equipment vendors reported as being affected by H.323 vulnerabilities

3COM	Alcatel	Apple Computer Inc.	AT&T
Avaya	Borderware	BSDI	Check Point
Cisco Systems Inc.	Clavister	Computer Associates	Conectiva
Cyberguard	Debian	D-Link Systems	EMC Corporation
Engarde	eSoft	Extreme Networks	F5 Networks
Foundry Networks Inc.	FreeBSD	Fujitsu	Global Technology Associates
Hewlett-Packard Company	Hitachi	Ingrian Networks	Intel
Intoto	Juniper Networks	Lachman	Linksys
Lotus Software	Lucent Technologies	MandrakeSoft	Microsoft Corporation
MontaVista Software	Multi-Tech Systems Inc.	NEC Corporation	NetBSD
Netfilter	NetScreen	Network Appliance	Nokia
Nortel Network	Novell	Objective Systems Inc.	OpenBSD
Openwall GNU/*/Linux	Oracle Corporation	RadVision	Red Hat Inc.
Riverstone Networks	Secure Computing Corporation	SecureWorks	Sequent
Sony Corporation	Stonesoft	SuSE Inc.	Sun Microsystems Inc.
Symantec Corporation	TandBerg	Tumbleweed Communications Corp.	TurboLinux
UniGone	Unisys	WatchGuard	Wirex
Wind River Systems Inc.	Xerox	ZyXEL	

Source: (CERT 2004:1)

Table C.2 - Affected companies who responded

Aastra Telecom	Adrenta Technologies	Alcatel	AltiGen Communications
Apple Computer Inc.	Atos Origin	Avaya Inc.	Check Point
Cisco	Cyberguard	eSoft	First Virtual Communications
Fujitsu	Hewlett-Packard	Hitachi	Innovaphone
Juniper	Lucent	Mediatrix	Microsoft
Mitel Networks	NetBSD	Netscreen	Nortel Networks
Objective Systems Inc.	OpenH323	OSS Nokalva	Polycom
RadVision	Red Hat	Sun Microsystems	Symantec
Tandberg	Tumbleweed	uniGone	Xerox
Zydacron			

Source: (UK National Infrastructure Coordination Centre 2004:1)