Local Loop Unbundling

A Way Forward for South Africa

ICT has a vital role to play to encourage economic growth. Local loop unbundling is a process that covers a series of regulatory offers that is intended at providing new operators with rights to use the copper based local loop in a competitive environment. Unbundling is aimed at increasing innovation, increasing the quantity and quality of services, reduce the prices paid by customers and increase the number of available business opportunities. This report presents a way forward for the unbundling of the copper based local loop in South Africa.

The Local Loop Unbundling Committee

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This report is a result of a desk-top literature study and extensive consultation across the ICT sector. Any omission of references and acknowledgement is not intended.

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2 List of acronyms

ADSL	Asymmetric Digital Subscriber Line
DLC	Digital Line Carrier
DP	Distribution Point
DSL	Digital Subscriber Line
DSLAM	DSL Access Multiplexer
FTTH	Fibre-To-The-Home
FTTK	Fibre-To-The-Kerb
HDF	Handover Distribution Frame
HDSL	High bit rate DSL
ICT	Information Communication Technologies
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
LLU	Local Loop Unbundling
MDF	Main Distribution Frame
NTE	Network Termination Equipment
ODF	Optical-fibre Distribution Frame
PSTN	Public Switched Telephone Network
SME	Small-to-Medium Enterprise
SMP	Significant Market Power
TV	Television
VDSL	Very high bit rate DSL
VLSI	Very Large Scale Integrated circuit
xDSL	Generic Digital Subscriber Line

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5 Executive summary

This report is a response to the mandate by the Honourable Minister Ivy Matsepe-Casaburri for the Local Loop Unbundling Committee (LLUC) to recommend how Telkom's local loop network could be unbundled. Unbundling is intended to facilitate affordable open access, lower prices of telecommunications and offer a wide choice of access to ICT services. Such open access and customer choice will not be meaningful without ensuring that customers can switch between service providers expeditiously. The overall task of the committee was to investigate possible local loop unbundling (LLU) methods and to make appropriate recommendations in this regard. In this report, the local loop is that portion of the telecommunication network that is situated between the end of subscriber's telephone connection and the Main Distribution Frame (MDF), where all the user lines come together before being connected to the telephone exchange.

In this report the LLUC has assumed that the local loop will continue to be owned by Telkom, and therefore this report does not deal with issues of ownership. Furthermore the report does not deal directly with the pricing of access to the local loop.

This report covers the technological aspects, legal and regulatory issues, as well as the economic implications of unbundling the local loop. Firstly, the report gives a general introduction on issues around unbundling the local loop, including the characteristics of the incumbent operator and new entrants, and gives the background to broadband technologies and relevant applications. Secondly, the report explains the forms of collocation in the unbundled local loop, the LLU methods and explains the technical limitations of the process of the LLU. Thirdly, the report discusses the issues relevant to the implementation of the LLU, the incumbent's anticipated response to this process based on foreign experience as well as strategic issues that need to be considered in the process of the LLU. Fourthly, the report explains the economic, legal and regulatory impact of the process of the LLU. Lastly, the report presents a design and implementation process based on case studies for the LLU from countries such as the USA, Europe and Asia.

Based on the above the LLUC has come up with the following recommendations:

- It is appropriate to have a combination of three unbundling models, namely,
    - Full unbundling
    - Line sharing and
    - Bitstream (wholesale) access
- A new facilities and services management entity is formed by the incumbent on such terms and conditions as shall be agreed with ICASA.
- That the pricing levied by the incumbent for access to the local loop be regulated.
- Regardless of who owns the local loop, any operator appropriately licensed by ICASA should have access to the local loop to deliver voice and/or broadband services.
- The regulator should implement carrier pre-selection as soon as possible so that customers would have a choice on who would transmit voice and data on the local loop infrastructure to their premises regardless of who owns the local loop.
- That any form of collocation of facilities for LLU be fully allowed as may be necessary to ensure flexibility and reasonable access to the LLU for the new entrants.
- The costs of collocation must be regulated taking into account factors such as cost of renting space, electricity and security.
- ICASA be capacitated to physically inspect the incumbent's premises to establish the size, location and other information about the incumbent's premises as may be required for the implementation of the unbundling of local loops.
- A regulatory guideline be developed and overseen by ICASA to ensure that strategic issues such as the quality of the local loop, its maintenance, technical compatibility are optimized for regulation and service delivery.

Based on these recommendations the LLUC believes that customers will be able to:

- Select carriers of their choice for the transmission of voice and/or data.
- Exercise carrier pre-selection choice as effortlessly as possible.

It is postulated in formulating this report that the implementation of the LLU process should improve the prospects for better pricing, affordable services and improve the quality of services.

6 Introduction

The incumbent operators or simply the incumbents are national incumbent telecommunication operators who for many years have been enjoying the monopoly and dominance in distributing voice and data services to all segments of the market. The incumbents typically have national presence and extensive national and international backbones. In many parts of the world the incumbents are characterized by having the main copper based local loop network, and the majority of their financial and infrastructural resources were usually gained through Government subsidies, usually in a telecommunication environment that was not competitive. In the present day, incumbents face the critical need for developing new high growth services as traditional voice revenues are no longer major streams of income generation. Furthermore, they now operate within environments where competition for the provision of data and content is increasing in intensity. The emergence of broadband technologies and the urgent need to provide broadband services to customers have opened up new opportunities for individuals and companies to request to be granted licenses to operate in the same telecommunication space as the incumbents.

In South Africa, Telkom SA is the incumbent operator which provides fixed-line telephony, data communications and satellite services to the market. Telkom SA also indirectly provides mobile communications through a joint venture with Vodacom a mobile operator. Telkom's infrastructure consists of terrestrial, undersea and satellite communication networks, and pathways, broadband circuits and connections that allocate voice, data and video communication services. Telkom SA made its introduction on the Johannesburg and New York Stock Exchanges on March 4, 2003 and Appendix 1 presents an overview of Telkom SA, as is found from its website – The Annual Report for 2006.

New entrants or competitors, who in this report are referred to interchangeably, are companies that desire to operate in the telecommunication market space where the incumbent is already operating. New entrants are viewed as being an essential value added constituent in telecommunication industry by better serving customers with more services. These new entrants are viewed as elements whose presence in the telecommunication marketplace will dynamically enhance competition in the telecommunication space in the country. In South Africa, the current penetration of main lines is close to 9 percent, with approximately four million Public Switched Telephone Networks (PSTN) lines. It is therefore expected that the rivalry introduced by the new entrants will result in fixed line improvements,

an immediate advancement of the availability of broadband access and data services at more competitive and affordable prices.

Towards the end of 2005, the South African communications regulator, the Independent Communications Authority of South Africa (ICASA) issued a license to a new entrant – the Second National Operator (SNO) to provide telecommunication services in the space in which the incumbent Telkom SA operates. The dawn of the SNO ended Telkom's exclusivity in offering fixed line telecommunication services in South Africa. A summary of the SNO can be found in Appendix 2. Even though Telkom SA has been diversifying its product offerings and for the reason that the government does not permit Value Added Networks (VANs), Private Telecoms Networks (PTN) and mobile operators to build and operate their own International gateways, the demand for data services and high speed Internet remains robust, particularly in the business segment of the market. Given the current level of demand for telecommunication services in the market, new entrants would ideally like to compete in this space to provide data communications services and broadband access to customers. In spite of the telecommunication services to be offered, the main difference between the incumbent and new entrants is that the incumbent already has a very widespread fixed line infrastructure for both national and international connectivity, while the new entrants do not have any. It is therefore in the interest of national economic growth that a new regulatory framework be put in place to permit the incumbent and new entrants to contribute to the value chain of the development by offering of information communication technology services in the country.

Unbundling of the Local Loop is the process of allowing both the incumbent operator and the new entrants to have open access to use the copper-pair of the local loop infrastructure, which are the fixed-line telephone connections from the telephone exchange to the customers' premises. This local loop is owned by the Incumbent Local Exchange Carrier (ILEC) and in South Africa by the dominant player, Telkom. For the new entrants and the incumbent to share the usage of the local loop, a new regulatory framework that will bring fairness in competition and balance the benefits to all stakeholders needs to be put in place by ICASA. LLU is commonly opposed by the ILECs because of the naive and narrow-minded view that new entrants choose to be 'parasites' on the incumbent's network as an alternative to building their own local loop network. On the other hand, new entrants disagree that, they cannot economically replicate the incumbent's copper local loop and that they cannot make available certain telecommunication services such as ADSL without access to the local loop infrastructure. As a result, not implementing LLU will promote the incumbent operator to go on monopolising the fixed-line

telecommunication market and repressing innovation and in so doing reducing economic growth of South Africa. In addition, it is the case that the local loop was built in an uncompetitive market environment with government's financial support to Telkom.

Some of the reasons given in reference [1-20] for the local loop to be unbundled are:

- facilitate telecommunication providers to innovate and differentiate their product offerings,
- promote competition in the provision of broadband services,
- offer opportunities for innovation to drive product and price differentiation,
- permit providers to give a better choice of applications and improved service levels,
- allow customers to have alternatives in terms of telecommunication services and price,
- speed up national economic growth and increase competitiveness in the global market;
- and support ICT in the country, and hence promote economic and social growth in addition to employment opportunities.

Duplicating the copper local loops of the incumbent's network is not economically sensible for new entrants as it requires major new civil engineering projects in all residential areas. This is not usually the case for countries in Europe and in the USA for business customers. In these countries, these customers are connected onto the fibre optic rings supplied by new entrants and cable TV networks are improved to offer voice telephony and high-speed Internet access [1, 5, and 16]. The incumbents as a consequence remain as monopolies for the provision of telecommunication services via the local loop to residential customers and small-to-medium-sized enterprises (SMEs).

The incumbents are consolidating their dominant market position by including the new emerging high speed telecommunication services based on Digital Subscriber Line (xDSL) technologies. While the incumbent operators have of late started to supply Asymmetric Digital Subscriber Lines (ADSL) broadband services to their own customers, access to the copper local loop for competitors wishing to offer similar telecommunication services needs ICASA to formulate an improved regulatory framework that enables new entrants to better compete. Benefits to customers will consist of provision of spectrum for high bandwidth telecommunication services, range of types of services, high quality telecommunication services and reduced prices. Experience from Europe shows that incumbents are unwilling to better facilitate the offering of telecommunication services provided by new entrants through the use of the incumbents' local loop network. This is because incumbents think new entrants

would compete with their own telecommunication services and deprive them of the Significant Market Power (SMP).

Telkom SA has 47% business and 53% residential customers [15]. Nevertheless, for the reason that its business customers account for more than 75 percent of the total fixed-line revenue, the opportunity for growth is by increasing its business customer base for Small and Medium Enterprises (SMEs) and government. Other segments such as residential and the top corporate have been experiencing decreasing growth compelling Telkom SA to seriously market ADSL and be prepared to put forward WIMAX and internet based television.

For new entrants to compete with the incumbent in providing high-speed telecommunication services to customers, they need to gain access to the copper based local loop. This necessitates the incumbent to consent to the competitors installing their own equipments on both sides of the local loop in order to provide their own telecommunication services using processes such as collocation.

Permitting competition on the local loop would place a strong downward pressure on tariffs for high-speed voice and data services and diminish significantly the cost of Internet access. This report proposes various models for unbundling the local loop in South Africa. The report gives insights on the technologies involved, LLU structures, technical limitations, implementations and issues of implementing LLU. The report finally presents the expected attitude of incumbents based on foreign experiences and the strategic issues and concludes with recommendations for LLU and the way forward. The recommendations arrived at in this report were based on a desk-top literature and case studies that were conducted in many countries including the European Union, the USA, India and Australia [1-29].

7 The incumbent operator and new entrants

Unbundling the local loop process must strive to attend to the needs of the incumbent, the new entrants, the entire telecommunication sectors and the country in order to advantage customers and positively contribute to national economic growth. The incumbent, Telkom SA, remains a major role player in offering broadband services given that it has the principal fixed-line network of more than four million PSTN lines. The introduction of the SNO and the freeing up of the South African ICT market encourage the incumbent to advance the quality and quantity of telecommunication services as well as increase productivity. Given the legalization of international VoIP, the SNO NEOTEL will be challenging

the incumbent for international traffic. The incumbent and the SNO will effectively be sharing a duopoly for international calls.

Broadband access and data communication services are two core areas that the SNO and other new entrants are expected to focus on versus voice traffic as a primary revenue generator. The demand for data services and high speed internet access remains upward in the business sector and it is rapidly growing in the residential sector. The levels of saturation for business and the residential sectors will only be reached when usage prices are low; there is a fast deployment of improved telecommunication services and competitive customer services. The value chain of ICT sector depends on the physical network's infrastructure and the telecommunication services offered. It is generally assumed that in most rural areas or around SMEs, the incumbent has not managed to provide the desired broadband services. In some places that broadband services have been deployed, the prices are still too high to encourage large-scale take up of such telecommunication services and the quality of such services is not adequate. The new entrants will be competing in offering the same broadband services and the increased competition due to an increased number of providers will give customers better pricing, better quality and quantity of telecommunication services as well as give broad coverage to the country with broadband services in urban, rural, business or residential areas. These broadband services should ideally be always available and when the LLU is implemented, these services will be available real-time and on demand. Figure 1 indicates a general competition situation with respect to customers. It shows that before LLU, the incumbent dominates the fixed line space or local loop infrastructure in distributing data services and providing those services to customers.

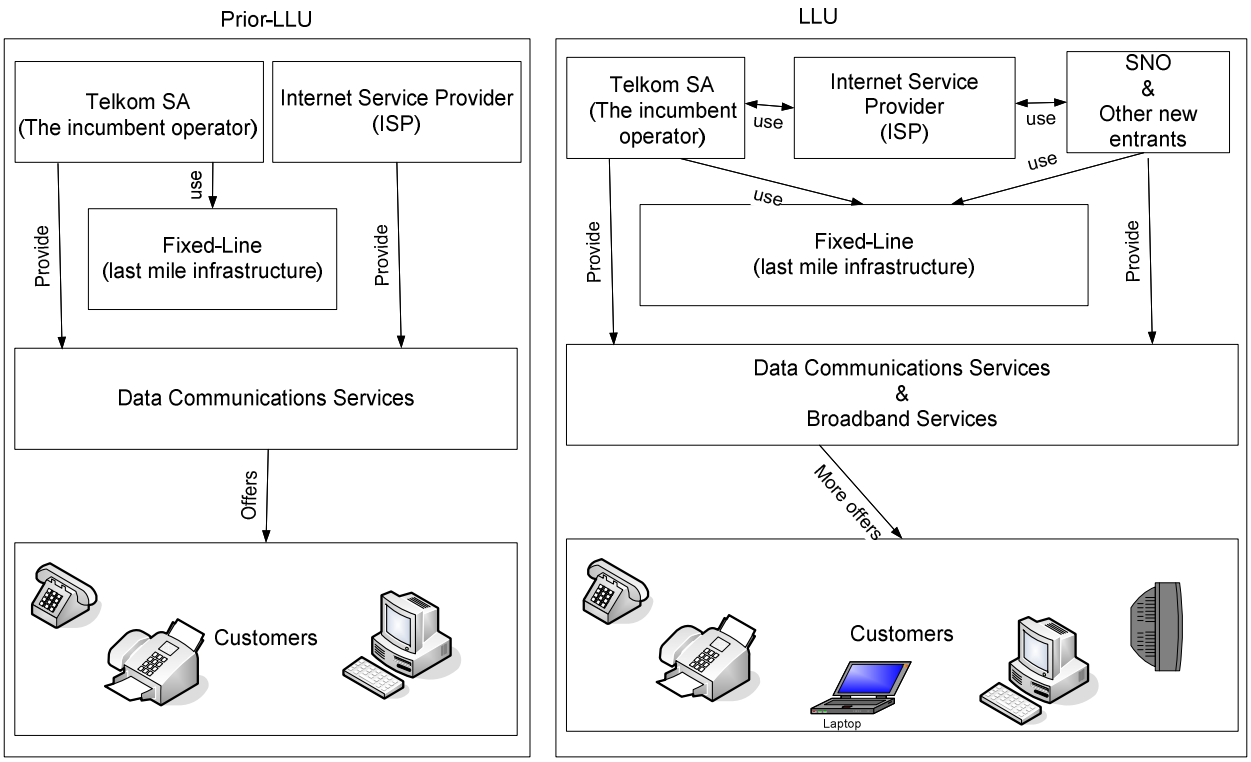

Figure 1: Competition scenario with respect to customers (adapted from [1-20])

It is argued in this report that, while the incumbent is confronted with the challenge of meeting customers demand in terms of telecommunication services and the local loop coverage, there is no competitive element that forces the incumbent to align with the rate of demand and to profile advances in technologies. The other argument advanced in this report is that the internet service providers are limited by what the incumbent network infrastructure is physically capable of providing for data communication services. From the customers' side, the argument is that there is very limited choice of telecommunication services, prices are excessively high and the infrastructure coverage has limited bandwidth. The LLU process will position the incumbent, the SNO and any other new entrants, who may also be existing or new internet service providers, in an environment that addresses all the challenges that existed due to the incumbent monopoly and exclusivity. Figure 1 illustrates that after LLU there are more data and broadband services from both the incumbent and the new entrants available for customers. There is also the sharing of the incumbent's local loop that enables the new entrants to provide ADSL and thus increase the broadband services coverage of the country. The ISPs have a choice on whom to do business with and are guaranteed full access to the local loop infrastructure. The customers in Figure 1 under LLU will more likely get lower prices for telecommunication services, more

services, and a choice of service providers. Figure 2 elaborates on the various types of equipment in the incumbent's network, which is of significance in the process of unbundling the local loop.

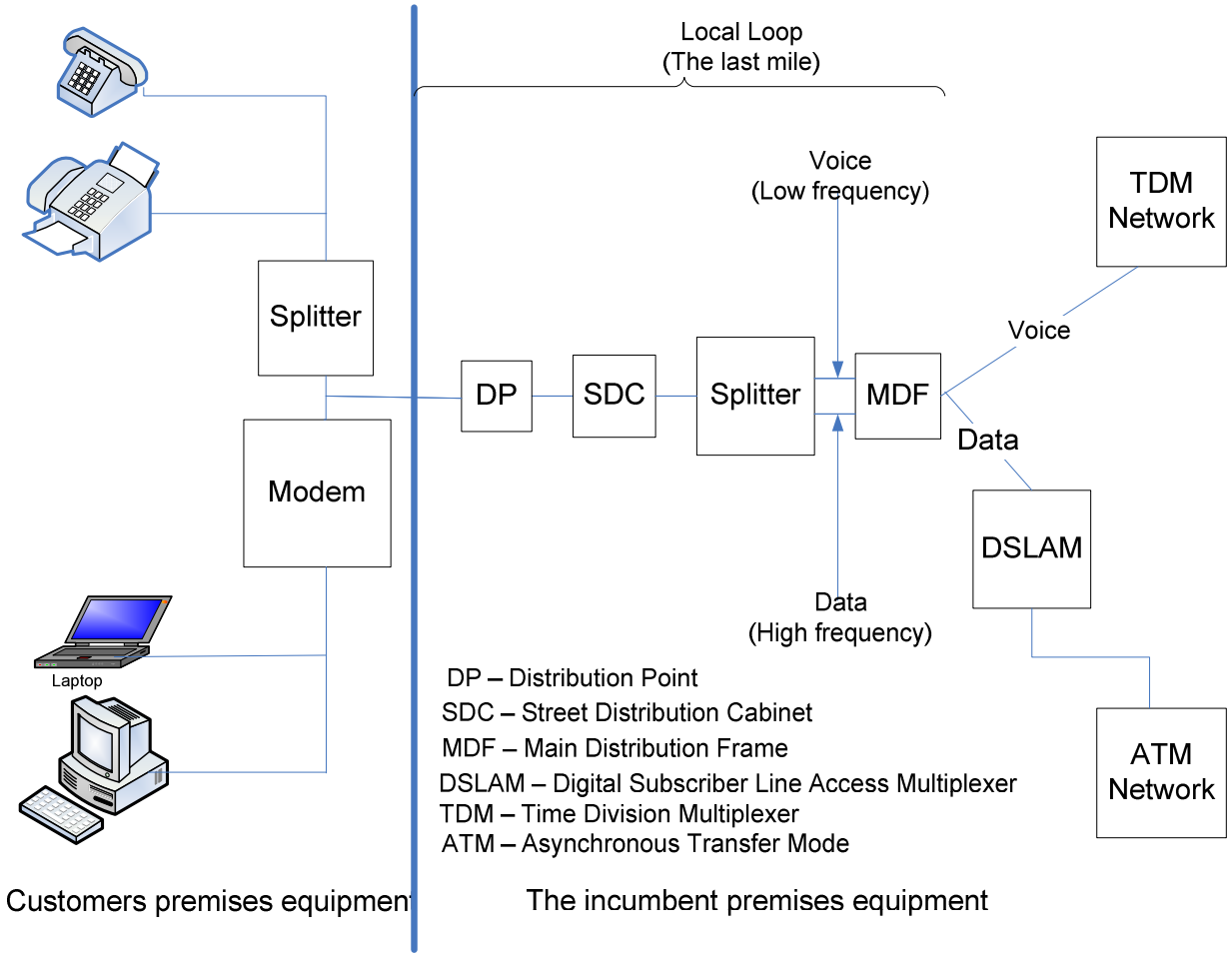

Figure 2: Summary of the network equipment for Local Loop Unbundling (Adapted from [16])

From Figure 2 it can be observed that to add broadband services and customers, the nature, size and location of the MDF and the DSLAM play central roles and strategies and tactics for unbundling the local loop must address these roles. Figure 3 illustrates in detail the technical issues of connectivity and demonstrates the meeting point of the incumbent and the new entrants.

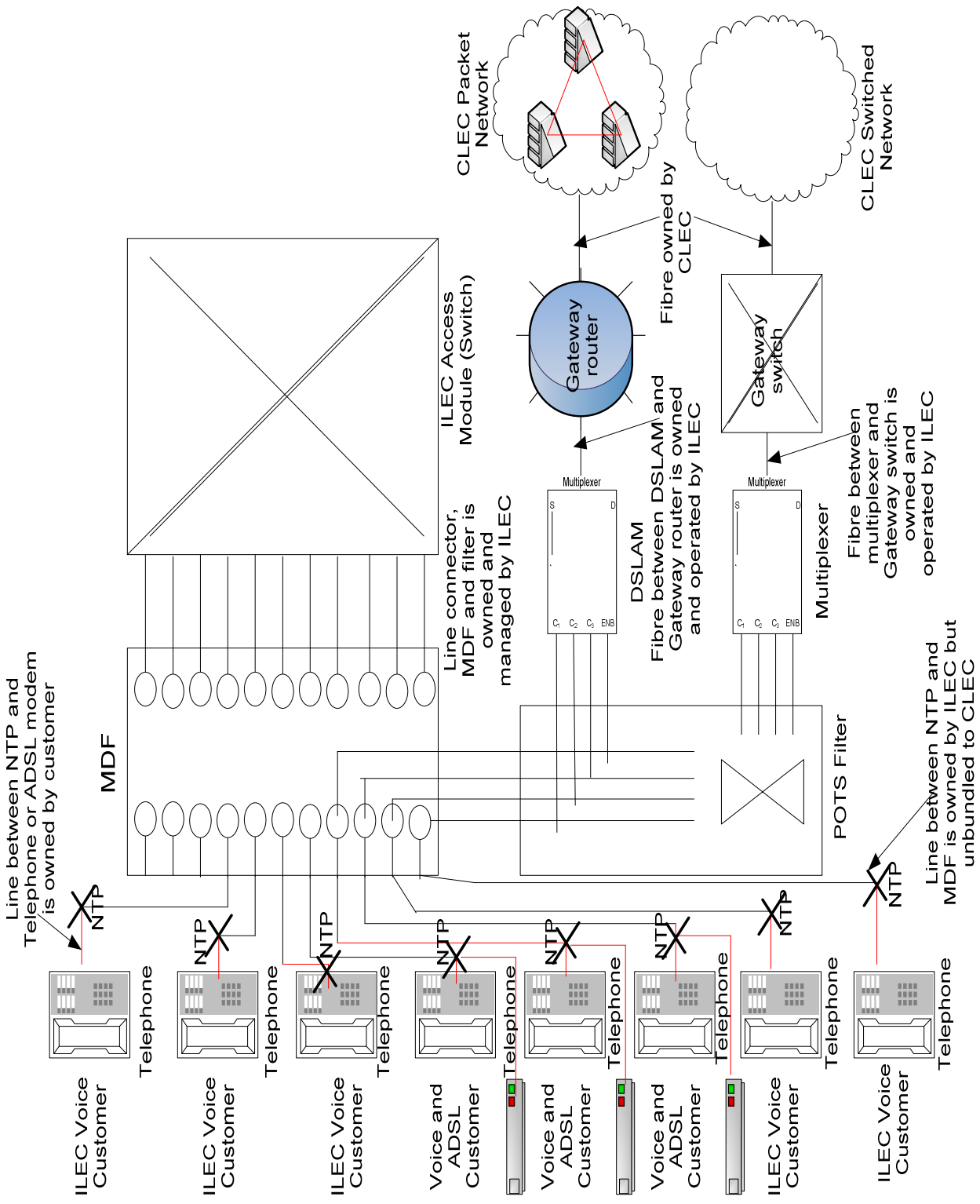

Figure 3: Competitor and the incumbent wiring scenario (Adapted from [7])

8 Background to broadband technologies and applications

The goal of unbundling the local loop is to achieve improved innovation and to provide applications and telecommunication services on the incumbent's copper based local loop. For the supply of high quantity of applications and telecommunication services on the local loop, various categories of broadband technologies should be considered by both the incumbent and the new entrants. Broadband technologies permit the operators to distribute more and better applications and telecommunication services at a high speed and low prices. Section 8 provides an outline on broadband technologies that may be considered in planning the process of local loop unbundling implementation.

The Digital Subscriber Loop (DSL) family of technologies make sure that the transmission of data at rates as high as 50Mbit/s over copper access pairs that had primarily been designed for analogue voice transmission at frequencies of up to 3.4 kHz is possible. The DSL technologies are very advanced, and they use latest technology in digital signal processing such as wavelets transforms and Very Large-Scale Integrated (VLSI) circuit techniques. The details of the DSL family of technologies can be found in many applications and theory of communication books. The next sub-sections introduce some of the technologies that are used and which would most likely be used by new entrants to offer broadband applications and services over the fixed copper wire infrastructure.

8.1 High Bit Rate DSL (HDSL)

The HDSL is a constituent of the xDSL set that provides symmetric data rates in the region of 2 Mbit/s [27]. It achieves this by using two copper loops, one for each direction of transmission. It is said to be symmetric for the reason that it is the same capacities in both directions. HDSL is not compatible with the ongoing utilization of the line for ordinary telephony and as a result takes over the usage of the entire line. More details on this technology can be accessed in http://it.wikipedia.org/wiki/HDSL.

8.2 Asymmetric Digital Subscriber Loop (ADSL)

The ADSL system is a member of the xDSL family that provides a high downstream bitrate, approximately 1-6 Mbit/s, from exchange to customer and a lower rate in the return direction (6-640 Kbit/s) over one copper pair of the local loop [27]. This high speed rate is realized even in the presence of baseband telephony and for that reason the conventional use of a telephone line can continue even in the presence of the ADSL signals. More details on this technology can be found in http://en.wikipedia.org/wiki/ADSL.

8.3 Very High Bit Rate DSL (VDSL)

The VDSL is a type of the xDSL family that aims at very high symmetric or asymmetric bandwidth, of 13-52 Mbit/s upstream, but only over short copper loops, usually less than 500m for the higher rates [27]. It offers very fast transmission of data over a twisted copper wire of the local loop. The fast transmission of data indicates that it is able to carry high bandwidth applications such as High Definition Television and voice over IP. More details on this technology may be found in http://en.wikipedia.org/wiki/VDSL.

8.4 xDSL system architecture

The schematic illustration of the xDSL system architecture for xDSL is shown in Figure 4.

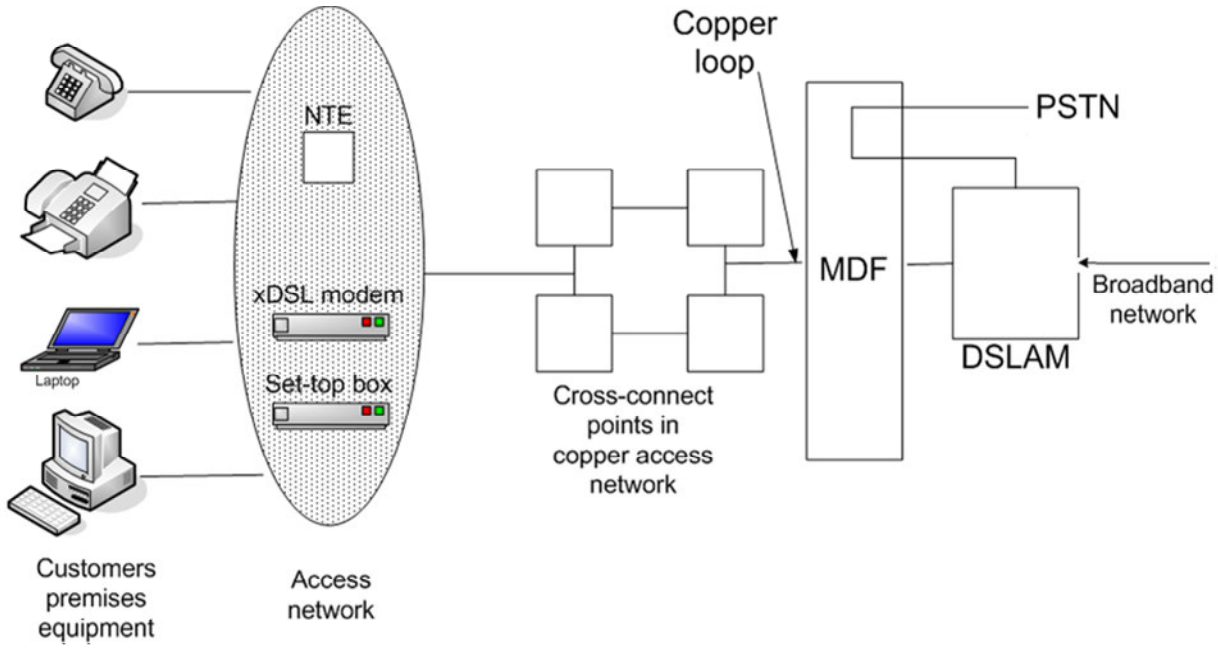

Figure 4: Basic DSL service architecture (Adapted from [1])

Figure 4 shows the xDSL architecture for ADSL and the Public Switched Telephone Network (PSTN) and in this figure by shifting from the right to the left, the broadband signals, which are depicted from an external broadband network, are transformed into the xDSL signal and transmitted into the copper line at an xDSL Access Multiplexer (DSLAM). The connection between the incumbent's ordinary telephone network and the copper line is achieved at a splitter/combiner at the DSLAM. The copper loop departs the exchange building through the Main Distribution Frame (MDF). It then connects to the customers' premises via the copper access network, most likely traversing one or more cross-connection points on the way. At the customer's premise, the line comes to an end at the Network Termination Equipment (NTE) and supplies the sockets which offer connection to broadband and telephone equipment in the customer's premise.

To sum up, Table 1 furnishes the features of the constituents of the xDSL types that have been presented in this report.

Table 1: The characteristics of the xDSL family [27]

xDSL family	Downstream	Upstream	Line support	Loop pair
ADSL	1-6Mbit/s	16-640Kbit/s	Baseband + Telephony	One copper pair
HDSL	2Mbit/s	2Mbit/s	No baseband telephony	Two copper pair
VDSL	13-52Mbit/s	1.5-2.3Mbit/	Baseband + Telephony	Only over short copper loops < 500m

8.5 xDSL applications

The xDSL technology brings to customers' premises the higher bandwidths that can be utilized for a range of applications such as voice over IP. The listings of some of the applications that can be distributed by means of xDSL technologies include [27]:

- Video distribution, including games and educational applications.
- Delivery of a total package of telephony, data services and Internet connectivity over a single local loop.
- High speed, reliable Internet access.
- Extensions for an in-building local area network over a wider area to other premises occupied by the customer.
- High rate private circuits at a fraction of the conventional cost.
- Bulk delivery of service to the manager of the wiring of a multi-terminated building.

8.6 Alternative technologies for broadband

The xDSL technology provides a powerful platform for the delivery of broadband service to residential and small business customers using for the most part existing copper based local loop infrastructure. Big business and corporate customers will be interested in high capacity links and even fibre access which is not the subject of this report. It is important to note that the xDSL is not the only the means to deliver broadband to the homes and businesses. Some copper loops will be too long or else of too inferior a quality to support xDSL. Other technologies which may also be used in a complementary design to the fixed line infrastructure include [1-27]:

- Cable TV systems,
- Fixed wireless systems,
- Satellite delivery,
- Fibre distribution, either Fibre-To-The-Home (FTTH) or Fibre-To-The-Kerb (FTTK) with a final metallic drop to the home.

9 Collocation in the process of unbundling the local loop

Collocation in the practice of Unbundling the Local Loop is a recent component that is a product of the actual execution of system architectures where the incumbent is competing with new entrants. It is the logistical arrangements through which a new entrant obtains access to physical connection to the copper loop and furnishes the equipment on the incumbent's premises according to a formally defined business agreement. When the local loop is unbundled, the physical connection to the loop will require the new entrants' equipment such the handover distribution frame (HDF) and the DSL access multiplexer (DSLAM) to be installed in the incumbent's premises, where the main distribution frame and tie cables are installed. Collocation can also occur in the space made available by incumbent's own exchanges for the new entrants' transmission and connection equipment.

Experiences in Europe and North America, which are documented in publicly available literature [1], show that collocation for LLU must be seriously considered during the implementation of the LLU. Issues that arise from collocation may include the incumbent claiming that there is not enough physical space available for new entrants, for in some cases the old electro-mechanical switching or other unused equipment may not have been removed from the exchanges, or that the new entrants' digital equipment, which is much more compact, cannot be installed if there is an uncontrolled number of new entrants. If this occurs it may result in a scarcity of floor space, which will mean that few of the new entrants may really deploy their businesses nationally, thus causing inconvenience to or denying serious new entrants' access to the market. It is therefore important that ICASA the regulator should ensure that it is appropriately capacitated to be able to deal with all issues on collocation.

The first element that needs to be discussed in collocation and local loop unbundling process is the Main Distribution Frame (MDF) – or it can be called the Optical-fibre Distribution Frame (ODF) depending on

whether the terminals are for copper wires or are for fibre optical cables. In this report MDF is used to represent copper wire distribution frame but when needed, MDF can be substituted with ODF to represent optical fibre cables. The MDF is a steel frame structure that is housed adjacent to the telecommunication switch in the incumbent's premises. One side of the MDF terminates copper wires or ADSL cables from the customers' premises and the other side of the MDF terminates cables from Digital Subscriber Line Access Multiplexer (DSLAM) and the incumbents line switching equipment (i.e., exchange).

Figure 5 illustrates a typical configuration on both sides of the MDF. The types of cables, the number of racks, the size of MDF, the number of frames and other technical information are required to facilitate access to the local loop in the incumbent's network. This information would be required from the incumbent during the implementation phase of unbundling the local loop. To choose the best collocation model, we need to look at four types of collocation, each of which has its own advantages and disadvantages.

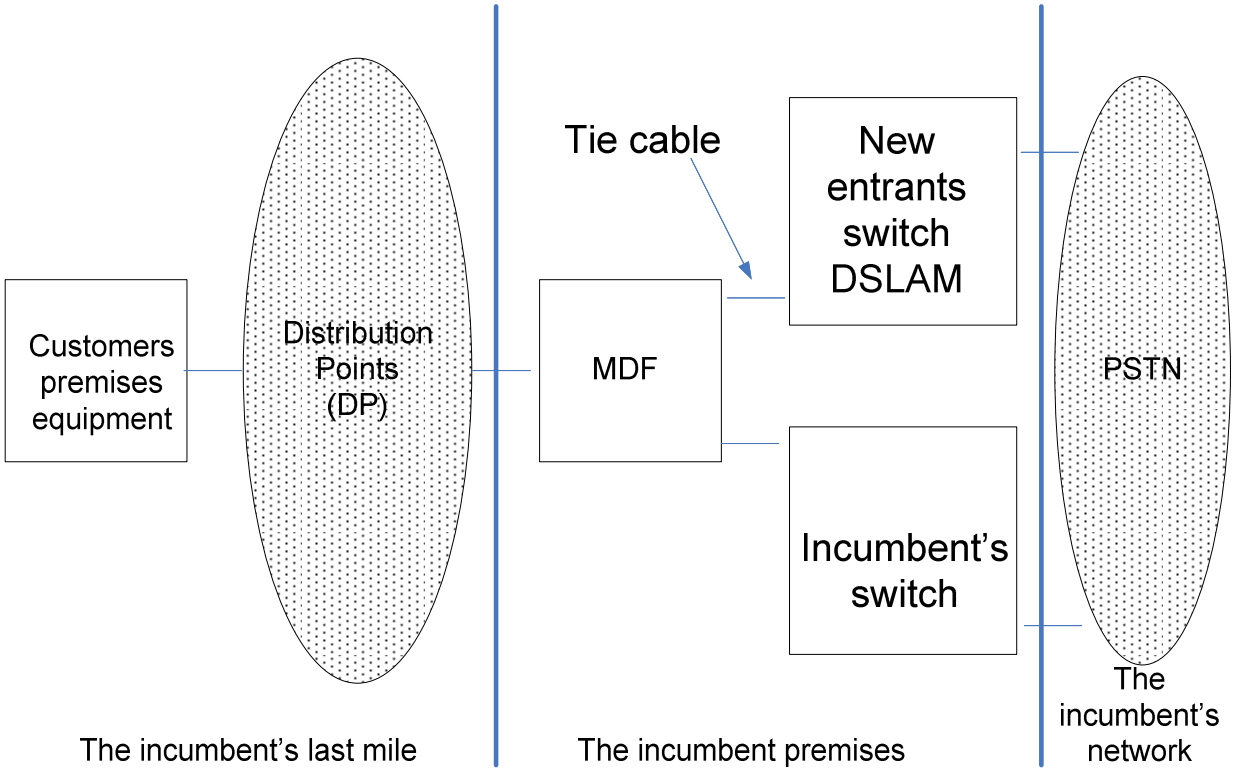

Figure 5: The MDF overview (Adapted from [29])

Four collocation models [1] will be discussed in the next subsections.

9.1 Caged collocation (Hostel-collocation)

Caged collocation provides a dedicated area away from the rest of the incumbent's equipment and physically separated by wire mesh or solid partition. The benefit of this type of collocation is that it can present superior security for both new entrants within their own separated space as well as for the incumbent within the building. Successful collocation needs that the new entrants have effortless access to their equipment at the incumbent's exchanges. In this caged collocation, care must be taken into account to make certain that space is made available on the basis which does not show prejudice against new entrants through high costing [19].

9.2 Co-mingling collocation (Cageless)

Co-mingling collocation or cageless collocation is like caged collocation except that there is no wire mesh or solid partition physically separating the new entrant's equipment from the rest of the incumbent's equipment [1, 29]. Co-mingling is not expensive when compared to caged collocation, however, it is often disputed by the incumbent operator that due to technical feasibility or the desire to sustain network integrity it cannot be executed well [1, 29]. In countries such as Canada, Japan and the United Kingdom, the available literature shows that the incumbents are obliged to provide co-mingling to competitors unless they have special reasons not to [1].

9.3 Remote collocation (In-curtilage)

Remote collocation is a type in which the equipment of new entrants is installed on premises near the incumbent's building but within the boundaries of the incumbent's own site, for example in the car park [29]. The disadvantage of this arrangement is the possibility that premises near the incumbent's buildings may not easily be obtained and if the distance is large it may require extension of the length of copper pairs which usually reduces the quality of service [30].

9.4 Virtual collocation (Bespoke arrangements)

Virtual Collocation is a case where an interconnection agreement exists in which the incumbent installs and maintains equipment to connect networks at new entrant's request but the new entrant does not have access to these premises [29].

10 Local loop unbundling structures

The literature review reveals that there are technically four methods that may be used in the LLU process [29]. The methods can be used in isolation or in combination depending on factors such as the extent of the main distribution frame (MDF), the size of it, the availability of collocation space, the

demands of customers etc. Unbundling is made possible by the incumbent operator giving access to the local loop infrastructure for use by other operators or service providers.

Figure 6 shows a classical situation for the incumbent's network architecture, showing the access network from which the unbundled loop access to other operators or new entrants is exposed. The unbundled loop access stimulates a number of business possibilities that the incumbent as well as new entrants would like to clearly understand in a new regulatory framework that invites new entrants to participate in the LLU process. The subsequent subsections describe how each method is technically implemented. These methods can either be implemented individually or in combination as is further discussed in this report.

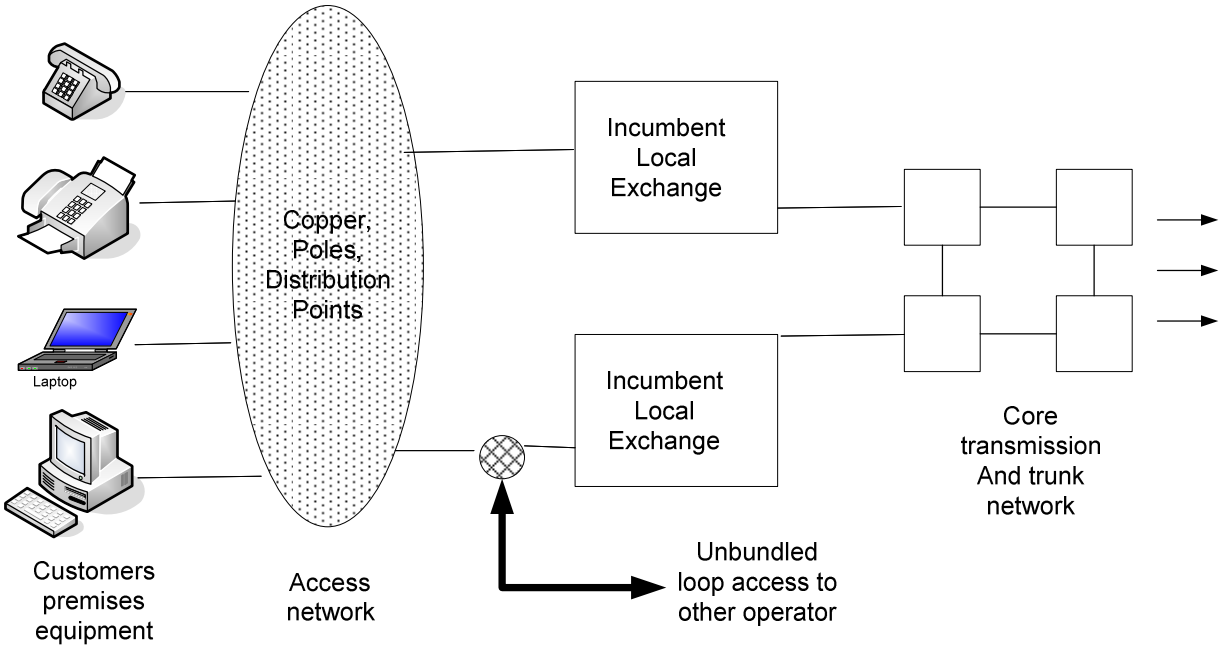

Figure 6: Typical incumbent network architecture with unbundled loop access (Adapted from [29])

10.1. Full unbundling – access to raw copper

This method assigns the entire copper local loop to the operator that is leasing [30]. If chosen with an ADSL service, then either the LLU operator must take over responsibility for the ordinary baseband telephony on the line, or the customer must give up the services.

Figure 7 shows a full unbundling method whereby the incumbent is required to lease access to its copper lines to new entrants. New entrants will then install their own broadband equipment. Collocation gives this method a flavour that would require the new entrants to place all the equipment in the incumbent's premises or outside the incumbent's premises depending on which collocation model is most appropriate. With reference to Figure 6, when remote collocation type is adapted, literature shows that the tie cables will change to external tie cables, hence the quality of service may be compromised and there is an additional cost for that [31]. The following points should be taken into consideration when full unbundling is planned [29, 31]:

- Local loop copper pairs connecting a subscriber to the MDF are leased to a new entrant from the incumbent
- The entrant manages the copper pairs of the local loop and supplies subscribers with the entire telecommunication services together with voice and data.
- The new entrant can improve the copper wire by adding new technology such as ADSL.
- The incumbent maintains ownership of the unbundled loop and is responsible for maintaining it and the relationship between the two operators is regulated.

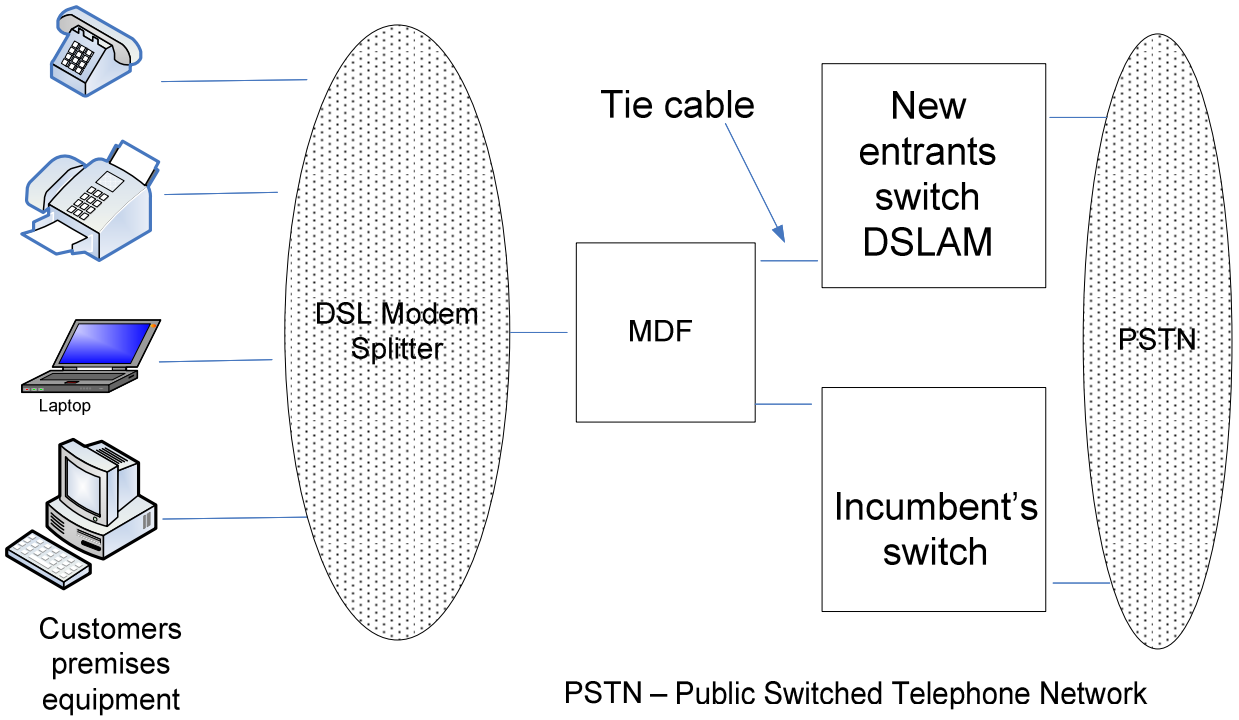

Figure 7: Full unbundling method (Adapted from [29])

10.1 Line sharing

Line sharing takes place when the incumbent retains the use of the local loop for its baseband, PSTN service, but unbundles the higher frequency part of the spectrum for use by another DSL operator [29]. Figure 8 explain that the new entrants share the line with the incumbent and it can also be viewed that the new entrant maintains only the broadband line while the incumbent retains the voice channel. The following points can be deduced from the line sharing method [29]:

- The incumbent maintains control of the copper pair.
- The incumbent provides some services to the subscriber while allowing a new entrant to have part of the copper pair spectrum to provide services to the same subscribers.
- Line sharing enables the incumbent to continue with voice services while new entrants provide broadband (xDSL) services on the same copper pair.
- With line sharing, the competing supplier uses the non-voice frequency of the loop.
- Consumers obtain broadband service from the most competitive provider without installing a second line.

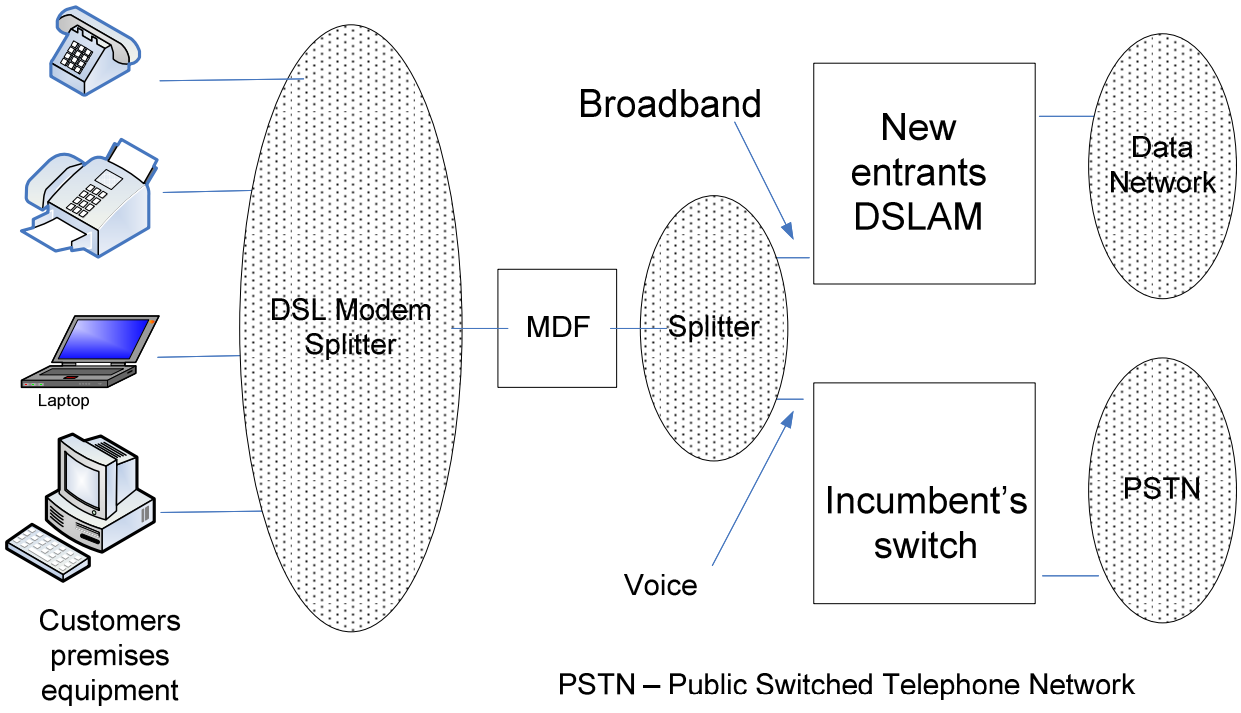

Figure 8: Line sharing method (Adapted from [29])

Although line sharing is relatively cheaper when compared with full unbundling when it is implemented, it has some shortcomings which are discussed in [29] are:

- It faces technical interface problem when the incumbent is not open to presenting the available interfaces to the new entrant.
- Implementation of ADSL with telephony and with ISDN uses different spectrum allocations so that different equipment may be necessary for both the splitter and for the ADSL.
- Line sharing may slow down the speed of digital access due to “frequency unbundling”.
- Line sharing may cause “crosstalk” due to high-speed data being run along adjacent telephone lines. Crosstalk is a phenomenon that occurs when one wire creates noise into the next wire, interfering with the signal and resulting in slower data transmission rates [31, 32].

10.2 Bitstream access – wholesale access

Bitstream access method emerged when there was an introduction of the Internet when Internet Services Providers (ISPs) realised a new requirement for separate data access to subscribers. To support this new need, broadband was implemented by incumbent operators. Therefore, with bitstream access method, the incumbents provide a whole data service for ISPs to service the fast growing Internet market. Bitstream access method is automatically established when the process of LLU is conducted while the incumbent has implemented the broadband network. Figure 9 shows the bitstream access configuration where the incumbent operator installs DSLAM into its local exchange to upgrade the wires to carry broadband services.

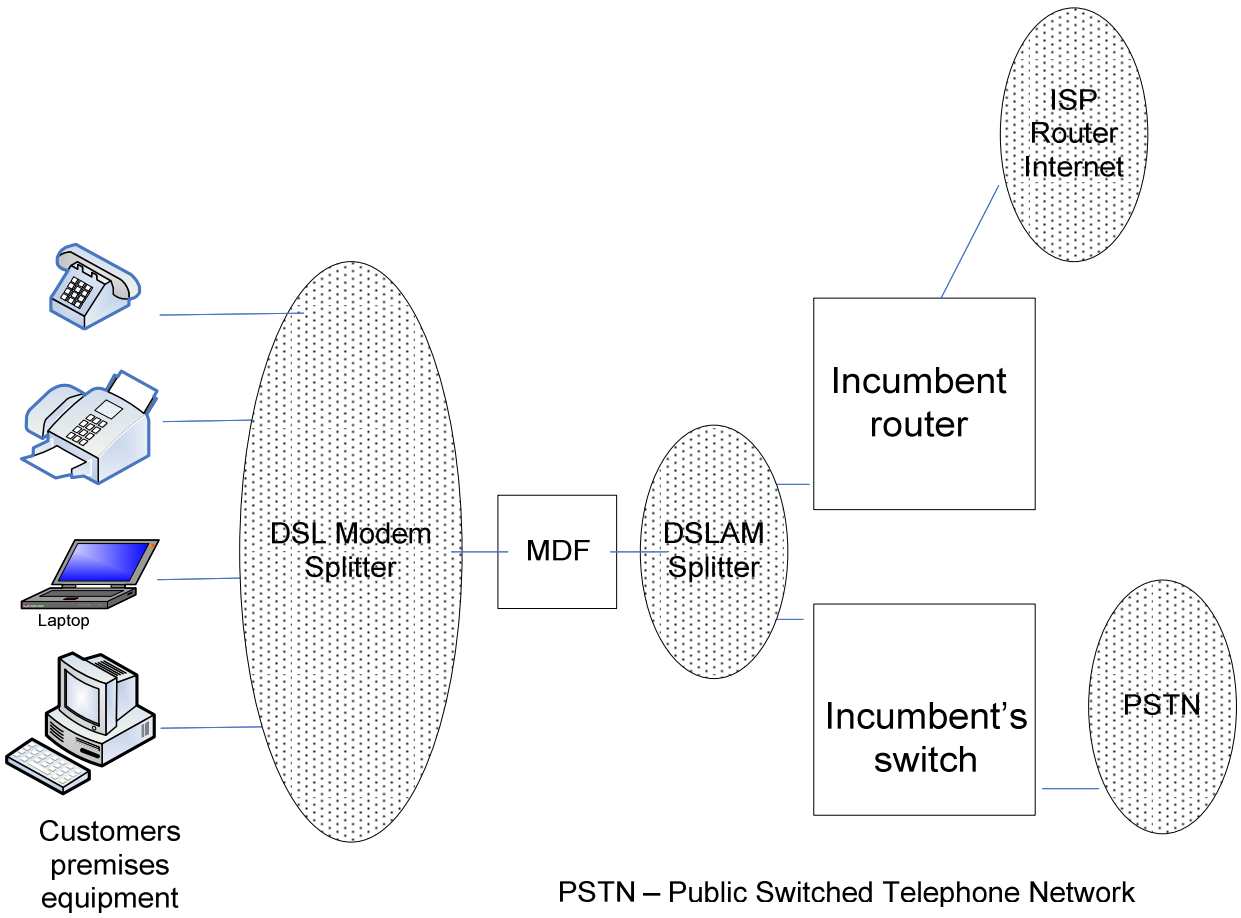

Figure 9: Bitstream access method

The bitstream access method has been found to present the following issues to note [11]:

- Bitstream access offers ISPs with wholesale xDSL service from the incumbent.
- The incumbent preserves control over the subscriber's line but allocates spectrum to a new entrant.
- The incumbent supplies modems and ADSL technology in order that new entrants do not have management control over the physical local loop line.
- Different to full unbundling and line sharing, the new entrants can only offer the telecommunication services that the incumbent selects.
- New entrants are not permitted to add other equipment.
- There is no competition at the physical layer.
- There are no encouragements for the incumbent to install new technology.

- A low level of service-based competition can be expected for the new entrants because they can only gain access to the system that the incumbent opts to put into practice.
- The incumbent handles the spectrum management between operators.
- This method is not preferred by new entrants although it is a preferred choice for ISPs.
- For concurrent use of xDSL technology by more than one operator, there may be complications in operating at the same time and the definitive source of disturbances may be complex to identify.

Bitstream access can be agreed upon with one of four options that prescribe where equipment is positioned with respect to incumbent's premises. The options described are also based on what equipment the new entrant is bringing to the unbundled loop. A description follows of the four options that one gets in using bitstream access [1-20].

10.2.1 Resale of local traffic services

Resale of local traffic services is a type of bitstream access whereby the incumbent operator sells traffic services to new entrants at a wholesale price and the new entrants resell those services at a retail price.

10.2.2 Bitstream with collocation

In the case of bitstream access with collocation, admittance to the incumbent's premises is designed in such a way that collocation automatically included.

10.2.3 Bitstream without collocation

Bitstream without collocation is bitstream access at a point of interconnection outside the incumbent's premises that is arranged in such a way that collocation is excluded.

10.2.4 Resale of access services

Resale of access services is a bitstream access whereby the incumbent sells access services to new entrants but at a wholesale price.

It should be noted that in the bitstream with collocation and bitstream without collocation, the incumbent leases access to its broadband network. This means that new entrants do not install DSLAM. The incumbent is required to sell its retail local and access services on a wholesale basis to new entrants [6].

10.3 Sub-loop unbundling

Sub-loop unbundling applies when some, though not all, of the copper loop from exchange to customer is leased to another party. This may be the typical mode of operation with very high speed data connections, where the unbundled loop is taken from a cross-connection point within about 500m of the customer and fed there from an optical back-haul by the leasing operator or service provider. Literature studies show that currently sub-loop unbundling is uncommon in most countries, though it is now a requirement in terms of the European Union regulations in anticipation of growth of very high bandwidth services [33]. Sub-loop unbundling is more extensive and intricate than other models as it lets the attainment of access to the incumbent's network on an unbundled basis closer to the customer than at the MDF [16].

11 Technical Limitations of Local Loop Unbundling

The incumbent operator may be reluctant to cooperate on the local loop unbundling due to business or other reasons but that can be covered in LLU business strategies and appropriate regulation. This report presents some technical limitations of LLU as they may slow the speed of implementation. The technical limitations are [7]:

- The new entrants will be compelled to reorganize their network at the risk of making unprofitable investment, in situations and areas where the incumbent attempts to supply digital line carrier (DLC) technology in local loops after the deployment of the new entrants' xDSL services in the exchange area.
- Employment of LLU depends vitally on the pace at which the incumbent improve its MDFs.
- xDSL services are controlled by the length of the copper loop from the premises of end users to their local exchanges. It is therefore complex to implement LLU in rural areas where the distances of the copper local loops are estimated to vary beyond 8 km, which degrades the broadband services and increase cost [34]. The issues that need to be considered for areas that fit the characteristics of rural areas should be addressed by ICASA as they include regulatory framework are [34-36]:
    - What are the lengths of local loops in rural areas?
    - What are the lengths of locals loop in other areas?
    - How LLU can be easily implemented in rural areas?
    - What should the incumbent do in rural areas?

    - What should the new entrants do in rural areas?
    - The adaptability of xDSL has limited value to customers and so they may ask: what are they buying and how will it perform?
    - What needs to be done in places where fibre access is already installed?
    - What are the other available technologies similar to copper loops [37]?
- When the unbundling process is in progress, the incumbent might place an upper limit on the number of local loops that it can technically unbundle in each local exchange per day in the process of disconnecting and reconnecting the lines. This brings about the following doubts that need to be addressed for an effective LLU process [38, 39]:
    - What should the rate of unbundling the local loop be?
    - What have other countries done to overcome this?
    - By whom and how is the unbundling cost covered?
- xDSL modem must electronically match the digital interface at the remote terminal, so that new entrants will not have difficulties providing their own broadband services if the incumbent seeks to limit the equipment that can be placed at the terminal.

Shortcomings emanating from practical execution may be solved by negotiating suitable contracts in the regulatory framework. The cost of implementing LLU will need to be addressed in the regulatory framework to avoid the incumbents wanting new entrants to recover the costs and hence burden to customers or fail to unbundle the local loop.

- In the situation where the incumbents decide to extend fibre beyond the local exchange to the user's premises, the exchange area is usually converted to a digital carrier transmission (DLC) standard and consequently the following issues may arise [1]:
    - Boundary point between copper pairs and fibre will be situated in an access junction or cabinet in the street.
    - The copper pair of the local loop will end at the point between the local exchange and the user's premises instead of on the MDF.
    - Fibre-in-the-loop systems may enlarge if the incumbents make available more DLC systems to sustain their own broadband services.

The incumbent may arrange its local network on the customer side of the local exchange in ways which may produce obstacles to LLU at the MDF of that local exchange. Generally, the incumbent may according to references [29, 30, 36, 38, and 39] have:

- *used "pair gain" configurations*. While copper continues to end on the MDF at the local exchange, pair gain technology enables a multiplication of the number of pairs at the customer end compared with the local exchange end. For example, there may be 48 copper pairs at the customer end but only 24 copper pairs ending on the MDF in the local exchange. The "multiplied" copper pairs at the customer end may be used to serve many different customers, only one of which may be interested in the alternative direct service provided by a competing carrier; or
- *extended fibre beyond the local exchange towards the customer premises and converted the exchange area to digital loop carrier transmission standard (**DLC**)*. As a result, the copper pair connecting individual customer's premises supplied by a local exchange will not terminate on the MDF in that local exchange but at some outside point between the local exchange and the customer premises called a "remote terminal". The interface point between the fibre extending from the local exchange and the copper pairs will include equipment such as a concentrator or multiplexer. This interface point will be situated in an access hole or cabinet in the street. The connection between the remote terminal and the exchange usually will be by a fibre or E1 lines (using HDSL technology) which will concentrate 30 voice lines in digital form.

12 Implementation of Local Loop Unbundling

Implementation of LLU requires the incumbent, new entrants and regulator to be committed to the success of the process.

On the part of the incumbent to [38, 39]:

- Avail preliminary information necessary for the implementation of LLU process.
- Allow collocation to permit new entrants to install their equipment on the incumbent's premises.
- Permit connection of collocated equipment to the networks of the new entrants.
- Provide for inspection and monitoring of physical premises and services provided to new entrants.

- Grant for proper planning to ensure that technical standards are met.

On the part of new entrants, to [38, 39]

- Supply of the information on how they are going to enter the market in terms of equipment to be used in the local loop and other specifications. This, however, renders the new entrants to a disadvantage, fearing that they are exposing their business plans.
- Supply information on how they will be able to service the customers.

On the part of regulator [35, 38, 39]

One of the functions of the regulator is to establish ways to motivate the incumbent to implement LLU process. Creating such an incentive is even more difficult when the incumbent is already providing xDSL services as is the case in South Africa. Therefore implementing the LLU process should include the following recommendations [40]:

- A delivery schedule should be established with defined and binding milestones and timeframes.
- The delivery schedule should cover both urban and rural areas as well as both residential and business sectors in which there are reasonably firm proposals by new entrants to use LLU process.
- Other exchanges not in the initial delivery list would only be conditioned if a request was received from one or more new entrants.
- Space availability: the incumbent may claim that the exchange space is constrained while the new entrants will be sceptical of the responses by the incumbent. It is therefore advised that the regulator ICASA should establish a process to confirm the space availability in the incumbent's premises so that such information can be used in implementing the LLU process with the least complaints.
- Structural integrity: the equipment installed by the new entrants will add to the floor loading of the exchange building, especially if there are multiple new entrants sharing the space. The incumbent may desire to conduct a review of the additional floor loading and new entrants may consider these studies as a chance to hold-up the unbundling process.
- Environmental system: the new entrants' equipment will need to operate in a stable, controlled environment, as does the incumbent's own equipment in the exchange building. As with

structural integrity, the regulator ICASA will have to make sure that such environment is available within a specified period.

- Ducting and MDF capacity: an assessment will need to be conducted on whether there is enough space for the external tie cable if installed by the incumbent, and the internal tie cable between the collocation space and the MDF.
- A detailed flow process, including all relevant issues such as space requirements, for applications for collocation space will need to be developed.

On the part of the local loop

Unbundled local loop elements from which access may be offered should be covered, in particular the following elements [38]:

- Raw copper local loops, which are copper infrastructure terminating at the local exchange.
- Sub-loops, which are copper infrastructure terminating at the remote concentrator.
- Non-voice frequencies of a local loop, which are high frequencies band, in the case of shared access to the local loop.
- Space within an MDF area of the incumbent for installation of the DSLAMs and similar types of equipment to the local loop of the incumbent.

On the part of the regulator's knowledge [20]

- All pertinent aspects concerning the local network architecture and information regarding the locations of physical access sites and the accessibility of copper pairs in specific parts of the access network.
- Technical characteristics of copper pairs in the local loop, including lengths of the loop, diameters of the copper pairs, loading coils and bridged tabs, line testing, conditioning procedures, condition for xDSL equipment, splitters, spectrum limitations and electromagnetic compatibility.
- Procedures such as line investigations for relevant xDSL technologies, provisioning and ordering process, usage restrictions.

On the part of collocation services [20]

- Information on collocation sites: in particular the precise locations of the incumbent's relevant sites, including exchanges, MDFs, concentrators, and remote points such as street cabinets, pedestals and vaults. Requirements of the reference such as the website where the updated list of locations is published. Availability of alternative collocation site when physical collocation is not available.
- Available collocation approaches and the accessibility of electric power and air-conditioning facilities at these sites as well as the relevant rules for sub-leasing of collocation space.
- The characteristics of the equipment that can be collocated such as capability, efficiency, restrictions, etc.
- Measures put in place by the incumbent operator to ensure the security of their locations is guaranteed, conditions for access by the staff of competitive operators in order to identify and repair service problems.
- Safety standards by the incumbent should be considered sufficient for the competitive operator's equipment taking into account the general safety laws of the country.
- Conditions for the operators and ICASA to inspect the locations at which physical collocation is available, or sites where collocation has been refused on grounds of lack of capacity.

On the part of operational support systems [17]

- Specify circumstances for right to use the operator's operational support systems, information systems or databases for pre-ordering, ordering, provisioning, maintenance or repair requests and billing.
- The operational support system (OSS) factors scheduled must cover the right of entry to all local loop qualification information. These should include the capacity of the local loop in question to support advanced telecommunication services.
- Service level agreements with the relevant service providers for electricity, air-conditioning, fire protection, disaster recovery solutions etc especially because of the shared physical environment.

On the part of deployment conditions [17]

- Lead time for reacting to demands for supply of telecommunication services and facilities, as well as contractual payment presented in case of failure to satisfy time frames, service level agreements, fault resolution and escalation procedures.

- Prices for each attribute, purpose and facility as well as one time and frequent rental payments.

13 Issues on Implementation and Customers Perspective

Implementation of the LLU is the final part of the entire process of bringing broadband applications and services which are beneficial to customers and giving new entrants the power to compete with the incumbent. This section presents issues which need to be addressed before the implementation of the LLU process.

In the case of South Africa, Telkom SA is the incumbent operator. There are three issues that need to be considered with respect to Telkom SA in restructuring for the benefits of LLU process.

- Telkom SA allows the entire local loop to be used by other operators in providing telephony and broadband services.
- Leave the local loop with Telkom SA and regulate its use.
- Telkom SA must share the local loop with other players.

Whatever the model chosen, the regulator will have to motivate LLU to be smoothly implemented. The following are strategic issues that, when answered, will provide a clear understanding of the model that can be used to attain the benefits of LLU for the incumbent, new entrants and customers:

- What is the right role for the incumbent in the broadband services market itself [41-46]?
- What are the separate business units of Telkom SA and what do they own?
- How many entrants should be admitted to the market?
- Is it wise to be cautious in the introduction of innovative technology [47]?
- How useful is unbundling for new entrants?
- What is the relation between unbundling and investment in new access infrastructures [48-49]?
- What is the cost of the local loop?
- How desirable is unbundling for the end customers?

For a model where the incumbent operator will be competing with new entrants, the significant questions that surface are [50-52]:

- What is the fixed cost of connecting with the different loops of the incumbent?

- What are the costs of back-haul to their network entry points?
- What are the costs per line?
- What type of collocation is to be used and how is it paid for?

Customers' perspective

On the implementation of unbundled local loop customers will be able to select an operator of their choice through carrier pre-selection procedure as proposed by operators and approved by ICASA.

14 Incumbents' Attitude – based on foreign experience

The incumbent's attitude is another aspect that requires special attention in planning for LLU. Based on experience from other countries in Europe and North America, the incumbents' possible attitude can be put into one of three categories [1]:

- The incumbent wishes to prevent or delay for as long as possible the implementation of LLU and DSL within its own or anyone else's product ranges. Such attitude requires the regulator to work decisively [1].
- The incumbent accepts the technology, though with a determination that it will dominate and control the market for DSL based broadband products. The incumbent will resist to the maximum possible not the technology but competition and unbundling [1].
- The incumbent recognizes the new market, views competition as a means of growing the market for the common benefit, and co-operates in encouraging it. This attitude has been seen in Germany [1].

15 Strategic Issues for Local Loop Unbundling

The handling of LLU by regulators requires a fine and delicate balancing of strategic issues, as well as discretion, bearing in mind the local situation and the prevailing incumbent operator's attitudes. The primary purposes of the regulator should be, to ensure that consumers enjoy the best possible products at a reasonable price and to encourage the optimal level of competition in the provision of those services. On the one hand, unbundling can stimulate the development of a soundly based, competitive

broadband service market over the incumbent's access infrastructure. However, unless loop prices are very carefully weighed, it may encourage inefficient players into the market and deplete investment by the incumbent while simultaneously deepening its dominance.

The xDSL technology offers an attractive proposition to businesses in the form of data transmission at 2Mbit/s over ordinary copper loops, which ought to allow them to make substantial savings on the cost of expensive leased private circuits, access to data networks or providing multiple exchange line capacity. The basic regulatory approach to local loop unbundling is to use licence conditions, typically insisting that players with SMP provide services in unbundled local loop.

15.1 Interference

The deployment of xDSL services over twisted pairs involves the use of bandwidths much higher than would otherwise be used for voice and these higher bandwidths can cause interference to signals on other twisted pairs within the same cable. This interference, is caused by electromagnetic coupling between unshielded twisted pairs, has the potential to unacceptably degrade the performance of telecommunication services deployed over that cable.

Both operators will agree that the deployment of additional xDSL services in a cable should not degrade the performance of existing xDSL services in that the same cable and that existing xDSL services in a cable should not degrade the performance of additional xDSL services to be deployed in that same cable. However, the incumbent may claim that certain xDSL technologies cannot be used because of interference issues. In addition, the incumbent will treat the ability to upgrade its network as it sees fit, for instance increasing the penetration of optical fibre throughout the customer access network, as an absolute right. However, this has a direct impact on the deployment of xDSL services which require uninterrupted copper. As a result, the point of deployment of xDSL services will be progressively forced from the local exchange out to remotes. This tends to favour the incumbent which is typically better prepared for such deployment having, in most cases, already secured planning approvals and established facilities. A further complication results from the fact that deployment of xDSL services from a remote may in some circumstances interfere with services deployed from the local exchange to the point of effectively preventing deployment from that local exchange.

One way to ensure the effective usage of the unbundled local loop is to define a set of deployment rules and performance benchmarks specifying which xDSL service may be deployed and in what manner, for

example taking into account of distance and speed limitations, so as to make sure spectral compatibility between services and to ensure minimum performance benchmarks are achieved and that overall network integrity is maintained.

- The regulator ICASA needs to produce a frequency spectrum management guideline, which ensures that the quality of service is not degraded.
- The regulator ICASA will also be responsible for the development of technical guidelines in relation to the deployment of telecommunication services in the county.
- The incumbent may be required to submit to the regulator plans for the already deployed xDSL services and how they are going to be managed in an unbundled competitive environment.
- Specifications about the copper pairs used by the incumbent should also be available to the regulator.

15.2 Technical incompatibility

The problem of technical incompatibility occurs when the incumbent's copper network is inappropriate for LLU in a given area because of reasons such as the copper pair to a customer's site is too old or the size is too large. In this regard and in regard to other issues associated with the unavailability of good copper network in some areas, the following will need be provided and be known to the regulator [1]:

- Quality of the copper wire as well as features such as age and material characteristics of the copper pairs
- The presence of loading coils and other devices in the local loop.
- The length of copper from the local exchange to the customer's premises. Distances of more that 3-5 kilometres can be a problem and affect the suitability of copper being used to support xDSL services. Urban areas may not be the issue but rural areas can be of great concern.
- The plan of the incumbent to upgrade its network by extending fibre beyond the local exchange towards the customer's premises.

15.3 Provisioning

Provisioning is the process by which a new entrant orders LLU services from the incumbent to connect an individual end user's premises to the new entrant's own network [1]. The criticisms normally

attended to from new entrants are related to those which come up in the way of provisioning leased capacity, and relate largely to the timeliness of provisioning and the complication of the process.

The first step is to get a picture of the provisioning process before considering whether there are problems with the process. Confirm whether the provisioning process is the result of multilateral process or bilateral negotiations. The following may need to be considered in picturing the provisioning process [16].

- Forecasting: Are new entrants required to forecast their own anticipated requirements and what requirements are needed to facilitate the forecasting process? Forecasting may be given for specified time period and updated on a rolling basis. It is important to understand the financial consequences if the new entrant under-forecasts (demand exceeds the forecast) or over-forecasts (the forecasts exceed demand).
- Ordering: a description of the process of ordering, detailing the main steps and timeframes is needed. This should be bound with the acknowledgement by the incumbent that an order has been received and specify the minimum lead-time to fulfil the order. In under-serviced areas, what is the process to be followed to ensure the construction work to install new pairs for the local loop?
- Charges: in a case of rejection because of errors or cancellation of orders, will there be separate charges for such cases?

15.4 Collocation

Collocation is the process locating equipment of the new entrant at the incumbent's telephone exchange area to connect to the individual unbundled local loop (ULL) in the telephone exchange area. Usually this equipment will consist of transmission equipment and fibre which connects the exchange to the new entrant's exchange and routers located in another building, usually across the town. The equipment which must be collocated is not of large dimensions, and probably can be accommodated in 1 or 2 equipment racks the size of a stereo wall unit.

The key issues that need to be taken into consideration include [1]:

- the claim by the incumbent that there is no space in the relevant exchange;
- the application of overly onerous technical requirements on the competitor's equipment as opposed to the equipment used by the incumbent itself;

- discriminatory security measures;
- the requirement by the incumbent that the competitor takes a minimum amount of space or that the incumbent has caged collocation as opposed to cageless collocation;
- the requirement that a competitor cannot interconnect with other competitors within the exchange or that if the two do interconnect, the interconnections must be purchased from the incumbent;
- the allocation of all site preparation costs to the first competitor regardless of whether all costs are attributable to that competitor;
- failure to allow collocation in adjacent buildings;
- lack of provision of information on space availability;
- if new collocation arrangements have to be negotiated, can that be done in a multi-lateral forum or bi-laterally?
- what is the provisioning lead-time on getting collocation space in an exchange building and what are the main steps?

15.5 Cutover

Cutover is the process by which an individual line is disconnected from the incumbent's network and the line is then connected to the new entrant's network [1, 3]. The process involves a short duration and complete outage of the customer's service. The customer actually loses a dial tone and cannot make calls and these impacts on revenue. This process is unlike the number portability processes in resale/pre-selection where the customer remains connected to the same network, but a change is made in the designation of their retail provider in the billing system or the exchange support databases. Obviously, the longer the process takes or the more problems will arise, the greater the inconvenience to current customers.

There should consequently be a comprehensive project plan which illustrates the process of cutover of ULL lines. Typically this will be conducted by physically disconnecting the line at the MDF in the local exchange and connecting it to the new entrant's network. This process is usually undertaken by the incumbent's technicians. From the literature [1-20] the plan should clarify the following issue

- What is maximum timeframe within which the cutover is to occur?

- During what hours are cutovers normally organized? When out of normal working hours is considered, it should be known that there will be out-of-hours charges by the incumbent.
- A description of the co-ordination mechanisms between the incumbent's technicians and the new entrant's technicians.
- Reversal procedures if the service cannot be activated on the new entrant's network.
- A minimum cancellation notice for the cutover process to take place.

15.6 Local number portability (LNP)

On one hand, many customers who are provided telecommunication services by the new entrants using LLU will want to take their telephone numbers with them when migrating from the incumbent's network [53]. On the other hand, if the customer wishes to reconnect, then the unbundled local loop will need to be reversed and the number reported [53]. The LNP process is expected to have been possibly agreed upon separately and at an earlier time than the unbundled local loop. The correlation between the unbundled local loop ordering process and the LNP process needs to be understood in advance. If the two processes are not completed together, the customer may end up connected to one network whilst the telephone number is linked with the other network. The true number may have been left in the previous operator or changed ahead of the unbundled local loop cutover. In both cases, people calling the number will not get connected to the customer and this can have serious implications particularly for corporate customers and for emergency calls.

15.7 Fault detection and repair

It is vital to comprehend how the incumbent operator and new entrants deal with the fault reporting and repair process and the allocation of responsibilities between the two operators. A key issue is who is responsible for receiving end user fault reports [1]. This is particularly important where there is line sharing and the customer maintains a relationship with both operators [3, 7]. What is the responsibility of the operator that receives a fault report about the service being offered by the other operator? Another key issue is that once a fault report has been received, who is responsible for diagnosing the fault and testing the relevant network elements? Again, this may differ depending on whether the new entrant has control of the entire loop or whether it is sharing the loop with the incumbent. Once the fault has been identified, who is responsible for repairing the fault and what service timeframes are offered by the incumbent to the new entrant? Does the incumbent require a particular level of

specificity in the trouble reports before it will accept them and how does the incumbent prioritise fault repairs? Are certain types of customers, for example large corporate customers, prioritised ahead of smaller customers such as residential customers? Are the priorities informed by Service Level Agreements? Is there a baseline of service offered by the incumbent and can the competing entrant request and pay for higher priority service? Where the incumbent is required to have contact with the new entrant's customer, to repair a particular fault, what are the processes for co-ordination between the two operators and the customer? What requirements are placed on the incumbent's use of the competing carrier's information about the customer? This means that the incumbent will not use the information to attempt to win back the customer or to disparage the new entrant? What other information is the competitor able to access on the repair process? For example, how frequently can the competitor update itself on the progress of the fault repair? Is the incumbent required to provide financial penalties if it fails to meet repair deadlines? Answers to these questions have been given to some extent in the literature [7].

15.8 Line sharing

Line sharing involves the provision of xDSL-based service by a new entrant and voice band service by an incumbent for example on the same copper local loop [1].

The line sharing in the EU is mandated by the LLU Regulation as well as in the US.

Line sharing requires the incumbent to provide access to the high frequency portion of the local loop which can support the xDSL based services. While ADSL is the most common xDSL based technology which can be used in conjunction with voice, there are other xDSL based technologies being developed that can co-exist on the same local loop. In order to provide line-sharing, the carrier must separate the two streams of traffic, the data channel and the voice channel, when they reach the exchange [1, 3]. This is generally performed by two items of equipment: a Digital Subscriber Line Access Multiplexer (DSLAM) and a splitter. A splitter is installed at each end of the shared line to separate the broadband and narrowband paths. The DSLAM sends the customer's voice traffic to the public circuit switched network and the customer's data traffic to a packet switched data network. The incumbent may be worried that transmitting incumbent voice band traffic through competitive facilities could result in voice band service deterioration, while new entrants may convey similar fears in relation to their xDSL traffic [21].

16 Economics of the Unbundling Local Loop

The LLU process usually results in the increase in regulation. The LLU also impacts on prices and it may vary depending on the region of operation resulting in more costs for the incumbent when implemented.

16.1 Costs of LLU

The incumbent operator may incur costs in implementing LLU and these costs require to be recovered through prices charged to new entrants. These charges can consequently be the fees that subscribers pay when using the services. There are three kinds of costs that the incumbent may incur [18, 51]:

- A once-off cost for line implementations
- Charges for the access of telecommunication facilities, such as [51]:
    - monthly line rental charges,
    - line repair, and
    - maintenance.
- Collocation costs including [22]:
    - the cost of renting space,
    - site preparation,
    - exchange site surveys,
    - utility usage and
    - security.

Additionally, as with any regulatory policy, mandating the incumbent to permit the new entrants right to use their local loop infrastructure by availing the local loops on an unbundled basis has both costs and benefits. The development of the market will be influenced by many issues that work together in an intricate manner in shaping exactly how competition will increase ultimately. These factors are the ones such as [9]:

- The demand for existing and new telecommunication services,
- Issues affecting the cost of commissioning alternative access networks, such as the population distribution,
- The regulatory framework that determines the incentives faced by the incumbents and new entrants to invest in infrastructure, offer services and develop new markets.

The critical principle of cost orientation on pricing for access to the local loop implies that telecommunication services have to be priced on an individual basis such that prices are aligned with costs, experienced from many limitations. The tendency for the incumbent operator is to charge out all costs and to overstate costs and charges. This also inflicts a profound information load on the regulator in the sense that the asymmetric flow of information between regulator and the incumbent is the main hindrance.

It is important that the costing and pricing rules for local loops and related facilities should be fair. Setting such an environment requires a regulatory muscle and an honest participation of the operators. Pricing rules that the regulator should ideally set should make sure that the local loop provider can cover its appropriate costs in this regard with a reasonable return on investment. These pricing rules for local loops should foster fair and sustainable competition where strategies such as investing in technology and services are a cornerstone for success. Furthermore, they should ensure that there is no twisting of competition, in particular that there is no unfair discrepancy between prices of wholesale and retail services of the notified operator. The offer should be adequately unbundled that the customer does not have to pay for network elements or amenities which are not necessary for the supply of its services. Furthermore, the sale provisions must have a description of the details on the offerings as well as terms and conditions. Experience shows that the regulatory intervention is an effective mechanism for reaching agreement on technical and pricing issues for local loop access [1]. Another factor which can have a positive impact on reduction of prices is the use of technological innovation.

16.2 Impact on prices

The topic of unbundling carries in the requirement for a balanced subscriber prices especially the fixed subscriber line charges to ensure that they reflect costs incurred [50, 51].

- Re-balanced prices are central for new entrants desiring to exploit unbundling. The regulator has to investigate how re-balancing of prices process is structured and conducted and how it should not result in unfairly increasing prices in subscriber's monthly accounts [50].
- LLU costs vary depending on the region and as such there should be a geographical harmonization of subscribers' line charges. These categories are known to affect the costs of communication services and therefore may be used as categories to average the subscriber line charges [34]:
    - Business areas / Residential areas

- Urban areas / Rural areas
- Under serviced areas.

The prices are dissimilar for different implementation models. In the case of line sharing unbundling, the incumbent remains the provider of voice, thus new entrant does not have to pay for fully unbundled lines. The rental charges may vary according to the number of connections that are offered to a new entrant by the incumbent [1, 3, and 17].

- With different categories such as rural areas and urban areas, a geographic de-averaging of prices should in principle be supported and encouraged in order not to expose the incumbent from having to supply unprofitable loops in rural areas whilst new entrants self-benefit in low cost areas [73]. However, the approach to de-averaging requires to consider the demands of realism and efficiency provision as may be found in areas such as those in commercial, residential and under-serviced areas. Consequently, there should be broad price bands within which prices would vary to reflect the broad divergence in cost, but for which prices would be averaged. For an example, one price band can be set for urban areas, another price band be set for rural areas and another be set for under-serviced areas [34].
- The residential and business sub-categories may have a sub-price band that is averaged in a different way for urban areas as opposed to rural areas or for under-serviced areas [34].

16.3 Interconnection charges

Interconnection charges are viewed in the literature as the most vital issue in regulation of telecommunication sector [51, 68, and 69]. They are significant for fostering competition and securing return on investment in the incumbent's facilities in an optimized manner. The terms and conditions, on which a new entrant is interconnected, are crucial for its ability to successfully and fairly compete with the incumbent in the unbundled space. In this respect price setting is a vital parameter although not the only parameter to ensure a fair and competitive playing field [70]. To achieve healthy returns on investment for the incumbent's telecommunication facilities the temptation is to charge high interconnection fees.

These interconnection charges must be regulated to encourage competition [70]. In addition, new entrants must be given access to existing network facilities under conditions that facilitate competition on a fair basis [71]. It is essential that interconnection rates be competitive so that they do not dampen

investment in new network facilities and hold-up facilities competition. In order to maintain the equilibrium between regulation and investment in facilities, concepts like Long Run Average Incremental Cost and Total Element Long Run Incremental Cost must be developed and implemented [1]. In analyzing the impact of interconnection charges, central issues that should be put into consideration are matters such as how the level of competition will be affected by the level of interconnection charges in the short and long run as well as how the level of interconnection charges and the level of competition affect investments [23-24].

16.4 Challenging economic issues

In unbundling the local loop there are economic issues that have been debated in Europe, America and Asia as being the challenging issues [1-20]. These issues are either static or dynamic [25]. A static issue is that, whereby the existing local loops, access to these loops should be available to the particular new entrant who would make most efficient use of them. It is not easy to anticipate in advance how a particular operator will be able to efficiently use the local loop. The relevant questions that ought to be asked are [25]:

- Should the investment in future local loops be promoted by the promising prices that enable an anticipated proper and fair return on investment?
- In order to encourage any type of competition in the local loop is it vital that competitors have access to the existing local loops and make efficient use of them rather than build their own?

It is expected from the extensive literature conducted by the Local Loop Unbundling Committee of South Africa that competition from unbundling the local loop will emanate from the provision of broadband services [1-61]. The existing copper pairs using xDSL technologies can supply voice and broadband services [71].

It is important to note that technological alternatives will arise in the future to compete with the local loop copper infrastructure by supplying fast and reliable data and voice. A challenging issue here is for the regulator ICASA to come to a decision on the period the unbundled local loops should be made mandatory.

16.5 Comment on the economics of the LLU

This statement is concerned with the broad economic implications of LLU, especially for the pricing of telecommunication services and the possible benefits that may accrue to society due to the unbundling of the local loop [1, 9, and 62]. As a departure point, it is vital to understand the current structure of that component of the incumbent's telecommunication value chain that is considered for unbundling.

A naive pricing model supposes that in a given area, the monopolistic incumbent can make available as much or as modest services as it desires, and does not take into consideration the advantages to the network and the economy or even the social benefits of adding more customers. The model assumes additionally that the incumbent Telkom is reluctant and will only add an additional customer in a local exchange area if there is financial gain for the incumbent. This basic model is based on a belief that the incumbent functions entirely as a revenue-maximizing monopoly, when providing its selected quantity of land-line services in an area. Consequently, if it was permitted to choose the quantity of services it offers, despite the actual demand in the area, it will seek only to optimise its profit earnings.

The unbundling process tries to foster competition among services providers, as well as the incumbent itself. Nevertheless, for this process to be successful, the new entrant must have access to the production technology that ensures that the incumbent benefits from the observed scale of economy. *Put differently, the incumbent must split approximately the same cost structure as the new competitors.*

We now presuppose that the unbundling process results in the transfer to a neutral institution under the control of ICASA the local loop infrastructure. This institution may for example lease space and infrastructure on a fair basis. This basis may include the fact that the rental price is equal to the long run average costs of maintenance and space provisions of the local loop infrastructure. The unbundling process is consequently likely to bring into being the following effects [1-60]:

In the short run:

- **Sunk Costs [1]**: There will be costs linked with the implementation of the LLU process. These costs are once-off, and therefore they will not have any effect on the dynamics of the competitive scenario that will result from the unbundling process.
- **Long-run average costs increase [72]**: This increase in the short-run of average costs would be attributable to management adjustment. Until new management becomes skilled at how best to administer the technology, early inefficiencies are expected to happen. This will have a tendency to increase marginal and long-run average costs related with the provision of access to

the technology. On the other hand, over time, by their nature, these costs will go down. In addition, the extent to which they are a serious threat to the industry as a whole can be moderated by co-operation involving the incumbent and government to make certain that the new management of technology and skills are improved as rapidly as possible. Granted that there are plans that can be engaged to moderate these learning-by-doing costs, they are likely not to create severe pressure to the industry in the short-run.

In the medium- to long-run [1-10]:

- **Quantity demand for services rises**: For the reason of new entrants, there will then be option providers for telecommunication services. The consequential increase in service providers, as an outcome of lower entry barriers, will decrease the price per unit towards the long-run average costs encountered by each competitor as the quantity of telecommunication services offered by the industry rises.

- **Demand increases**: As a consequence of an increase in the provision of telecommunications services, it is anticipated that there would be advances in the efficiency of the economy as a whole. Economic activities that would be dampened under the current regime would start to surface. This would raise the economy's growth, which would move upwards for telecommunication services. This dynamic effect would persist until the stimulatory outcome of increased provision of telecommunications services on economic growth has been entirely exhausted.

Given the healthy growth of the economy in spite of the incumbent dispensation, it is anticipated that the resultant relentless upward shifts in the demand for telecommunication services would be sufficiently robust to maintain considerable investment in the sector. New entrants would consequently find it rewarding to penetrate the industry. Social welfare is also expected to progress as a consequence of the process. As the rental charge is expected for each competitor to be set as close as possible to the long run costs of providing access to the basic telecommunication infrastructure, the surplus enjoyed by consumers would increase. This surplus would also be increased as a consequence of a combination of healthy and robust growth in the economy and the encouragement of competition in the telecommunication industry. Robust growth without a major decrease in entry barriers in the

telecommunication industry is expected to engender higher telecommunication prices for customers, which may constrict the economy.

17 Local Loop versus Alternative Technologies

The process of unbundling the local loop is what is investigated in this report for the prospect of bringing competition, healthy product mix, innovative services and decreased barriers to entry [28]. The focus of this report is on the copper local loop which was usually acquired in an uncompetitive environment by the incumbent operator with huge subsidies from the government. Nevertheless, substitute technologies are discussed to point out how they can be of support in the understanding of the LLU process and the formulation of recommendations. This report is well conscious of other technological substitutes [54-60] and explains how to execute the LLU process in South Africa.

17.1 Alternatives for access to customers

The analysis of possible ways of deploying communication infrastructure and to get access to the customers indicates three major alternatives [1-60]:

(i). Construction of a new network infrastructure.

(ii). Unbundling of the local loop.

(iii). Alternative access networks.

17.1.1 Building a new network infrastructure

A fresh network infrastructure will typically devote an adequate amount of resources in terms of time spent and finances needed and as a result it is usually a costly course to be taken particularly when it is recognized that the incumbent acquired the network infrastructure in a non-competitive environment [1-62]. In order for the network operators to compete, building new networks may not be of priority in South Africa's case, where the goal is not just to get alternative operators but to create an environment that will foster affordable ICT participation.

17.1.2 Unbundling of the local loop

Unlike building a new network infrastructure, unbundling of the local loop creates an environment that allows new entrants to reduce investment into infrastructure. The new entrants can use the economies of scale and scope of the existing infrastructure to bring innovative services to customers in a fast and efficient manner. Utilizing the LLU course, the innovative services based on xDSL technologies are likely to increase and there would be an increase in the quantity of services supplied. In a competitive environment, operators can render services covering areas that are currently serviced as well as areas that are currently under-serviced. Taking advantage of the ULL customers can choose the services they want from the numerous services provided. Accessing customers by new entrants is simplified by the unbundling process.

17.1.3 Alternative access networks

Another important parameter for the evaluation of competition in the local loop is the development of alternative access networks [10]. There is no reliable procedure to evaluate which of these alternative networks is going to succeed in the PSTN and higher bandwidth services segments. Substitute access networks that can be employed include wireless based networks as well as cable networks. The presence of these alternative networks should not diminish the political will to implement the LLU process. In order to evaluate the alternative access networks, the next sub-sections will describe the assessment of these networks versus LLU.

17.2 Evaluating other access networks over LLU

Alternative technologies are matters of concern by operators and regulator when planning for the unbundling of the local loop. The report has put various alternative technologies for evaluation in order to highlight issues the regulator may have to incorporate in a process to implement the LLU procedure. With regard to the LLU three questions can be picked up to understand the association between alternative technologies and the local loop infrastructure. These questions are [1]:

(i). What are the available alternative access technologies for higher bandwidth transmission?

(ii). When are high bandwidth transmission technologies going to be available?

(iii). What are other uses of the copper local loop?

To answer the abovementioned questions, we need to look at the following other technologies that are presently considered viable alternatives.

17.2.1 Fibre-to-the-home (FTTH)

A solution that has been considered and even implanted in other countries [10] for high volume customers has been the use of fiber as a means of reaching customers instead of using the copper based local loop. However, it is not likely that a considerable increase in its use will occur in South Africa especially in places like the rural areas.

17.2.2 GSM/UMTS

GSM has experienced considerable improvements through the application of GPRS technologies. This has resulted in data transmission capacity increasing from 9.6kBit/s to 115kBit/s thereby enabling mobile data services [63]. UMTS can provide telecommunication services with capacity that vary up to a bandwidth of 2MBit/s. Currently in South Africa, an upgraded version of HSPDA has been deployed [64]. There are currently two major network operators in South Africa for these wireless technologies that can provide bandwidth of 2MBit/s. Access to customers for broadband services require mobile technology devices such as mobile phones, wireless network cards and computers that are compatible with wireless network cards. GSM/UMTS is not an immediate alternative access network for high bandwidths. Deployment of broadband services in most areas operated by incumbent operator can be much faster and relatively cheaper than the wireless technologies. The GSM/UMTS is commonly addressing the needs of higher end customers such as industries, banking sector and individuals of bigger organizations and therefore the requirements for rural areas particularly rural schools and hospitals are not catered for.

17.2.3 Powerline

Powerline technology is the supply of telecommunication services by using the electricity distribution network [10]. Powerline transmission of voice and data is one of the innovations, where a breakthrough has been advanced for years and broadband usage of these has been tested but successful implementation has not yet been achieved. Problems such as high noise to signal ratio and interference have been identified. It is expected that in the advent of new technology, these problems will eventually be solved.

17.2.4 Fixed radio access networks

Point to multipoint, e.g. wireless local loop, is utilized to provide a wider customer base while point to point access networks provide access for single customers with higher volume. The advantage of these

technologies is the construction speed, flexible usage and in several cases, moderately low investment costs [10]. The drawbacks are the necessary indivisibility and the scarcity of frequencies. At the moment, technologies developed thus far have not matured sufficiently to be commercially viable to compete with wired access technologies. Consequently, radio access cannot be viewed as a full counterpart of the unbundled local loop.

17.2.5 Satellites

Satellites networks are mainly used for the distribution of TV programs [65]. The provision of bidirectional services for the mass market goes along with high provision costs that cannot be the alternative access network. Currently, crossbreed solutions that use the usual PSTN lines where the satellite is used as a high capacity down link are available. The hybrid solution is provided as an effort to lower the high provision costs of using satellite technology. Therefore, satellite technology cannot be regarded as full alternative access networks.

17.2.6 WiMax

WiMax is a current buzz word in high bandwidth wireless technologies [66]. Even though not fully deployed, it is chiefly utilized as a backbone network. The last mile follows the same configuration as that provided by GSM/UMTS. WiMax technology as a backbone network can also be interfaced with conventional PSTN lines in order to provide broadband services to customers. WiMax is the best effort for high bandwidth in wireless technologies but cannot be regarded as an alternative to access network.

17.2.7 CATV networks

CATV [67] has not been used for the mass market in South Africa. It countries where CATV networks have been used to deliver TV services, it might be a potential alternative for the mass market. The prerequisite in those countries is the bi-directional upgrading of the existing CATV networks which is a major investment for CATV operators. CATV networks do not come cheap and involve massive work to install the network.

Subsequent to the assessment and a discussion of alternative technologies there are presently no considerable alternatives to the copper local loop. It is only the introduction of competitive environment in the local loop that will stimulate more benefits of the vast existing network infrastructure. The following table compares the options discussed previously to the unbundled local loop for new entrants. The criteria that have been used in the table for comparing the aforementioned technologies are [1]:

- Technology aspects. Is the option capable of providing bi-directional capacity from 114kBit/s to high bandwidth services?
- Costs. What investment structures are involved for every single option and what are possible market risks?
- Relationship to the core business. Are new skills, contracts and economies of scale necessary?
- Time frame. Is the option relevant now or in the near future?
- Regulation. Is there, in the current regulatory framework, an opportunity for new entrants to opt for the alternative access network?

Table 2: Local Loop vs. Alternative technologies [28]

Technology	Technological aspects	Cost	Relationship to the core business	Time scale	Regulation
Wireless Local Loop	• Flexible use • Scarce frequencies resources • Not fully developed for commercial use yet • Inter-visibility necessary	• Low investment costs for single transceiver stations. • Sound time-to-market relation • Coverage is affiliated with high costs(depends on the frequency band)	Yes	• Wireless Local Loop (WLL) short run. • Multi-distribution systems midterm	• Frequencies are scarce resource • Regulation for point to point connection is available • Auctioning of WLL and point to multi-point systems are in preparation
Satellite	• Asymmetrical and symmetrical transmission • Inter-visibility necessary	• High construction costs • High bandwidth (bidirectional) services are not affordable for the mass market	Only for a large operators	• available	• frequencies are scarce resource • No regulation framework

GSM/UMTS	• Stationary use allows high bandwidth(decreasing with mobility 144kBit/s – 2MBit/s)	• Costs are not assessable but generally does not address middle and low incomes	New entrants will be service providers only.	• available	• licenses for under service areas only available • Only four national operators
Powerline	• Currently low bandwidth available	• unknown	Hard to exist in the new entrants	• No technological breakthrough in sight	• Framework conditions are not clarified
CATV	• New infrastructure necessary	• Majority investment necessary	Can be available for CATV operators	• Can be a very length process	• CATV have no obligation for ULL

18 Legal and regulation framework

The legal and regulation framework was prepared using [74-77] and other documents such as the Electronic Communications Act No. 36 of 2005.

18.1 Introduction

18.1.1. Chapter 8 of the Electronic Communications Act no.36 of 2005 ("**the Act**")[1] sets out a comprehensive framework for electronic communications facilities leasing[2] which is necessary for the effective implementation of local loop unbundling ("**LLU**"), whether full unbundling, line sharing or bitstream access. Furthermore, section 43(8)(a) of the Act deems local loops and sub-loops to be essential facilities[3].

18.1.2. Implementation of LLU will involve, to a degree, a restriction on Telkom's right to use its property and therefore amounts to deprivation of property within the meaning of section 25(1) of the Constitution[4]. Section 25(1) provides as follows:

"***No one may be deprived of property except in terms of law of general application, and no law may permit arbitrary deprivation of property***"

18.1.3. Deprivation involves an exercise of the state's regulatory powers over property and is an interference or restriction on property, distinct from expropriation where the state compulsorily acquires the property, either for itself or to transfer to another. Where the state deprives a person of property it has no duty to pay compensation to that person.

18.1.4. However, section 25(1) of the Constitution curtails the power of the state to deprive a person of property by requiring that a deprivation of property must be exercised in accordance with law and due process. Section 25(1) sets out a two-step inquiry: the first involves an inquiry into whether the depriving law is applicable to all and not an individual or group of individuals?

[1] Act no 36 of 2006
[2] That is, the obligation to lease electronic communications facilities by ECNS licensees such as Telkom to seekers of electronic communications facilities
[3] An essential facility is defined in the Act as "*an electronic communications facility or combination of electronic communications or other facility that is exclusively or predominately provided by a single or limited number of licensees and cannot feasibly (whether economically environmentally or technically) be substituted or duplicated in order to provide a service in terms of this Act*"
[4] Act 108 of 1996

Secondly, the depriving law must not be arbitrary, that is, action that is '*capricious or proceeding merely from the will and not based on reason or principle*'[5]. The second part of the inquiry presupposes that a depriving law will be arbitrary if no procedural fairness is followed. The authors of "The Bill of Rights Handbook"[6]argue that where a discretionary power of deprivation of property is conferred by legislation, that power will be arbitrary if there are insufficient or inadequate legal criteria to govern its exercise.

18.1.5. ICASA's prescribing of local loops and sub-loops to be essential facilities as contemplated in section 43(8)(a) of the Act and concomitant regulations thereto will provide a mechanism by which Telkom SA may be lawfully deprived of its local loop.

18.1.6. The Bitstream topology is partly in existence, having come about as a result of the incumbent rolling out broadband network for Internet Service Providers ("**ISPs**"). While pricing regulation does not exist for bitstream access, the provisions of chapter 8 of the Act and the Competition Act[7] prohibiting anti-competitive behaviour are applicable to Bitstream access.

18.2 Unbundling Obligations

18.2.1. In terms of section 43(1) all ECNS licensees are under an obligation to lease electronic communications facilities, upon request, to any other person licensed (or exempted from holding a licence) unless the request is unreasonable or unless ICASA has found[8] that the ECNS licensee does not have significant market power in the relevant market or market segment in accordance with Chapter 10 of the Act (which deals with competition issues).

18.2.2. A request for facilities leasing is reasonable where it is technically and financially feasible and will promote the efficient use of electronic communications networks and services[9]. The obligation must include access to installations relevant to full access, the necessary support systems, information systems and any ancillary functions necessary for purpose of the access.

18.2.3. If a dispute arises as to the reasonableness of the request for facilities leasing, ICASA must make a determination[10]. If an ECNS licensee is unwilling or unable to negotiate or agree on terms and

[5] Beckingham v Boksburg Licensing Court 1931 TPD 280, 282
[6] Johan De Waal, Iain Currie, Gerhard Erasmus "*The Bill of Rights Handbook*", Fourth Edition, 2001, 420
[7] Act no 89 of 1998
[8] Section 44(5) of the Act
[9] Section 43(4) of the Act
[10] Section 43(3) of the Act

conditions of a facilities leasing agreement within the time frames prescribed by ICASA, ICASA may[11]:

18.2.3.1. impose terms and conditions consistent with Chapter 8 of the ECA;

18.2.3.2. propose terms and conditions consistent with Chapter B of the ECA which the parties can negotiate and agree upon; and

18.2.3.3. refer the dispute to the Complaints and Compliance Committee[12] (the CCC) for resolution in accordance with ICASA's facilities leasing regulations. Note that a decision by the CCC is binding on the parties unless an order of court is granted against the CCC's decision;

18.2.4. The Act provides that the leasing of facilities must be non-discriminatory as among comparable types of facilities being leased and not be of a lower technical standard and quality than that provided by the ECNS licensee to itself or an affiliate[13].

18.2.5. The Act provides that ICASA must prescribe regulations to facilitate the conclusion of electronic facilities leasing agreements by stipulating principles for such agreements which may include[14]:

18.2.5.1. a framework for the establishment and implementation of wholesale rates applicable to specified types of facilities and associated services, taking into account the provisions of Chapter 10 of the ECA, which chapter deals with competition issues; and

18.2.5.2. a leasing offer containing model terms and conditions for the leasing of essential facilities.

18.2.6. ICASA must also prescribe general facilities leasing regulations which may include:

18.2.6.1. the time frame and procedures for the negotiation, conclusion and technical implementation of facilities leasing agreements;

18.2.6.2. the quality performance and level of service to be provided;

18.2.6.3. wholesale leasing rates and the manner in which the structure of fees and charges for such facilities leasing must be determined;

[11] Section 43(5) of the Act
[12] Section ___ ICASA Amendment Act, 2006
[13]
[14] Section 44(1) of the Act

18.2.6.4. sharing of technical Information Including regarding disclosure of future network planning activities;

18.2.6.5. contractual dispute resolution procedures;

18.2.6.6. billing and settlement procedures;

18.2.6.7. the list of essential facilities;

18.2.6.8. services associated with the leasing of facilities such as support systems, collocation, fault reporting, supervision, functionality, unbundling, and cooperation in the event of faults;

18.2.6.9. access and security arrangements;

18.2.6.10. framework for refusing a request for facilities leasing due to planned expansion of the network;

18.2.6.11. framework for determining technical feasibility and promotion of efficient use of electronic communications networks:

18.2.6.12. requirement that an ECNS licensee negotiate and enter into a facilities leasing agreement with an applicant for an Individual licence; and

18.2.6.13. manner in which unbundled facilities are to be made available.

18.2.7. Section 45 of the Act also contains provisions regarding the filing of facilities leasing agreements. They are as follows:

18.2.7.1. facilities leasing agreements must be in writing and must be submitted to ICASA upon which they are effective and enforceable unless a court orders otherwise or unless upon review thereof ICASA Issues a written notice of non-compliance which it will do when it determines that a term or condition of a facilities leasing agreement is not consistent with the facilities leasing regulations. In such a case ICASA's notice must direct the parties to agree on new terms and conditions consistent with the facilities leasing regulations and

18.2.7.2. ICASA must publish facilities leasing agreements and must furnish copies upon request and upon the payment of a fee.

18.2.8. It is important to note that facilities leasing regulations made by ICASA (or its predecessor) under the now-repealed Telecommunications Act continue to remain in force unless specifically repealed by ICASA in terms of section 95 of the ECA.

18.2.9. SATRA (the predecessor to ICASA) has promulgated Facilities Leasing Guidelines[15] which have since been supplemented[16]. The Facilities Leasing Guidelines set out the following important issues:

18.2.9.1. facilities leasing agreements are required to deal with scope and specification of facilities, service levels and maintenance, charges, billing and settlement procedures, ordering, forecasting, provisioning and testing procedures, provision of co-location for facilities, technical specifications, confidentiality, duration, renegotiation and review procedures and dispute resolution procedures;

18.2.9.2. continuation of leasing facilities, the facilities seeker must be given at least three months within which to remedy a breach and if the facility falls within the definition of an essential facility, the agreement cannot be terminated without ICASA's consent;

18.2.9.3. non-discrimination principles, this requires a facilities provider to treat each facilities acquirer on a basis that is non-discriminatory and not less favourable than the treatment the facilities provider affords its own subsidiaries or affiliates. The non-discrimination provisions of the Act are more stringent and refer to the facilities provider itself as well as its subsidiaries and associates;

18.2.9.4. the time period within which facilities leasing agreements must be entered into, namely as soon as possible but in any event within three months of facilities leasing being requested unless extended by ICASA; and

18.2.9.5. time period for supply and quality of service, this requires facilities to be provisioned within 45 days unless extended by ICASA. Also the facilities leasing agreement must contain service levels that reflect good facilities leasing practise. Remedies must be set out for failure to comply.

18.3 Access charges

[15] Notice 1260 published in Government Gazette No. 20993 dated 15 March 2000.
[16] Notice 1215 published in Government Gazette No.23613 dated 9 July 2002

18.3.1. The Facilities Leasing Guidelines stipulate that charges be transparent and sufficiently unbundled so that the facilities lessee does not have to pay for facilities that it does not require. Further, the charges structure must distinguish and separately price: establishment and implementation of facilities, rental charges for the use of facilities and variable charges for supplementary services[17].

18.3.2. Further, section 13 of the Facilities Leasing Guidelines provides that major operators of essential facilities must lease essential facilities at the long run incremental cost (LRIC) of those essential facilities, which cannot be more than the fully allocated costs therefore. LRIC is to be calculated on the basis of relevant forward looking economic costs calculated for an efficient telecommunication service provider and including a reasonable cost of capital. Note that until *9* July 2004 (unless extended by the Authority) the supplementary facilities leasing guidelines' provisions regarding facilities leasing charges shall apply. This is aimed at permitting an orderly to the LRIC pricing regime and requires cost-based charges.

18.3.3. ICASA is in a position to monitor adherence to price regulation using the Chart of Accounts and Cost Allocation Manual ("**COACAM**")[18] which positions out a structured accounting and regulatory reporting framework for all operators. The stated objectives of COACAM are [78]–

18.3.3.1. to make sure that operators do not unfairly take advantage of their market power to make excess monopoly profits;

18.3.3.2. to make certain that operators do not engage in predatory pricing;

18.3.3.3. to ensure that operators do not engage in anti-competitive cross subsidization;

18.3.3.4. to make sure that operators do not price on a discriminatory basis;

18.3.3.5. to make certain that charges are cost orientated and sufficiently bundled;

18.3.3.6. to protect consumers by supervising and approving tariffs and pricing regimes; and

18.3.3.7. to monitor and examine the financial performance and state of affairs of the operators.

18.3.4. In a paper titled "*Competition in EC Telecommunications – Cross Subsidisation, Access and Predatory Pricing"* 1999, P Nicolaides and R Polmans argue that the cost oriented model for pricing suffers weaknesses in that the incumbent are able to inflate costs and charges and the model requires a

[17] *Ibid,* section 12
[18] Regulatory Accounting Guidelines notice

deep information load on the regulators. The authors uphold that a probable solution to such limitation in the model is to break up or divestiture the incumbent.

18.3.5. One of the most intricate barriers to broadband employment is the question of cost allocation and what is supposed by many as the "necessity to avoid cross-subsidization of new broadband services by regulated services." [26]. It appears that most of the points of views advanced in this area are interrelated to doubts concerning the central function that the incumbent would take part in the broadband services market. There are two possible costing principles. The price for the line sharing service should include two types of costs, namely [1]:

18.3.5.1. incremental line sharing specific costs; and

18.3.5.2. some allotment of the costs of a line over which the line sharing service is offered.

18.3.6. The cost of a line over which a line sharing service is offered, should be calculated on a geographically de-averaged perspective. That is, the cost should vary depending on the area in which the service is being provided. The alternative to this is the geographically averaged prices.

18.3.7. Establishing costs for line sharing is easier than undertaking the same exercise for bit stream access. The challenge for ICASA will be lessened with line-sharing access.

18.3.8. A central precondition for any access seeker is the accessibility of enough information to authorize it to correctly coordinate its utilisation of the partly unbundled local loops. Information may well include the location, lengths per area of the local loop, the quantity of non-copper loops and connection orientations and must be supplied on a non-discriminatory manner.

18.4 Technical and Operational Issues

18.4.1. Line Sharing

18.4.1.1. The quality of service is potentially low owing to the risk of interference between the two services/technologies offered on the same local loop infrastructure by the incumbent and new entrant. The consequential service quality degradations are expected to possibly influence the inter-operator relationships as well as the operators/customer relationships.

18.4.1.2. Line sharing elevates similar operational issues as full LLU and as a result technical savings are not attained. For this reason, line sharing offers additional benefits compared to full LLU.

18.4.1.3. If the customer wants to expire the incumbent's voice telephone subscription, this option develops into meaninglessness and therefore broadband access on the same line relies on continued access to the incumbent for voice.

18.4.1.4. From the MDF, the copper wires are linked to a splitter, which is a devise that splits the voice and broadband. The incumbent supplies voice on the lower frequency spectrum of the line, while another operator provides DSL services on high frequency component of the same line [28]. A vital complexity will be to state a physical interface and there may be different equipment used for both the splitter and for the ADSL because "ADSL above POTS" and "ADSL above ISDN" utilize different spectrum allocation [28]. Another difficulty with frequency unbundling is that it may slow down the migration to a digital access, where the POTS-band would be reallocated for digital communication to augment reach and performance [28]. The literature demonstrates that in the UK and Ireland, the opposition to this type of unbundling has been strong [28].

18.4.2. Full unbundling

18.4.2.1. A study [19] commissioned by the European Commission examined the implementation of LLU in Australia, Hong Kong, USA, UK, Denmark, Spain and Germany and documented technical and operational issues necessitating regulatory intervention. These issues are described in the next few paragraphs.

18.4.2.2. Roll-out of collocation Space

The incumbent creates and make available space at the local exchange for collocation by new entrants. Typically, new entrants complained of [1] –

18.4.2.2.1. interruptions in the provisioning of properly conditioned space for collocation;

18.4.2.2.2. the implementation of unreasonably extended processes in assessing fittingness for collocation;

[19] Gilbert & Tobin / Political Intelligence "Operational Implications of Local Loop Unbundling and the need for technical co-ordination" 19 September 2001

18.4.2.2.3. the period it took to construct or prepare the collocation space was incredibly long; and

18.4.2.2.4. excessive charges for studies into the feasibility of collocation space.

18.4.2.3. Collocation space constraints

Incumbents in the majority of the countries studied [1-20] were confronted with enormous demand for collocation space mainly in the metropolitan areas. The aforementioned study revealed that requests for collocation were often rejected on the basis of factually incorrect information on space availability. To counter this problem certain of the aforementioned countries set maximum space or equipment dimensions for each new entrant.

18.4.2.4. Caged collocation versus cageless collocation

Most countries in the aforementioned study apply caged location, that is, equipment of all the new entrants is collocated in a common space physically separated from the incumbents'. The costs of cageless collocation are significantly lower than those of caged collocation. Security and systems integrity have been raised as concerns by incumbents. In 2001, the UK regulator published a directive[20] declaring that British Telecom ("BT") must meet all the requests for co-mingling unless it is impracticable to do so and this should be on account of technical grounds and would consequently directly and necessarily impair the integrity of any of BT's systems. The directive went on to require BT to provide reasons for refusing co-mingling and to stipulate the basis upon which a refusal is entertained. BT was further directed to enter into negotiations for co-mingling with LLU operators within set time periods.

18.4.2.5. Access

18.4.2.5.1. The incumbents in many of the countries referred to in the above study enforce supervised access while new entrants have often complained that incumbents have often applied excessively expensive and discriminatory security requirements that consequently unreasonably delay the provision of access and thereby affecting their ability to regularly maintain, upgrade and replace their equipment.

18.4.2.5.2. Access to collocated space is regulated in Australia and the US [1]. The regulators in those jurisdictions have declared that an incumbent ought to implement a security system that is cost effective and therefore

[20] Statement and Direction issued by the Director General of Telecommunications "Local Loop unbundling: provision of co-location in the form of co-mingling, 10 October 2001

affordable and offers reasonable access by the new entrant into the local loop unbundled infrastructure.

18.4.2.6. Restrictions

18.4.2.6.1. A large number of incumbents have sought to impose restrictions on the type of equipment LLU operators may install[21] and the activities that may be conducted within the collocation space (see also Cases in Appendix 3). As an example, the incumbent in Germany prohibits LLU operators from interconnecting their equipment within the collocation space such that they could exchange traffic between them [1].

18.4.2.6.2. A US court decision[22] annulled a FCC ruling which stated that the incumbent must "*permit collocation of any equipment that is used or useful for either interconnection or access to unbundled network elements no matter what other functionalities the equipment might have..*" and said that an incumbent was required to only permit physical collocation of equipment "*that is directly related to and is necessary, required or indispensable to interconnection or access to unbundled network elements*".

18.5 Bitstream Access

18.5.1. As stated in the previous sections, no pricing regulation currently exists for Bitstream access. In order to guarantee extensive access at reasonable prices to subscribers, the regulatory framework needs to deal with the suitability of prices charged by the incumbent to ISPs for providing them with wholesale xDSL products. Moreover, regulation needs to address the issue of margins of service providers to subscribers to guarantee affordability. At this level regulation should be aimed at creating a ceiling on prices to subscribers and allow marketplace to autonomously resolve suitable margins which should be below that ceiling.

18.5.2. Bitstream access is not expected to promote a great deal of facility based competition and as regulation can only set minimum standards, the incumbent should not be compelled to invest in new technologies. Consequently, in a situation when it is possible, care must be exercised in setting wholesale prices to make certain that the section of the market stays attractive to new entrants and is sufficiently profitable to encourage future investments by the incumbent.

[21] Safety standards are often the reason for such restriction.

[22] GTE Service Corporation et al v Federal Communications Commission and United States of America 205 F.3d

18.6 Process for Implementing LLU

18.6.1. The Gilbert & Tobin[23] research established that every country studied chose not to allow only the regulator to resolve technical and operational issues, however, instead opted for process that includes all relevant stakeholders. The study revealed that the multi-pronged approach by and large manifested three manners –

18.6.1.1. A committee that is driven by industry is formed which is independent from any form of interference by the regulator. However, issues of difference of opinions are consigned to the regulator for determination and this model was adopted by Australia, France and Germany [1];

18.6.1.2. An industry round-table be assembled and be under the initiative and guidance of the regulator. This model was adopted in Hong Kong and the UK [1];

18.6.1.3. Whereas a multi-pronged method is undertaken by establishing broad technical and operational needs, execution is accomplished by the appointment by the regulator of an independent technical expert to help out the incumbent in the design, testing and commissioning of processes and principles for LLU. This model was adopted by the US [1].

18.6.1.4. The Gilbert & Tobin study also indicates that the self-regulation model often proved unsuccessful as the process was tremendously time-consuming and was devoid of direction. The study, however, demonstrates that France and Australia accomplished a number of successes with self-regulation in LLU nevertheless this has been attributed to the regulator playing an indirect part in the process.

18.6.1.5. The co-regulatory model which was applied in the UK and Hong Kong was considered by many[24] as capacitating the regulators to establish "informal determinations" without observance to fair process as more formal process would entail. In addition, the regulators were perceived as acting the tasks of both arbiter and policy maker in the LLU implementation process. In its research[25] on industry self-regulatory procedures, OFTEL which is the forerunner to the present UK regulator declared the following:

"Self and co-regulation cannot become much more extensive unless sufficient stakeholders are committed to it. Responses to OFTEL's discussion paper revealed

[23] Gilbert & Tobin / Political Intelligence "Operational Implications of Local Loop Unbundling and the need for technical co-ordination" 19 September 2001
[24] Gilbert & Tobin / Political Intelligence p28
[25] Oftel "*The Benefits of Self and Co-Regulation to Consumers and Industry*, July 2001, www.oftel.gove.uk

that there was in general a low level of enthusiasm for a formal independent stakeholder body like Australia's ACIF. Given these views, it is difficult to see how, in the absence of formal power; such a body could be established. For this reason alone, OTEL does not see any scope to establish such a body within the current regulatory framework. Further, OFTEL does not consider that such a body would necessarily be any better than effective alternative measures on a less formal basis. The previous experience of self and co-regulation already gives some good examples of success based on stakeholder co-operation, and it is questionable in OFTEL's view whether compelling co-operation within a formal body would give any better outcomes. Further stakeholder involvement in self and co-regulation may evolve towards more formal structures, but whether this is the chosen route remains to be seen".

18.6.1.6. Gilbert & Tobin / Political Intelligence discovered that the participation of an independent project manager ended up in the accomplishment of "*robust, sophisticated and largely electronic systems for LLU which provide a very high level of non-discriminatory functionality between incumbent's retail operations and new entrants' utilising LLU*". The condemnation for this method has principally been the cost linked with the procurement of this independent project manager. Gilbert & Tobin/Political Intelligence additionally promote a structure whereby technical and operational issues are dealt with by an industry-based working group that includes the incumbent, the main potential users of LLU and equipment manufactures. Such working groups should be chaired by a neutral party with experience in the sector, such as a retired engineer. Furthermore, the national regulator should chair a high level project steering committee to oversee and manage the process by establishing codes for implementation of the LLU; however, such steering committee should not be an active participant in the working groups. The national regulators should formulate dispute resolution mechanisms and resolve any disputes stemming from the working group.

18.6.2. MNP Implementation Process

18.6.2.1. In South Africa, the process of implementing Mobile Number Portability ("**MNP**") can be cited as an example of a co-regulatory model that has been adopted using the local legal and regulatory framework.

18.6.2.2. MNP was implemented in November 2006, following a two year regulation-making process. The legislation mandated MNP, and in this case there was no need for the Minister to issue further policy determinations and directives.

18.6.2.3. ICASA, however, had to make regulations setting out the method of the implementation of the MNP. It did so by the publishing the MNP regulations (high level, setting out the principles) and a Functional Specification (setting out high level

technical requirements). Each of these regulations was published for comments in terms of section 96 of the Telecommunications Act for a period of no less than 30 days. Public hearings were held, comments considered and final regulations were made.

18.6.2.4. Further to the regulations and Functional Specification, more technical detail was required. This is set out in an Ordering System Specification ("**OSS**") which was developed by the regulator in consultation with the operators. ICASA hired a technical expert to work with it on the entire MNP process, and project managed the development of the OSS on behalf of the Authority. Thus, the Authority was involved in the preparation of the document and in the debates and discussions leading to its finalization, although much of the technical expertise and drafting was provided by the operators themselves. This recognizes the fact that the operators are more familiar with their own technical capabilities and networks. ICASA managed the process and ensured that regulatory principles (as set out in the regulations and Functional Specification) were upheld in the drafting of the OSS and that timelines were met. The presence of ICASA in the process ensured that disputes were avoided or resolved swiftly. In the event of a deadlock, the constant threat was that ICASA would intervene.

18.6.2.5. The OSS was to be published as a regulation. After it was completed, in order to comply with the legislation, ICASA published it for comments in terms of section 96 of the Telecommunications Act. Not a great deal of comments was received since interested parties had participated in its drafting. It has not been published as a final regulation, since it provides that the final version will be published as a regulation 6 months after the implementation of MNP (May 2007).

18.6.2.6. The decision not to publish the OSS as a regulation from the outset was guided by the fact that the document is a 'working document' and that it may still be amended. Since MNP had never been implemented in SA or by any of the operators involved, it was envisaged that there may be technical "teething" problems, and a need to adjust the technical specifications accordingly.

18.6.2.7. Even though MNP has been in place for nearly 6 months, the working group dealing with the OSS is still in place. It meets monthly, and ICASA is present at all meetings, as is required by the general regulations and the Functional Specification.

18.6.2.8. The MNP process is an example of how ICASA has dealt successfully with complex technical regulatory issues and the implementation thereof. It may prove to be a model for LLU.

18.6.3. Bearing in mind the above,

18.6.3.1. The Minister can issue policy determinations setting out the manner in which LLU should be implemented.

18.6.3.2. ICASA could then make regulations, and if necessary license amendments, based on the Minister's policy determinations.

18.6.3.3. Consultation processes envisaged in section 4B of the ICASA Act (i.e. publication for comment and hearings) would then be followed.

18.6.3.4. Further to that, ICASA could set up working groups/committees consisting of affected industry members to draft the technical implementation documents in line with the principles that have been announced by the Minister (by way of policy determination) and ICASA (through general regulations & functional specification).

18.6.3.5. The working groups would be given timelines to observe and come up with technical implementation requirements, failing which ICASA could intervene.

18.6.3.6. The "LLU OSS" would then be published as a regulation by ICASA. Alternatively, the ECA now provides for the making of industry Codes and there is therefore a possibility that it could be published as a Code.

19 Conclusion

The various case studies (See Appendix 3) make it abundantly clear that LLU is a complex process and that regulation and monitoring must be firmly in place to ensure the effective implementation by both the incumbent and new entrants of the Local Loop Unbundling process.

The implementation of the local loop unbundling in South Africa must therefore offer better pricing; affordable services and quality products that would have significant impact on the economic growth of the country as far as information and communication technologies are concerned. LLU must be understood to be a stimulant to economic growth and a necessary component for the attainment of South Africa's Millennium Goals of 2014. The implementation should not simply be the provision of alternative service providers but those that will make a difference in the lives of ordinary South Africans and on the economy of Southern Africa.

20 Recommendations

20.1 General recommendations

The committee is of the view that it is unsuitable for a regulator to establish the operational and technical planning of the LLU by itself. It is then recommended that the regulator invite and involve the incumbent and new entrants to embark on the detailed work required to produce technical and operational solutions. Multilateral forums should be employed to consider the technical and operational issues. This process would manage criticisms from new entrants viewing that the incumbent will not be fair when dealing with new entrants. Furthermore, the resource demands of separate negotiation tracks can potentially present the incumbent with additional justifications to carry in a measured pace. The various case studies (See Appendix 3) demonstrate that incumbent and new entrant's attitude should not be treated as a minor item. The implementation of LLU should be managed in much the same ways as a complex IT project is done and requires discipline, the use of latest project management tools and adequate resources to run as a successful initiative. To ensure transparency and smooth implementation, the regulator can establish the following decision-making frameworks to resolve technical and operational issues [7]:

- Technical and operational issues must be mainly dealt with by stakeholders spanning different topic areas for instance pricing, collocation, regulation, maintenance, ordering and provisioning. All affected parties such as the incumbent operator, business and residential customers, manufacturers and new entrants ought to consider all relevant strategic issues and come up with a plan stipulating steps that ensure a thriving operation of the LLU process. This working group must not be led by either the incumbent or a new entrant, but by a neutral party that is knowledgeable of the industry.
- The regulator must lead a high-level project steering committee. This committee must have oversight and management roles and should develop the process of instituting and putting into practice the LLU. This committee ought to develop a project plan for the operation of the LLU and must lay down the goals for concurrence on critical operational and technical needs, manage advancement associated with the project plan, assure that every member has tendered resources for the project and that the correct mechanisms are employed to overcome barriers.
- The steering committee must spell out understandable terms of reference for every LLU working groups, as well as identify the subjects which ought to be attended to, the involved outputs, for example the Code of Practice and the timeframe in which the tasks ought to be concluded.
- There have to be a full-time secretariat that ought to execute administrative function in addition to project management to sustain the LLU working groups. This secretariat must have knowledge and understanding of the implementation of a large communications and IT project.
- The regulator must stipulate the escalation process from each LLU working group and should be trained to manage disagreements from the working groups. It should be borne in mind that it is impossible to adjudicate all matters on to the LLU process but an appropriate implementation plan and Code of Practice increase the success of the deployment of the local loop unbundling process.
- The regulator, in discussion with the industry, should think about establishing a stakeholder's organization, which would offer a steady and long-term industry decision-making structure.
- The regulator must provide an understandable direction to the LLU process on the critical principles for developing technical and operational guidelines. This should be done in a fair and transparent manner.
- The regulator must establish rules that demand that the incumbent records and reports frequently on the progress and critical matters on the implementation of the LLU.

- The regulator must publish whenever possible information on the progress of the LLU process for the benefit of the public.
- The regulator must embark on a preliminary process to obtain submissions from the stakeholders prior to issuing guidelines. The matters that could be asked for may include:
    - The level of MDF information and the time and nature of its availability.
    - The type of collocation, that is best for the new entrants.

20.2 Recommendations based on international best practice

- The regulator must institute a delivery timetable and define mandatory goals. It is robustly recommended that the LLU is in an advanced stage of implementation by 2010.
- The delivery timetable must include both urban and rural areas as well as business and residential areas. This schedule should be developed by the regulator in consultation with the incumbent and new entrants.
- The regulator must spell out space allocation per new entrant.
- There ought to be the right to reserve space for a maximum period of time which should be prescribed by the regulator.
- On condition that collocation closer to the exchange MDF cannot be provided for by the incumbent, the incumbent must be required to provide, if feasible, virtual collocation at no added cost to the new entrant.
- The distinction in costs between physically separated and cageless space should be separated evenly among the incumbent and new entrants since there are advantages and disadvantages for both parties in this plan.
- There should be the choice of the common collocation space being constructed by one of the new entrants via the contractors of the incumbent.
- New entrants should only be able to locate within collocation spaces of the incumbent's local exchanges only equipments which are needed to provide services over unbundled local loops.
- The incumbent should give a notice of at least 12 months on the closure of any MDF sites.
- If the MDF site is utilized by new entrants and the incumbent had not informed them on the closure before the availability of collocation, the incumbent should compensate the new entrants' costs of relocating. This should include additional recurrent costs for a period of 3 years from the date of relocation.

- The incumbent must supply the new entrant with information on alternative means and technologies, which are accessible to allow the new entrant to keep on providing services to customers in the concerned exchange area using LLU. This should include, without restriction, line cards in an access multiplexer in the event that the MDF site is to become a remote switching or multiplexing site.
- The regulator should begin to address the issue of DLC/ fibre in the local loop because this topic will become significant over the coming years as the incumbent keeps on upgrading its network.
- The new entrants ought to be obliged to make available forecasts of collocation and metallic path demands. These forecasts should not be binding, however, must be used as a guide to resource planning.
- The incumbent ought to be mandated to avail network-related information to new entrants who are potential acquirers and users of the LLU services. The information should include strategic issues such as exchange locations, lines connected to those exchanges, map coverage, ease of access of collocation space and strategies and tactics by the incumbent to improve local loops within the future period of 12 months. The new entrants may enter into a confidentiality agreement to be given such delicate information.
- The new entrants must be permitted to devise customer-authority forms. These forms should include information endorsed by the regulator.
- The regulator must devise a detailed cutover process. This process should engage the new entrant's and the incumbent's technical staff. The process should specify the maximum timeframes within which the cutover is to happen. The cutover process should account the opinions of customers who have been using the service and these customers must be informed about the services to be offered.
- The regulator must lay down target service restoration periods, which should vary across different geographic areas depending on the infrastructural requirements and the need to maximize ease of access.
- There must be a comprehensive process for maintenance and fault reporting. This should be intended to achieve the target service restoration times, as well as specifying the conditions in which the incumbent can surpass the target service restoration times.

20.3 A call for public comments

- To obtain the final recommendations that regard all telecommunications stakeholders, the committee recommends that a call for public comments be made. The most appropriate model or mixture of models would at that time be qualified in reflections with recommendations that will come from industry working groups.
- This process can consist of a presentation of this report and sharing of case study information similar to the processes followed by DoC for similar projects such as Telecommunications Amendment Act, transition to Digital Broadcasting etc.

20.4 Collocation of facilities

- Collocation of facilities should be fully allowed but public comments should be invited to find out stakeholders' options. This report has explained four different ways in which collocation can be implemented. The four collocation types should all be implemented to allow flexibility for the new entrant's demands when requesting to operate in the unbundled local loops and flexibility depending on the incumbent's real situation on the availability of premises in a given geographical area.

20.5 Empowering regulator

- Collocation of facilities requires a strong and appropriate regulatory muscle to enforce implementation and solve disputes that may arise. It is therefore recommended that ICASA be capacitated in this regard and be able to physically inspect the incumbent's premises to be able to record the size, location and other information of these premises as may be required for the implementation of the unbundling of local loops.

20.5.1 Local loop unbundling structures

- Local loop unbundling structures have been presented in this report. The committee therefore recommends that three unbundling structures namely, full unbundling, line sharing and wholesale should be considered for implementation. Furthermore, all three structures can be concurrently implemented, and this will allow innovations to be deployed in the competitive environment. Nevertheless, the incumbent will be in a position to fairly compete as the structures will leave enough room for innovative competing service.

20.6 Strategic issues

- The implementation of local loop unbundling presents strategic issues that need to be overseen by the regulatory framework. The committee recommends a regulatory guideline be developed

that will be overseen by ICASA to make sure that the strategic issues raised in this report are controlled. The regulatory guideline should be formulated after reviewing comments from the public.

20.7 A way forward

- The committee recommends that the implementation of the process of unbundling the local loop should be given top priority so as it can happen sooner rather than later. The stakeholders who will be involved to forward their comments should be encouraged to do so in exactly the period to be announced by the Minister.
- The new structure responsible for implementing the process should propose a formula that would motivate the provision in under-serviced areas and rural areas.

21 References

1. European policy on local loop unbundling: Competition law background and problems of implementation. 42-2nd quarter 2001 and EURO CPR conference 2001, Venice.
2. Interim pricing of local loop unbundling in Ireland: Epilogue – J. Gregory Sidak, Hal J. Singer.
3. Local loop unbundling: White paper: Q3 2006 – Sonus networks.
4. Draft decision regarding prices on the local loop unbundling to enter into force as from 01.01.2006 – ANACOM http://www.anacom.pt/template31.jsp?categoryId=215322.
5. Case study Finland for the recommended practices for collocation and other facilities sharing for telecommunications infrastructure – Tera consultants study for DG XIII of the European commission December 1998.
6. Local loop unbundling: French Case – Marc Bourreau ENST, Department of Economics.
7. Operational implications of local loop unbundling and the need for technical co-ordination – Gilbert & Tobin http://www.gtlaw.com.au, Political Intelligence http://www.political –intelligence.com 19th December 2001.
8. Developments in local loop unbundling- Directorate for Science, Technology and Industry Committee for Information, Computer and Communications Policy, 10th September 2003.
9. A comment on the economics of local loop unbundling in New Zealand – OVUM Pty Ltd 28th June 2000.

10. Local loop unbundling in Australia – Summary of the decisions Z 12/00, Z 14/00, Z 15/00 of the Telekom-Control Commission (TKK) of March 12, 2001.

11. Local loop unbundling and Bitstream Access: Regulatory practice in Europe and the US. Deutsches Institut fur Wirtschaftsforschung Pio Baake, Brigitte Preissl (editors) Berlin 2006.

12. Local loop unbundling for cable and wireless Jamaica. Consultative Document, January 20, 2006 – Office of Utilities Regulation.

13. ETP recommendations on local loop unbundling: Provisioning and O&M issues- September 2001 issue 2.

14. Local loop unbundling – Wikipedia.

15. Telkom SA. www.telkom.co.za. Last Accessed: 10 May 2007.

16. Working Party on Telecommunication and Information Services Policies. Website: http://www.oecd.org/dataoecd/25/24/6869228.pdf Prepared by Atsushi Umino for the OECD's Directorate of Science, Technology and Industry.

17. On Unbundled Access to the Local Loop. Website: http://ec.europa.eu/comm/competition/liberalization/telecom/local_loop/recommendation_2000_04_26_en.pdf.

18. Local Loop Unbundling for Cable & Wireless (Barbados) Limited, February 2007.

19. Scott Wallsten "Broadband and Unbundling Regulations in OECD Countries". Working Paper 06-16. Jun 2006.

20. 2000/417/EC: Commission Recommendation of 25 May 2000 on unbundled access to the local loop: enabling the competitive provision of a full range of electronic communications services including broadband multimedia and high-speed Internet (notified under document number C(2000) 1259).

21. Federal Communications Commission, Third Report and Order in CC DOCKET NO. 98-147, 1999.

22. Collocation - Virtual to Cageless Collocation Conversion Overview - V1.0.
Webpage: http://www.qwest.com/wholesale/clecs/collovirttophyscagelessconv.html Last Accessed: 10 May 2007.

23. Falch, Morten (2002): TELRIC – The way towards competition? A European point of view Review of Network Economics Vol. 1, Issue 2 – September 2002.

24. Falch, Morten (2004): W D R D i a l o g u e T h e m e 2 0 0 3 D i s c u s s i o n P a p e r W D R 0 3 0 8 Cost based interconnection charges, competition and investments.

25. Pierre-André Buigues European policy on local loop unbundling Competition law background and problems of Implementation. Communications and strategies number 42 - 2nd quarter 2001 and EURO CPR Conference 2001, Venice.

26. Progress & Freedom Foundation. Comments of The Progress and Freedom Foundation 1998 Webpage: http://www.pff.org/issues-pubs/filings/980914pffdocket.html Last accessed: 20 May 2007.
27. John Buckle Telecommunications regulation. Institution of Electrical Engineers. London: IET, 2003, Pages 157-173.
28. Roland Belfin, Martin Lukanowicz, Paul Pisjak, Rainer Schnepfleitner, Alois Schrems. Unbundling the local loop in Austria – The rationale behind the Regulatory approach" paper prepare for the ITS conference in Torino, 23, 09, 2000.
29. LLU Factsheet: Ofcom Website: www.ofcom.org.uk Last accessed: 15 May 2007.
30. Annabel Z. Dodd. The Essential Guide to Telecommunications. Prentice Hall, 2002.
31. AS Lorenz, FC Marti, CR Curry. "Telecommunications connector with improved crosstalk reduction". US Patent 6,007,368, 1999.
32. Cook, J.W et. Al (1999), "The noise and crosstalk environment for ADSL and VDSL systems" Communications Magazine, IEEE, vol. 37, pp. 73-78.
33. Marc Bourreau and Pinar Dogan. Unbundling the local loop. European Economic Review, Volume 49, Issue 1, January 2005, Pages 173-199.
34. Anne Gabelmann Regulating European telecommunications markets: unbundled access to the local loop outside urban areas. Telecommunications Policy, Volume 25, Issues 10-11, October-November 2001, Pages 729-741.
35. Kostis Christodoulou and Kiriakos Vlahos. "Implications of regulation for entry and investment in the local loop". Telecommunications Policy, Volume 25, Issues 10-11, October-November 2001, Pages 743-757.
36. ITU: ITU Research Reports on local loop unbundling for West Africa, 2007.
37. Webb, W., "A comparison of wireless local loop with competing access technologies", IEEE Electronics and Communication Engineering Journal, Oct. 1998.
38. Issues on local loop unbundling in International Telecommunication Union, http://www.itu.int.
39. Local loop unbundling, Openreach-BT, http://www.openreach.co.uk/orpg/products/llu/llu.do, Issue date May, 2007.
40. ETP (01)-020, ETP recommendations on local loop unbundling: Provisioning and O&M issues, issue 2, Sept. 2001.
41. Pach, A.R.; Papir, Z., "Guest Editorial broadband access copper technologies", IEEE Communications magazine, May 1999.

42. Cook, J.W et. Al (1996) "Broadband multimedia delivery over copper", IEE Electronics and Communication Engineering Journal.

43. van Eijk, N., "Broadband services and local loop unbundling in the Netherlands", IEEE Communications magazine, Oct. 1999.

44. Walter Distaso, Paolo Lupi and Fabio M. Manenti. **"**Platform competition and broadband uptake: Theory and empirical evidence from the European Union**".** Information Economics and Policy, Volume 18, Issue 1, March 2006, Pages 87-106.

45. Chris et.al, "Broadband Network Architectures: Designing and Deploying Triple-Play Services", ISBN-10: 0-13-230057-5, 2007.

46. Michelle S. K., "Deployment of broadband infrastructure in the EU: Is state intervention necessary?" Sept. 2002.

47. Narumiya, K. "A consideration of ADSL service under NTT's network", IEEE Communications Magazine, May 1999.

48. Rowbotham, T.R., "Local loop developments in the UK", IEEE Communications Magazine, March. 1991.

49. Bregni, S.; Melen, R. "Local loop unbundling in the Italian network", IEEE Communications magazine, Oct 2002.

50. WDR Dialogue 0308 "Cost based interconnection charges, competition and investments", Feb. 2004

51. Monten F., "Cost based interconnection charges as a way to introduce competition" CTI work paper no. 85 for center for Tele-information, 2004.

52. Papir, Z.; Simmonds, A., "Competing for throughput in the local loop", IEEE Communications magazine, May 1999.

53. G.N. Prezerakos and S.E. Polykalas. Maximizing the adoption of fixed number portability within the EU: An empirical analysis Telecommunications Policy, Volume 31, Issues 3-4, April-May 2007, Pages 179-196.

54. Goralski, W., "xDSL loop qualification and testing", IEEE Communications Magazine, May 1999.

55. Nilsson et. al (2002), "Autonomous synchronization of a DMT-VDSL system in unbundled networks", IEEE Journal on Selected Areas in Communications.

56. P. France, "Local Access Network Technologies", ISBN: 0-85296-176-6 & 978-0-85296-176-6, 2004.

57. Uesugi, S., “E-business for depopulated areas: why not "re-bundle" local loops?”, IEEE Applications and Internet Workshops, Jan. 2004.

58. Dumont, H.A., “Wireless local loop implementation?” 4th IEEE AFRICON, 1996.

59. “Competition in the local loop: unbundling or unbungling?” Telecoms, Infotech forum, www.trp.hku.hk/tif, July. 2003.

60. Nicholas E., “Real options and the costs of the local telecommunications network”, Jun. 1999.

61. T. Marwala. Local Loop Unbundling. EngineerIT April 2007, page 8.

62. Ashish Kelkar Economics of unbundling the local loop through provision of DSL Webpage: http://in3.dem.ist.utl.pt/downloads/cur2000/papers/S27P06.PDF Last accessed: 9 April 2007.

63. Guide to GSM. Webpage: http://www.cellular.co.za/gsm-overviewpage.htm Last accessed: 10 May 2007.

64. Guide to UMTS. Webpage: http://www.cellular.co.za/umts.htm Last accessed: 10 May 2007.

65. J. F. Wakeling and W. H. Dobbie. Satellite Access Services. BT Technology Journal, DOI: 10.1023/A:1009699814474.

66. WIMAX Wikipedia Webpage: http://en.wikipedia.org/wiki/WiMAX Last accessed: 10 May 2007.

67. Cable Television Wikipedia Webpage: http://en.wikipedia.org/wiki/Cable_television Last accessed: 10 May 2007.

68. R. Frieden. Unbundling the local loop: A cost/benefit analysis for developing nations. Info 7 (6), pp. 3-15, 2005.

69. J. Taaffe and D. Molony. The numbers game. Total Telecom (FEB.), pp. 14-15, 2006.

70. K. Wieland. In search of level playing fields. Telecommunications International 39 (1), pp. 37-38+44, 2005.

71. H. Kul and I.H. Cavdar. Modelling XDSL lines under crosstalk effect [XDSL hatlarin çapraz gürültü etkisi altinda modellenmesi]. 2006 IEEE 14th Signal Processing and Communications Applications Conference 2006, art. no. 1659791, 2006.

72. Long Run Average Costs Wikipedia Website: http://en.wikipedia.org/wiki/Long_run_average_cost Last accessed: 20 May 2007.

73. Louisa Gosling, DG Information Society Working Document, Unbundled Access to the Local Loop: March 2000: http://europa.eu.int/information_society/index_en.htm Last accessed: 10 May 2007.

74. Douglas C. Sicker, The End of Federalism in Telecommunication Regulations? Northwestern Journal of Technology and Intellectual Property, Volume 3, Issue 2, 2005.

75. Lawrence Spiwack, Perspective: Why local loop unbundling is no telecoms panacea, Communications week international, 26 April, 1999.

76. John Ure, Competition in the local loop: unbundling or unbungling?, Emerald Volume 5, Number 5, 2003, Pages 38-47.

77. Christian M. Dippon, Local loop unbundling: flaws of the cost proxy model, Journal of policy, regulation and strategy for telecommunications information media, Volume 3, number 2, April 2001, Page 159.

78. ICASA, COACAM. Website: http://www.info.gov.za/gazette/notices/2001/22400.pdf Last Accessed: 30 May 2007.

This report is based on the information from the literature review and where references are omitted the LLUC apologise. The report was a collective effort of all the stakeholders contacted and was prepared by ICT researcher Mr. Teddy Mwakabaga for the LLUC.

22 Appendix 1: Telkom South Africa - Overview

22.1 Telkom South Africa: Key facts

- Listed on the JSE South Africa and the New York Stock Exchange Inc.
- Group revenue: R47.6 billion
- Group total assets: R57.5 billion
- Internet subscribers in South Africa: 284,908
- ADSL subscribers in South Africa: 143,509
- Total mobile customers: 23.5 million (South Africa and other African countries)

22.2 Table 5: Telkom SA Shareholders as at March 31, 2006

Government	PIC	Elephant Consortium	Telkom subsidiaries	Freefloat
The Government of the Republic of South Africa is the largest shareholder in Telkom. The Government holds the Class A share.	The Public Investment Corporation (PIC), an investment management company wholly owned by the Government, invests funds on behalf of public sector entities. The PIC holds 8.6% of Telkom's issued shares and the class B share acquired from Thintana Communications LLC in November 2004. In addition, the PIC also holds 7.1% of Telkom's issued shares acquired in the market.	The Elephant Consortium is a Black Economic Empowerment group, which through Newshelf 772 (Pty) Ltd, holds shares in Telkom which it acquired from the PIC.	Rossal No 65 (Pty) Ltd holds 2.3% (12,687,521 shares) which was purchased for the Telkom Conditional Share Plan. Acajou Investments (Pty) Ltd holds 2.0% (10,849,058 shares) which was purchased for purposes other than the Telkom Conditional Share Plan.	Included in the freefloat are 9,408,452 shares held by 85,432 retail shareholders representing 1.7% of Telkom's issued shares.
38.0%	15.7%	5.6%	4.3%	36.4%

50% joint venture	64.9%	100%
Vodacom Group	Telkom Directory Services	Swiftnet
Vodacom Group (Pty) Ltd is the leading mobile communications company in South Africa, providing mobile communications services to 23.5 million customers in South Africa, Tanzania, Lesotho, the DRC and Mozambique. Vodacom has an estimated market share of 58% in South Africa.	Telkom Directory Services (Pty) Ltd (TDS) provides Yellow and White page directory services, an electronic directory service, 10118 'The Talking Yellow pages' and an online Web directory service.	Swiftnet (Pty) Ltd trades under the name FastNet Wireless Service. FastNet provides synchronous wireless access on Telkom's X.25 network, Saponet-P, to its customer base. Services include retail credit card and cheque terminal verification, telemetry, security and fleet management.

23 Appendix 2: Second Network Operator – Overview

The Second Network Operator's (SNO's) equity share capital is allocated amongst 6 main shareholders:

- Black empowerment group, Nexus Connexion (19 percent)
- Transtel and Eskom (30 percent)
- Communitel (12.5 percent)
- Two Consortium (12.5 percent)
- The India-based Tata Group, represented in South Africa by Tata Africa Holdings (26 percent)

The SNO shareholders and equity share capital are diagrammed as follows:

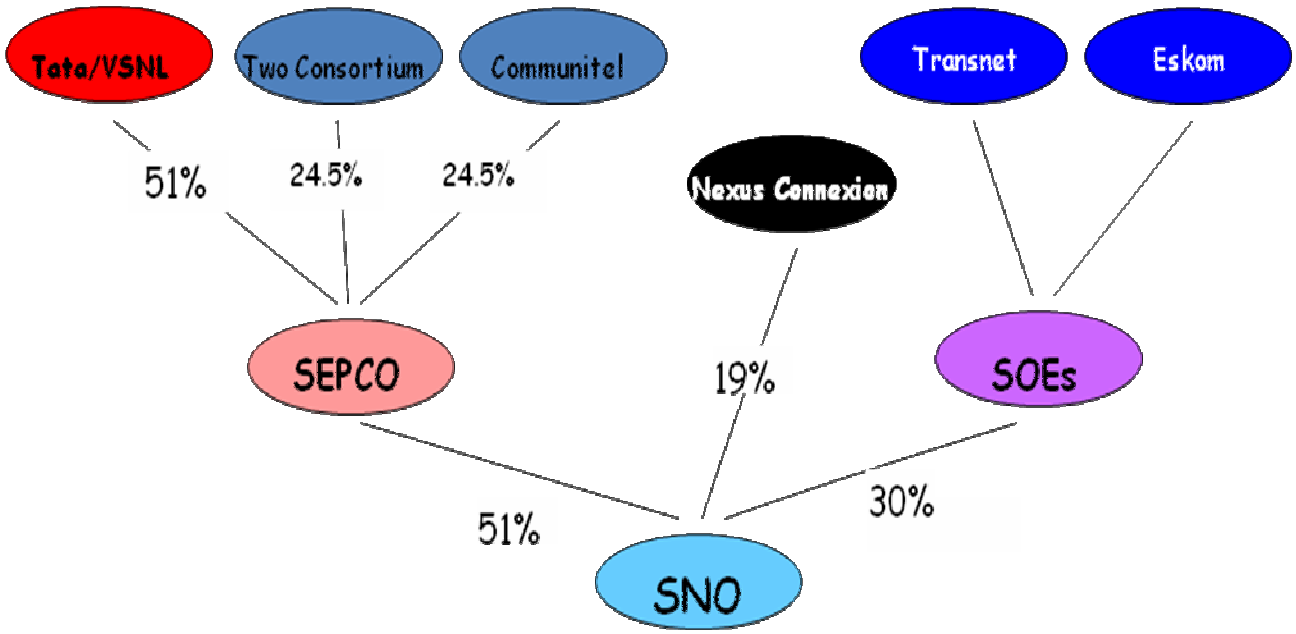

Figure 10: SNO shareholders and equity share capital

An overview of the license for SNO follows:

- The license is for 25 years, effective from 9th of December 2005.
- The license fee is R100 million.
- The operational coverage under this license includes
    - Local access;
    - National long distance;
    - International and limited mobility, various wireless and wireless backhauls with CDMA2000 for basic voice and data.
- The rollout targets are set as
    - Covering the Metropolitan centres in 5 years, initially with presence in the six major metropolitan centres, growing over time;
    - Covering 80% of the population in 10 years.
- Community service obligations, targeting High-speed Internet access for 2500 schools and 2500 rural clinics.

SNO plans to offer services categorized as:

- Wholesale: Voice, Leased lines, Internet;
- Enterprise /SME: Voice, IP VPNs, Internet and various broadband services;
- Consumer: Voice, Internet and broadband.

24 Appendix 3: Case Studies – Overview

The information in this report was drawn from various cases studies on the LLU in the following countries [1-60]:

1. Australia
2. Austria
3. Hong Kong
4. USA
5. Denmark
6. France
7. Germany
8. Spain
9. UK

25 Appendix 4: Minister's Mandate

The Recited Minister's mandate follows:

- In accordance with the spirit of Section 3(2) of the ECA, and to ensure affordable open access, lower prices and wider choice of access to international ICT infrastructure, I will be consulting shortly with ICASA on my intention to issue a policy directive to the Authority regarding the time-frame within which it will enable all licensees of electronic communications networks to interconnect with Telkom's local loop network. The Department will also be consulting with Telkom on this matter. In order to give effect to this decision without delay, I hereby appoint Dr Tshilidzi Marwala to chair the Local Loop Unbundling Committee (LLUC) whose task will be to oversee the development and the implementation of our local loop unbundling process and to make appropriate recommendations.

It is from the Minister's mandate that the local loop committee's aims can be arranged as:

- to make appropriate recommendations on the structure/s of the unbundled local loop
- to recommend the process for implementing the unbundling of the local loop
- to oversee the local loop development process.

The task of the local loop unbundling committee is therefore not

- to decide whether the local loop unbundling is necessary or not, nor
- to look at the political implications of unbundling the local loop.

However, the committee will look at all technical, legal / regulatory and economic implications of unbundling local loops and recommend appropriately. The expectations of the local loop unbundling process include:

- Produce new additions to the regulatory framework to cover the implementation of unbundled local loops.
- Provide a fair competition among operations
- Innovations with affordable open access
- An opportunity for new entrants to deliver
- Lower telecommunications prices in the country
- A wider choice to International ICT infrastructure
- More broadband services
- Enhance country's economical growth
- More offers for better pricing, service and new, quality products to telecomm. customers
- Employment opportunities

It is conversely not the expectation that the process of unbundling of the local loop will simply allow any alternative service providers but just those who will make a difference in the lines of ordinary South Africans.

26 Appendix 4: Committee Member's Bibliography

- ***Tshilidzi Marwala (Chair)***
  Expertise: Electrical Engineering, Researcher in Computational Intelligence

  Tshilidzi is the Carl and Emily Fuchs Chair of Systems and Control Engineering as well as the South Africa Research Chair in Systems Engineering both at the School of Electrical and Information Engineering at the University of the Witwatersrand, is on boards of City Power Johannesburg (Pty) Ltd, State Information Technology Agency (Pty) Ltd, Statistics South Africa, National Advisory Council on Innovation and a Fellow of the Council for Scientific and Industrial Research. He is a trustee of the Bradlow Foundation as well as the Carl and Emily Fuchs Foundation. He is the youngest recipient of the Order of Mapungubwe (whose other recipients are Nobel Prize Winners Sydney Brenner, Nelson Mandela, FW de Klerk and J.M. Coetzee) and was the first African Engineer to be awarded the President Award by the National Research Foundation of South Africa. He holds a Bachelor of Science in Mechanical Engineering (Magna Cum Laude) from Case Western Reserve University, a Master of Engineering from the University of Pretoria, a PhD in Engineering from St John's College, University of Cambridge and attended a Program for Leadership Development at Harvard Business School. He was a post-doctoral research associate at the Imperial College of Science, Technology and Medicine and in year 2006 to 2007 was a visiting fellow at Harvard University. In the year 2007 to 2008 he is a visiting fellow at Wolfson College, University of Cambridge. His research interests include the application of computational intelligence to engineering, computer science, finance, social science and medicine. He has published over 150 papers in journals, proceedings and book chapters and has supervised 30 master and PhD theses. His book: Computational Intelligence for Modelling Complex Systems is due for publication by Research India Publishers.

- ***Khulekani Dlamini***
  Expertise: Telecommunication, Finance, Industry

  Mr. Dlamini is currently at Renaissance Asset Management which he co-founded. He was formerly a portfolio researcher responsible for telecommunications, media, information technology and electronics research at Investec Asset Management. His other responsibilities included managing the local portion of the Sage SciTech fund and the absolute return funds. Mr Dlamini received his BSc and MEng in Aeronautical engineering at the Rensselaer Polytechnic Institute in upstate New York, and has also worked at the CSIR as a researcher and a computer systems engineer and consultant at Comverse Network Systems.

- ***Ndumiso Luthuli***
  Expertise: Legal, Finance, Business, Regulation

  Mr. Luthuli is currently a partner and one of the founders of the Law firm Luthuli-Sithole Attorneys and a member and managing director of BK consulting. Mr. Luthuli was a Rhodes Scholar having been awarded the Rhodes scholarship in 1999 and completed the Bachelor of Civil Law at Oxford University. He has also completed a Masters of Business Administration degree (MBA) at the Said Business School at the University of Oxford. He received his B.Proc and LLB from the University of Natal. He was admitted as an Attorney of the high court in 1999. Mr. Luthuli has worked as an Associate at Citigroup Investment Banking, an Analyst at Duetsche Bank Investment Banking, as a candidate attorney at Mooney Ford and a Junior Associate at Bowman Gilfillan. He is also chairman of the Indwala Rural Empowerment Foundation and a member of the Rhodes Scholarship National and Kwa-Zulu Natal selection committees.

- ***Mandl'esilo Msimang***
  Expertise: Regulations, Telecommunication Industry

  Mandl'esilo holds a BA from Cornell University (Ithaca, New York) and an MSc in Regulation (Utilities) from London School of Economics. She started her career in the telecommunications sector as an Advisor to Council at the South African Telecommunications Regulatory Authority (SATRA), now Independent Communications Authority of South Africa (ICASA) and later became a Senior Manager at ICASA responsible for competition policy, research and economic & financial analysis in 2001. Her work at ICASA included the development and implementation of universal service fund regulations, and the management of a project for the development of South Africa's Chart of Accounts and Coast Allocations Manual (COA/CAM). Mandl'esilo joined Cell C (Pty) Ltd in 2004 and worked as a Senior Manager: Regulatory Affairs. Mandl'esilo is currently working as an independent consultant. Mandl'esilo's independent consulting work includes for the ITU on communications policy issues primarily around universal service and access in developing countries.

- ***Nonkululeko Jamila Mabandla***
  Expertise: Regulation, Telecommunication, Legal

  Ms. Mabandla is currently a partner at Mahlangu Nkomo Mabandla Ratshimbilani Attorneys as well as the director as well as the director of G4S Security Services. Ms Mabandla has a wide range of experience in telecoms policy. She is currently advising Transtel on the legal and regulatory framework regulating the termination of telephone calls between the Telkom PSTS and the Transtel PTN. She has also advised ICASA on the legal implications of the carrier of carriers and multi media licences issued to Sentech in respect of a possible interconnection between Sentech and is acting on behalf of the Competition Commission in a referral to the

Competition Tribunal regarding the abuse of dominance by Telkom *vis-à-vis* Value Added Network Service providers, among other telecoms and broadcasting matters. She received her BA Law and LLB from the University of the Witwatersrand and is currently reading for an LLM at the same university. She has qualified the attorney's admissions exam in 2001, was admitted as an attorney of the high court in 2002 and has also completed courses in corporate governance.

- ***Sharoda Rapeti***
  Expertise: Broadcasting, Digitization, IT

  Sharoda Rapeti is the Managing Director of Technology at the SABC. Sharoda Rapeti holds a Higher National Diploma in Electronic Engineering and an MBA from the University of Wales. She was the Managing Director of the technology division of the SABC, where one of her critical tasks is to migrate the SABC to digital broadcasting platforms. Sharoda has delivered several papers at international conferences. Sharoda is the Vice-President of the Engineering Council of South Africa/ She is also the Vice-President of the Engineering Council of South Africa.

- ***Christopher Malikane***
  Expertise: Economics, Econometrics, Modelling

  Chris is a Lecturer of Economics at the University of the Witwatersrand. He holds a B.Econ.Sc(Hons) and an MComm from the University of the Witwatersrand. He also holds an MA in Economics from Fordham University and has recently completed a PhD in Economics from New School of New York.

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- ***Daniel Johannes Mashao***
  Expertise: Electrical engineer, Researcher in ICT

  Daniel Mashao joined SITA from June 19 2006 as a Chief Technology Officer (CT0). He is also carrying other responsibilities at the University of Cape Town. Daniel received a PhD degree in electrical engineering from Brown University USA and two MSc degrees one in applied mathematics from Brown University USA and another in electrical engineering from University of Cape Town. Daniel was appointed as associate professor of electrical engineering at the University of Cape Town in September 2005. He has been engaged in many duties in various universities, performed many duties nationally, consulted and many collaborations internationally.

This report was authored by Mr. Teddy Mwakabanga for the LLUC with the guidance of the LLUC.

Expertise: Engineer in Information and Communication Technologies, Researcher in ICT

Teddy Mwakabaga is currently finalizing his doctorate studies at University of the Witwatersrand in the school of electrical and information engineering, Johannesburg South Africa. Teddy holds BSc degree in electrical engineering from University of Dar Es Salaam, MSc engineering degree majoring computer applications and technologies from Central South University China. He has worked in telecommunication industry as an engineer and participated in various ICT projects. In year 2007, Teddy won an international silver award in SIMagine competition presented at the 3G world telecommunication conference in Spain Barcelona.