Local loop unbundling implementation model in South Africa's Information Communication and Technology sector.

TJ Modise

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Abstract

The cellular operators (Vodacom, Cell C, MTN and now Virgin Mobile) market has over 39-million mobile phone subscribers and the fixed operator (Telkom) has almost 5 million subscribers [13]. Although the telecommunication sector has been experiencing this significant growth (in terms of numbers), monopolisation of the local loop by Telkom has also resulted in communication prices that are not affordable to the majority of South Africans. The government of South Africa has identified cost of telecommunication services as one of the key initiatives that must be addressed to improve equal levels of access to ICT services in general.

Local Loop Unbundling (or LLU for short) has been identified by the South African government as a tool that will minimise control that Telkom has over the copper cable connecting exchanges to customers whilst at the same time driving down the costs of Telecommunication in the country. Although some countries have successfully implemented local loop unbundling, some have not been so successful [3]. This dissertation proposes ICT Systems and processes South Africa needs to have in place to become one of the few success stories. The proposed model was validated against the different models adopted in countries like France, Portugal, United Kingdom and Austria.

This dissertation develops a model for implementing local loop unbundling in the South African ICT sector. Local loop unbundling (in short LLU) has been successfully (and unsuccessfully) implemented in a number of countries around the world [3]. The model being proposed recommends best practices to be followed by all stakeholders to ensure successful deployment of local loop unbundling. The research takes a closer look at the South African ICT sector and makes recommendations on processes and systems that are necessary to ensure successful deployment of local loop unbundling in South Africa. The dissertation is written from the view of Telkom (The incumbent Operator), competitors (existing ones and new entrants) and the Regulator (ICASA) and focuses mainly on:

- Technical Processes and Challenges that must be addressed
- Regulatory Process and Challenges that must be addressed
- Economic Challenges that must be addressed
- Comparison to international ICT Markets and
- Recommendations and Conclusions.

The dissertation also covers the development of the Local loop unbundling model charter, Local Loop Management website and processes (Annexure A and B) developed (using HTML) used for the management of the unbundling process.

Keywords:

- Local loop
- Unbundling
- Information Communications and Technology
- Co-Mingling
- Full Unbundling
- Line Sharing
- Bitstream Access
- Caged Co-location
- Cageless Co-location(Co-Mingling)
- Remote Co-location
- Sub-loop Unbundling
- Virtual Co-location
- Interconnection
- Fulfilment , Assurance and Billing
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<td>3G</td>
<td>Third Generation</td>
</tr>
<tr>
<td>ADSL</td>
<td>Asynchronous Digital Subscriber Line</td>
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<tr>
<td>ASGISA</td>
<td>Accelerated and Shared Growth Initiative of South Africa</td>
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<tr>
<td>B2B</td>
<td>Business to Business</td>
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<td>BOM</td>
<td>Business Operations Map</td>
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<tr>
<td>CPE</td>
<td>Customer premises Equipment</td>
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<td>DP</td>
<td>Distribution Point</td>
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<tr>
<td>DSLAM</td>
<td>Digital Subscriber Line Access Multiplexer</td>
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<td>EBPP</td>
<td>Electronic Bill Presentment and Payment</td>
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<td>EP</td>
<td>Enterprise Portal</td>
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<tr>
<td>eTOM</td>
<td>Enhanced Telecoms Operations Map</td>
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<td>EWSD</td>
<td>Electronic Worldwide Switch Digital.</td>
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<td>GUI</td>
<td>Graphical User Interface</td>
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<td>HSDPA</td>
<td>High-Speed Downlink Packet Access</td>
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<tr>
<td>HTML</td>
<td>Hyper Text Mark-up Language</td>
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<td>iBurst</td>
<td>iBurst SA</td>
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<tr>
<td>ICASA</td>
<td>Independent Communication Authority of South Africa</td>
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<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
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<tr>
<td>ISP</td>
<td>Internet Service Provider</td>
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<td>LAU</td>
<td>Logical Area Unit</td>
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<td>LLU</td>
<td>Local loop Unbundling</td>
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<td>MDF</td>
<td>Main distribution Frame</td>
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<tr>
<td>MTN</td>
<td>MTN SA</td>
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<td>OSS</td>
<td>Operational Support Systems</td>
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<td>QoE</td>
<td>Quality of Experience</td>
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<td>RUO</td>
<td>Reference Unbundling Offer</td>
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<td>SARS</td>
<td>South African Revenue Services</td>
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<tr>
<td>Acronym</td>
<td>Definition</td>
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<tr>
<td>SDC</td>
<td>Street Distribution Cabinet</td>
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<td>Sentech</td>
<td>Sentech</td>
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<tr>
<td>SMS</td>
<td>Short Message Service</td>
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<td>SOX</td>
<td>Sarbanes Oxley Act</td>
</tr>
<tr>
<td>TBD</td>
<td>To be Done</td>
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<tr>
<td>TMF</td>
<td>Telemanagement Forum</td>
</tr>
<tr>
<td>USAL</td>
<td>Under Serviced Area License</td>
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<tr>
<td>Vodacom</td>
<td>Vodacom SA</td>
</tr>
<tr>
<td>WiFi</td>
<td>Wireless Fidelity</td>
</tr>
<tr>
<td>WiMAX</td>
<td>Worldwide Interoperability for Microwave Access</td>
</tr>
<tr>
<td>xDSL</td>
<td>X(different variants) of Digital Subscriber Line technology.</td>
</tr>
<tr>
<td>VANS</td>
<td>Value Added Network Services</td>
</tr>
<tr>
<td>POTS</td>
<td>Plain Old Telephone System</td>
</tr>
<tr>
<td>PSTN</td>
<td>Public Switched Telephone Network</td>
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## Definitions

<table>
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<tr>
<th>Definition</th>
<th>Explanation</th>
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<tr>
<td>Local loop</td>
<td>A wire connecting the customer to the exchange.</td>
</tr>
<tr>
<td>Unbundling</td>
<td>A process of separating components.</td>
</tr>
<tr>
<td>Full Unbundling</td>
<td>Type of architecture where Incumbent Operator (Telkom) rents out the entire local loop to the competitor. The competitor takes over everything including the customer who is connected to that local loop.</td>
</tr>
<tr>
<td>Line Sharing</td>
<td>Type of architecture where Incumbent operator (Telkom) uses the local loop to provide voice service only and rents out the higher frequency spectrum to competitors so they can provide other services.</td>
</tr>
<tr>
<td>Sub-loop Unbundling</td>
<td>Sub-loop unbundling is where part (not the entire local loop) of the local loop is leased to another party.</td>
</tr>
<tr>
<td>Caged Co-location</td>
<td>Competitors are provided their own space inside the incumbent's (Telkom's) yard but separate from the rest of incumbent's infrastructure.</td>
</tr>
<tr>
<td>Cageless Co-location(Co-Mingling)</td>
<td>Competitor’s equipment is placed in the same room as the incumbent’s (Telkom’s) equipment without any physical separation.</td>
</tr>
<tr>
<td>Remote Co-location</td>
<td>Co-location option where equipment of the competitor is installed near the premises of the incumbent’s (Telkom’s), but not inside the exchange building.</td>
</tr>
<tr>
<td>Virtual Co-location</td>
<td>Type of co-location where the competitor’s equipment is installed and maintained by the incumbent (Telkom) operator, and the competitor will not have access to the premises.</td>
</tr>
<tr>
<td>Drop wire</td>
<td>Refers to copper connection from the distribution point to the customer’s premises and terminating at the network terminating equipment.</td>
</tr>
<tr>
<td>Tie Cable</td>
<td>A cable that remotely connects the Telkom MDF to competitor’s local loops (i.e. connects MDF to remote buildings and street cabinets).</td>
</tr>
<tr>
<td>Internal tie cables</td>
<td>Links that connects the local loop of the competitor to Telkom’s MDF equipment within Telkom’s site.</td>
</tr>
<tr>
<td>External tie cables</td>
<td>Links that connects the local loop of the competitor to Telkom’s MDF equipment outside Telkom’s site.</td>
</tr>
<tr>
<td>B2B (Business to Business)</td>
<td>B2B (business-to-business) is the exchange of products, services, or information between businesses over the internet.</td>
</tr>
<tr>
<td>acronyms</td>
<td>definitions</td>
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<td>------------------------------------------------------------------------</td>
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<tr>
<td>eTOM</td>
<td>The eTOM describes the processes required by a communications service provider to successfully implement communications support systems and processes.</td>
</tr>
<tr>
<td>Fulfilment ,Assurance and Billing (FAB)</td>
<td>Refers to the three functional areas of the eTOM process.</td>
</tr>
<tr>
<td>USAL (Under Serviced Areas licensees)</td>
<td>A USAL operator provides ICT services to markets in under-serviced areas. The government introduced USAL's with the intention of increasing access to ICT services in areas that have not been adequately serviced by Telkom largely because they are remote, low density and in many cases are inhabited by low per capita income communities.</td>
</tr>
<tr>
<td>ICT (Information Communications and Technology)</td>
<td>ICT is the study or business of developing and using technology to process information and aid communications.</td>
</tr>
<tr>
<td>QoE</td>
<td>Quality of Experience. measure of a customer's experiences from the customer's point of view.</td>
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1. Chapter 1 – Introduction

1.1 Introduction

The current and future capacity of South Africa to generate and sustain access to information and communication technologies (ICT) for its citizens is an important development priority. The Accelerated and Shared Growth Initiative of South Africa (ASGISA), launched by government in 2006, identified key factors affecting South Africa’s drive to achieve 6% economic growth and to halve unemployment and poverty by 2014. One of the factors identified as delaying economic growth in South Africa is the expensive costs associated with telecommunication services [15].

The Information Communications and Technology (ICT) sector plays a key role in the South African economy. It is estimated that the telecommunication sector (which is part of the ICT sector) alone, contributes almost 10% of gross domestic product (GDP) of the country [68]. It is further estimated that the South African cellular industry is the fourth-fastest growing mobile communications market in the world [68].

South Africa’s internet population is expected to grow in the next five years as it has in the 15 years since the internet became commercially available in South Africa. According to a report by World Wide Worx, the number of internet users in South Africa grew by 12.5 percent to 4.6 million in 2008. This is the first time since 2001 the market has grown by more than 8 percent. The increased growth rate is expected to continue for the next five years, taking the internet user population to the 9 million mark by 2014 [67].

The South African government has identified a number of key initiatives that had to be implemented to drive down the costs of Telecommunications services in the country.

Some of the initiatives identified included [17]:

- Adoption of convergence of technologies- blurring the technological divide that existed between Telecoms, Broadcasting and Information Technology.
- Implementation of Local Loop unbundling process to minimise control that Telkom has on local loop and drive down costs of telecommunications.
- Aggressive drive to open up the ICT market by licensing more USAL’s (Under Serviced Areas licensees).
- Introduction of new companies (e.g. InfraCO [18]) that compete directly with Telkom when it comes to Telecommunications network infrastructure rollout projects.
- Encourage government departments, municipalities (e.g. Knysna [19] and Cape Town [20] Municipalities) and other stakeholders to build, operate and maintain their own telecommunication networks.

In his address to the Colloquium on the Pricing of Telecommunications Services in South Africa, Deputy Minister of Communications, Mr RL Padayachie said the following regarding pricing: “It must be widely accepted that ICT’s play an important role in the development of a country. Telecommunication services have become a central part of our everyday life and living, thereby assisting in bringing about improvements in the quality of life of all our people; and leading ultimately to the entrenchment of democracy and the establishment of social cohesion within our society. The pricing structure of telecommunications is vital, especially as it affects the poor, specifically in the take up of phone services and, of course, the Internet. The high cost of telecommunications and the inability to extend fixed line services to the overwhelming majority of the people are major barriers to achieving the necessary critical mass that would impact positively on our economic growth path.” [69]

This dissertation will focus on the local loop unbundling initiative. As indicated earlier, the Local Loop Unbundling (or LLU for short) process has been identified as one of the initiatives that will minimise control that Telkom (the incumbent operator) has over the copper cable connecting exchanges to customers whilst at the same time driving down the costs of Telecommunication in the country.
A local loop can be defined as the copper cable connecting the customer to the exchange [5]. In simple terms, local loop unbundling will enable competitors to use the copper cable connecting the customer to the exchange owned by Telkom to provide ICT services.

Allowing competition on the local loop would put a great deal of downward pressure on tariffs for voice and data services, and substantially reduce the cost of Internet access. Local Loop Unbundling will afford competitors a chance to provide services without replicating the expensive local loop that Telkom is currently owning and operating.

The unbundling process is intended to achieve the following objectives [21]:

- Increase innovation by creating new skills in the ICT sector.
- Increase the number of people who have access to ICT services (such as internet).
- Enable competitors to offer services and products to the following segments of customers:
  - Business customers.
  - Local government municipalities.
  - Residential customers
    - In Urban areas
    - Under serviced rural areas.
- Improve Quality of Experience (QoE) by enabling customers to effortlessly switch between service providers if they are not satisfied with the service they receive from a service provider.
- Lower communication costs by introducing new players in the ICT market. The increased competition might result in a price war and a subsequent decrease in communications costs.
- Increase availability of bandwidth to the South African public.
- Increase the number of business opportunities in the country by introducing small and medium businesses (e.g. more VANS) competing with Telkom.

1.2 Problem Statement

In May 2006 the Minister of Communications of South Africa Dr Ivy Matsepe-Casaburri established a task team to look into the possibility of implementing local loop unbundling in South Africa. The local loop unbundling committee had a mandate to make recommendations on [22]:

- Policy, legal and regulatory issues.
- Technical and engineering processes
- Costing models.
- Competition.

A year later the task team presented a report on how unbundling process should be undertaken in South Africa. The report focused more on technological details of the unbundling process without going into much detail about pricing and timeline challenges. The task team made policy and regulatory recommendations to consider the best model for a successful local loop unbundling process. A policy decision was also made that the unbundling process should be implemented and completed by 2011[5]. In essence this recommendation gives Telkom four (4) years to undertake the unbundling process.

Various Industry experts have raised reservations with regard to the timeline (4 years) given to Telkom as it is a fairly tight deadline if one compares it to unbundling processes in other countries. For example, the unbundling process in France started in 2002 and six years later it is still not yet complete [23].

The report on local loop unbundling was also handed to ICASA in January 2008. ICASA has acknowledged that the unbundling process will have a positive impact in the fulfilment of the Electronic Communications Act and in promoting broadband access within the ICT sector [24].
There is a need to develop a best practise model for local loop unbundling process that will be implemented by all stakeholders in the ICT sector. The model being proposed must ensure successful implementation of the unbundling process in South Africa.

1.3 Hypothesis and Objective – Local Loop Unbundling implementation model in South Africa’s Information Communication and Technology sector.

The objective of this dissertation is to develop a model to implement the local loop unbundling initiative in the South African ICT sector. This dissertation intends to provide South African ICT sector with Systems, Approaches, Procedures and guidelines that if correctly adopted will lead to successful implementation of the unbundling process.

The objectives of the dissertation can be summarised as follows:

- Develop a best practise model charter that summarises the implementation process for the local loop unbundling process (Addressed in section 2.2 of this dissertation document).
- Investigate systems, processes and underlying technologies necessary to ensure successful deployment of local loop unbundling process (Addressed in Chapter 2 of this dissertation document).
- Investigate and make recommendation on basic principles to be followed to ensure successful deployment of local loop unbundling process (Addressed in Chapter 3 and 4 of this dissertation document).
- Develop a sample user friendly website that will be used for the day to day management of the local loop unbundling process (Addressed in Chapter 4, Annexure A and Annexure C of this dissertation document).
- Develop sample management processes to be followed by all stakeholders to manage their local loop unbundling services (Addressed in Chapter 4 and Annexure B of this dissertation document).
- Investigate international case studies focusing on how local loop unbundling was implemented in other countries and the challenges experienced thus far (Addressed in Chapter 3 of this dissertation document).

1.4 List of Deliverables

Below is the list of deliverables that will be delivered by the researcher.

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<thead>
<tr>
<th>No.</th>
<th>Deliverable</th>
<th>Deliverable Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dissertation Document</td>
<td>The dissertation document written as a report on how to model the local loop unbundling process.</td>
</tr>
<tr>
<td>2</td>
<td>Local loop unbundling Model charter</td>
<td>A model charter that gives a high level overview of the unbundling process activities. The model charter maps to different sections of the dissertation document.</td>
</tr>
<tr>
<td>3</td>
<td>Local Loop unbundling Management Processes.</td>
<td>All stakeholders need to be familiar with different unbundling management processes. The processes were developed using the Microsoft Visio tool.</td>
</tr>
<tr>
<td>4</td>
<td>Local loop Unbundling Management Website</td>
<td>A website was developed by the researcher using HTML and Java scripts. This user friendly site models the management of the unbundling process between stakeholders.</td>
</tr>
</tbody>
</table>

Table 1: List of deliverables
1.5 Overview of Dissertation

The dissertation has been broken down into the following chapters:

- Chapter one (1) of this dissertation presents an overview of South Africa’s ICT sector and its impact on the economy. The researcher focused on the following topics:
  - Importance of the ICT sector to South Africa’s Economy
  - Objectives of the local loop unbundling process
  - List of deliverables to be delivered by the dissertation
  - Hypothesis and Objective of this dissertation.

- Chapter two (2) presents a literature review focusing on the different unbundling architectures and co-location models that have been proposed. The chapter focuses on:
  - Local loop unbundling model diagram that gives the reader a birds-eye view of the local loop unbundling process
  - Technological components that make up the local loop
  - Types of architectures recommended for implementation of unbundling in South Africa
  - Types of co-location models recommended for implementation in South Africa

- Chapter 3 presents technical and operational principles focusing on:
  - The different architectures
  - Co-location
  - Costing (Incurred vs. Recovery)
  - Separation models necessary to ensure that discrimination practices are not in play during the unbundling process
  - Different regulatory practices that must be in place to ensure successful deployment of the unbundling process.

- Chapter 4 focuses on the management of the unbundled products and services. The chapter explores the different Operations Support Systems (OSS) processes, principles necessary for management of customer services and products. The chapter focuses on the design, development and implementation of systems that perform Fulfilment, Assurance and Billing of services and products and a dummy website is developed using HTML and Java scripts.

- Chapter 5 is the Conclusion.

- Chapter 6 consists of Recommendations and the document is concluded with proposals for further research.

- Appendix A highlights screenshots for a website which was developed by the researcher to demonstrate how the local loop unbundling process will be managed. The researcher used HTML and Java scripts to develop the website.

- Appendix B is a list of processes that were developed along with the website

- Appendix D is the source code used to develop the unbundling management site written by the researcher.
Chapter 2 Literature Study: Network Architecture Modelling

2.1 Introduction

Duplicating Telkom’s local loop is not an achievable option for competitors since it would involve major new civil engineering projects that are costly and time consuming. It is practically and financially impossible for any competitor in the ICT today sector to duplicate Telkom’s current local loop network especially since it is based on old copper technology that is expensive to rollout and to maintain. Unbundling will enable competitors to enter or compete in the ICT sector without investing heavily in a fully developed local loop network.

Competitors can choose to invest only in some network elements and complement these with usage of network elements already installed by Telkom. Giving competitors access to unbundled network elements will lower the challenges of entry as the investment requirements are lowered.

Experiences from other countries has shown that incumbent operators are reluctant to facilitate access to their networks as it would allow competitors to market services that are likely to directly compete their own. In the past few months Vodacom, MTN, Sentech and iBurst have all improved their broadband packages or lowered their prices and this has posed direct competition to Telkom [67]. It is essential that appropriate regulation is put in place to provide a constructive environment to manage architecture and infrastructure requirements necessary for LLU.

Recently, stakeholders like Neotel, MTN and Vodacom have started investing heavily on ICT infrastructure rollout projects. The focus of this infrastructure rollout projects has not been on the copper cable connecting the customer to the exchange (i.e. local loop) but on transmission and core network technologies (e.g. Optic fibre, Next Generation SDH, IP Core etc.). These stakeholders have not invested on the local loop because they have come to expect (and rightly so) that the local loop will be fully unbundled by 2011. These infrastructure rollout projects are taking place in most of South Africa’s metropolitan cities with the view of providing more services to business and corporate customers [25]

This chapter focuses on the different unbundling and co-location architectures as proposed by the local loop unbundling committee. The first section of the chapter focuses on the unbundling model chart that was developed by the researcher. The unbundling chart aims to give the reader an overview of different sectors and technologies involved in the unbundling process. The rest of the chapter focuses on the literature study on the unbundling architectures. The first part of the literature study introduces the reader to the different architectural (or technological) components that make up the local loop and the remainder of the literature study focuses on the different unbundling architectures. Chapter Three will address best practice principles necessary to implement these proposed architectures and Chapter four will focus on processes necessary to manage these architectures.
2.2 The Local Loop Unbundling Model Chart.

The researcher developed the local loop unbundling model chart (depicted in Figure 1 below) that gives the reader a birds-eye view of the local loop unbundling process. The model chart highlights key topics core to the unbundling process. These topics form the basis of this research and are mapped to different sections of this dissertation document. Some of the topics covered include:

- **Stakeholders** – These are all stakeholders involved in developing, regulating and consuming of unbundling services and products. Some of the key stakeholders that will be impacted by the unbundling process include:
  - Customers (Residential, Business, Government, USALS etc.) – Customers are the key beneficiaries of the unbundling process. The expected impact of the unbundling process on customers is covered in different sections of this dissertation document.
  - Regulator (ICASA) – The regulator is central to the successful implementation of the unbundling process. The role of the regulator is discussed in detail throughout the dissertation document. Chapter 3 proposes principles that the regulator must adopt to ensure successful
  - Service Providers (MTN, Vodacom, Telkom, MWeb, etc.) – Service providers will benefit from implementing the unbundling process architectures proposed in Chapter two and will also have to adopt principles proposed in Chapter three of this document.

- **New Services** – Introduction of LLU will result in new services being introduced in the market place. Competition will also force all service providers to provide good quality, well priced services. All of these will be to the end benefit of customers. The new services that will be offered include (But not limited to):
  - Full Unbundling
  - Line Sharing
  - Bitstream Access
  - Sub-loop Unbundling
  - Support Services (e.g. Security, Electricity etc.)

The unbundling process will also speed up the offering of the following key services to customers:
  - xDSL (ADSL and its variants)
  - Voice (Reselling of Voice in different formats)
  - ISP (Internet access, Security, e-Mail, Hosting etc) services.

- **Processes (technological and operational)** – Implementation of LLU requires the introduction of new processes, principles and frameworks (Work practices). The new processes may require upgrading of existing system or buying of new systems. New processes and principles are discussed in detail in Chapter three and Chapter four of this dissertation.

- **Management of the Unbundling Process** – Unbundling is not a once off event; it is a continuous day to day process that if implemented correctly will benefit all stakeholders. Chapter four of this document introduces the reader to the management website and processes developed for the day to day management of the unbundling process.
Figure 1: Local Loop Unbundling Model Charter
2.3 Composition of the Local loop Network

In the ICT environment, the term network architecture refers to the design principles, physical configuration, operational procedures, and data formats used as the bases for the design, construction, modification, and operation of a communications network.

In the South African fixed line sector, Voice and ADSL connectivity are provided by means of a PSTN (Public Switched Telephone Network) network. The PSTN network is based on connection orientated, dedicated, Time Division Multiplexed (TDM) connections. The local loop network begins at the Main Distribution Frame (MDF) in the exchange and terminates at the Distribution Point (DP) closest to the customer’s premises and is the most costly portion of the PSTN network because it is a generally dedicated facility. Resources are dedicated every time a call is placed between the different parties. The local loop network consists of the following technological components [28]:

- Distribution Points (DP)
- Aerial Cables
- Street Distribution Cabinets (SDC)
- Manholes
- Underground cables (main, distribution and distribution point cables)
- Main Distribution Frame (MDF)
- Switches

The figure below generically depicts the PSTN network architecture. Sections 2.3.1 to Section 2.3.5 provides the reader with an overview of the different components that make up the unbundling architecture.

2.3.1 The Distribution Point (DP)

The distribution point (DP) connects customer lines to the access network. The Distribution Point is connected to the Street Cabinets via distribution cables. Distribution Points can be mounted in Poles or are based inside buildings where they are used to serve a building block. Pole mounted DP’s connect the underground cable distribution network to the overhead cable distribution network [26][27].
2.3.2 Street Distribution Cabinet (SDC)

The street distribution cabinet (SDC) provides a point where different cables from different distribution points are terminated on cross connection strips [26][27]. The SDC can be seen as the aggregation point for different distribution points in the area. From SDC’s customer lines are connected to different MDF (Main Distribution Frames).

![Figure 3: Street Distribution Cabinet (SDC)](image)

2.3.3 The Main Distribution Frame (MDF)

The MDF is the termination point for the local loop [28]. It is the termination point to which the wires from the exchange equipment are permanently wired (this side is referred to as the exchange side) to the line side (or customer side). The MDF is used to connect customer lines to exchange equipment using cross connect wires.

![Figure 4: Main Distribution Frame](image)

The local loop network that forms the basis of this dissertation is divided into 6 regions and each region is further divided into different sub-region known as Logical Area Units (LAUs). A logical Area Unit has one or more exchanges providing services to customer in each LAU.

There are 126 (Alcatel E-10 and Siemens EWSD) switching systems spread across this logical area units used primarily to deliver POTS (Voice), ISDN and ADSL services [26]. The exchanges span the entire country and all stakeholders will have ability to install their equipment (co-locate) at those exchanges.
The switching network connecting different local loop networks has been divided as shown in the table below:

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>E10 Switches</td>
<td>34</td>
</tr>
<tr>
<td>EWSD Switches</td>
<td>86</td>
</tr>
<tr>
<td>EWSD Test Switches</td>
<td>2</td>
</tr>
<tr>
<td>E10 Test Switches</td>
<td>2</td>
</tr>
<tr>
<td>ITE (International Exchanges) Exchanges</td>
<td>2</td>
</tr>
<tr>
<td>ADC (Automatic Distribution Centre)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Switches</strong></td>
<td><strong>126</strong></td>
</tr>
</tbody>
</table>

Table 2: Switches in the network

Figure 5: Example of switches in an exchange

2.3.4 Manholes

Manholes are underground vault openings used to house Telkom (and other service providers) equipment. Manholes are generally found occasionally under sidewalks. Manhole covers are used to cover manholes to prevent accidents [26].

2.3.5 Cabling

Different components of the local loop are connected to each other by means of ground and aerial cables. The underground cable begins at the Main Distribution Frame (MDF) in the exchange and ends at the distribution point (DP) closest to the customer’s premises. The overhead cable network uses aerial cables, suspended underground cables or open-wires to provide services. The Main cable connects the exchange (E-side) of a SDC to the line side of the MDF and the distribution cable is connected to the distribution side of the SDC and connected to the distribution point[26].
2.4 Local loop unbundling Architectures

The Local loop unbundling committee recommended four types of architectures that must be adopted in the implementation of local loop unbundling in South Africa. Selection of these architectures will be influenced by factors such as [5]:

- Geographical challenges of the area – In some areas it will be cheaper to rollout certain types of architectures whilst in certain areas it will not make sense to rollout those same architectures. There will be some cases where it won’t make sense to implement unbundling and alternative technologies might prove to be a better choice (e.g. wireless technologies might be preferred technology in areas where the maintenance of the copper cable is a challenge).
- Status of local loop network (e.g. main distribution frame not compatible for LLU implementation)
- Availability of space in the network (e.g. MDF size).
- Co-location space – Availability of space in the Telkom yard.
- Economic status of the area (economics of scale have proved that it is easier and cheaper to rollout services in high density urban areas than in rural areas).
- Business need - It will be uneconomical to implement Local loop unbundling in areas where low demand for the service is.

The four types of architectures recommended by the steering committee are [5][12]:

- Full unbundling
- Line Sharing
- Bitstream access and
- Sub-loop unbundling.

2.4.1 Full unbundling

In this type of architecture Telkom will rent out the entire local loop to the competitor. The competitor will take over everything including the customer. The competitor will have to install their own equipment (e.g. DSLAM’s, Modems, CPE’s) at a Telkom site and at the customer premises. The process of placing equipment inside and (or) outside Telkom’s exchange building is known as Co-location and is discussed in detail later in the document (Section 2.5.)

During full unbundling it is important to note that the competitor takes full control of the copper pair and can also provide the same voice service that Telkom is providing. The competitor can also decide to enhance the copper allocated to them and provide broadband services such as ADSL [5][29]. Although the local loop has been leased out, it is the responsibility of Telkom to maintain it as it remains the property of Telkom.

Figure 7: Full Unbundling Architecture
2.4.2 Line Sharing

In the line sharing architecture Telkom uses the local loop to provide voice service only and rents out the higher frequency spectrum to competitors so they can provide broadband services. This basically means that Telkom will have to share the line with competitors [5][29].

Telkom and competitors can own the same customer (or copper pair) but provide different services to the same customer (or copper pair). This type of unbundling architecture allows customers to receive different services from different service providers on a single line (e.g. Telkom provides voice service, MWeb provides ADSL and Internet Solutions can provide the Internet access service). By law Telkom is required to have knowledge of all the services rendered on local loops they provide.

This is one of the most difficult (and in some cases impractical) architectures to operate and as a result most stakeholders will not be in favour of this type of unbundling architecture [5][29]. Although line sharing might be cheap, it has its own limitations such as [5][29]:

- Cross talk - Phenomenon that occurs when one wire creates noise into the next wire.
- Interface problems – Telkom is forced to present its interfaces to competitors. Some interfaces were developed in-house with no industry standards followed and competitors won’t easily integrate to them.
- Line sharing may also slow down the speed of digital access due to frequency sharing. In case of simultaneous use of xDSL technology by more than one operator, there may be difficulties in operating at the same time and the ultimate source of disturbances may be difficult to identify.

![Diagram of Line Sharing](image)

Figure 8: Line Sharing

2.4.3 Bitstream Access

In Bitstream access architecture Telkom wholesales its broadband to different competitors. All that Telkom will be doing is to sell its spectrum to different competitors [5][29]. Telkom is responsible for the installation of the LLU equipment (DSLAM’s, Modems, CPE’s etc) and maintenance thereof. The competitors can only provide services based on the infrastructure installed by Telkom. The competitor does not have control over the physical line nor are they allowed to add other equipment. As a result competitors are restricted to supply services chosen by Telkom.

The risk exists that the availability of such a service may induce competitors to remain dependent on the engineering/commercial and network development decisions made by Telkom. Telkom can play dirty by providing an exclusive offer of ADSL broadband access as a retail service to its customers without making a wholesale offer available for its competitors. This method is not favoured by competitors who are competing with Telkom on infrastructure but is a good option for ISPs who compete on services.
Three (3) types of Bitstream access services have been proposed by the unbundling committee for implementation, they are [5][29]:

- Resale of local traffic services- Bitstream access were Telkom sells traffic services to competitors at a wholesale price and the new entrants resell those services at a retail price.
- Bitstream with co-location- Co-location is automatically sold with the Bitstream service
- Bitstream without co-location -Co-location is excluded from the Bitstream service.

2.4.4 Sub-loop unbundling

Sub-loop unbundling is where part (not the entire local loop) of the local loop is leased to another party. Sub-loop unbundling applies to both, full unbundled access and line sharing [5][29].

The researcher has consulted a number of industry experts on the topic of sub-loop unbundling and has come to a conclusion that this form of unbundling is not going to be popular in South Africa as it also failed to take off in other countries where local loop unbundling has been implemented [23]. The complexity of managing sub-loops is the main reason why this form of unbundling architecture won’t take off in South Africa.

2.5 Co-location of the Local loop

Once the unbundling process comes into effect, competitors will be required to place their network equipment (e.g. DSLAMs, Tie cables, Servers etc.) at Telkom’s premises. Co-location refers to the process competitors will follow to place and connect their equipment to the local loop network.

Competitors will require connection of their equipment to the Main Distribution Frame (MDF). One side of the MDF terminates copper wires from the customers’ premises and the other side of the MDF terminates cables from Digital Subscriber Line Access Multiplexer (DSLAM) and the Telkom’s exchange. There are four (4) types of co-location models that have been recommended by the unbundling task team to be implemented in South Africa. These models are [5]:

- Caged co-location
- Cageless co-location
- Remote co-location and
- Virtual co-location.
2.5.1 Caged Co-location

Caged co-location provides competitors their own space inside Telkom’s yard but separate from the rest of Telkom’s infrastructure. For caged co-location a separate room (also known as a hostel) is built within an exchange for the exclusive purpose of housing competitor’s equipment [21][23].

The biggest advantage of this model is that it is secure as it physically separates Telkom’s infrastructure from that of the competitors. This type of co-location allows competitors to have easy access to their equipment at Telkom sites. The hostel can be build to host one or more competitor’s equipment. Implementation costs for hostels are high, because construction may be required to build a suitable room. The hostel will also require fitting with its own heating, ventilation, air conditioning and power system. The hostel needs to be big enough to cater for competitor’s growth [12][30]. Telkom will charge competitors a monthly rental fee for space used in the hostels.

For successful implementation of this co-location model, ICASA needs to ensure that space is provided on a basis which does not discriminate against competitors. Although expensive, caged co-location will most likely be the preferred method of co-location for all stakeholders.

2.5.2 Cageless Co-location (Co-Mingling)

In Cageless co-location there is no physical separation of Telkom’s equipment from that of the competitors. Space is sold on a per-unit basis (one square meter per rack, for example) as a result this form of co-location is cheaper compared to caged co-location [29][30]. Cageless co-location will most likely be unfavourable to Telkom due to technical difficulties and the need to maintain network integrity between different sets of equipment. Racks are installed in any space that is available at the time and the risk of damage to competitor’s equipment is higher.

Once Telkom grants the competitor access to the site, The competitor will have access to any rack within that site. Because racks for a given stakeholder may not be located next to each other, cable runs will also become expensive. A stakeholder may need cabling to run between several different locations within the same exchange. Managing space, recordkeeping, and managing support services (electricity, Ventilation) can become more problematic with cabinet scattered within an exchange.
Cageless co-location will save room space for Telkom as no separate room (hostel) will be required to house competitor’s equipment but will require a good management system (or processes).

### 2.5.3 Remote Co-location

Remote co-location refers to the option where equipment of the competitor is installed near the premises of Telkom, but not inside the exchange building. Equipment can also be installed inside the Telkom yard but not inside the exchange building itself (e.g. Competitor’s equipment can be installed in the building opposite to the Telkom exchange) [5][29][30].

The disadvantage of this arrangement is the possibility that premises near the incumbent’s buildings may not easily be accessible. External Tie cables will be used to connect equipment from the two sites and hence the quality of service may be compromised. The other challenge for remote co-location is that there is an additional cost for the external tie cable.

### 2.5.4 Virtual Co-location

In this type of co-location the competitor’s equipment is installed and maintained by Telkom and the competitor will not have access to the premises [5][29][30]. This form of co-location will be favoured by Telkom and not by competitors as it ensures that Telkom’s equipment is secured at all the times. The fact that competitors won’t have access to the premises means that they wont have access to their own equipment and as a result it only favours Telkom at the expense of its competitors. Competitors are expected to trust Telkom to act in good faith at all times.
2.6 Conclusion

The new unbundling architectures and co-location models will need to take into account large investments made thus far to build the current PSTN network. The current PSTN network will have to be architected (or expanded) to cater for an increased number of service providers that are expected to participate in the unbundling process.

A well architected network will help competitors plan their services by identifying those exchanges with the densest concentration of suitable exchange lines and available co-location space and cross referencing this with publicly available information such as demographics and market profile of the potential LLU service areas. Telkom’s network must be architected in advance for unbundling and Co-location or else there will be considerable delays in implementing the unbundling process. Advanced planning is needed to ensure that space and equipment needed at exchanges are made available in time to ensure successful implementation of the unbundling process.

Chapter two presented a literature study focusing on the different unbundling architectures and co-location models as recommended by the local loop unbundling committee. Chapter 3 will focus on modelling implementation principles that will enable successful implementation of this unbundling architectures and models.
3. Chapter 3 - Modelling Implementation principles for Unbundling.

3.1 Introduction

The unbundling process is going to be a complex, and riskier process to implement because it involves introducing new processes and interventions (both manual and automatic) by all stakeholders. In some cases stakeholders will be forced to introduce new systems for the sake of managing the unbundling process. Chapter 3 proposes specific basic principles that provide guidance to all stakeholders involved in the unbundling.

ICASA will be the guardian of the principles proposed and will have to find ways (e.g. through penalties) to ensure that stakeholders adhere to the proposed principles. Some of the key topics that require basic operational and technical principles include (but not limited to):

- Co-location and Capacity planning (Section 3.2)
- Costing (Incurred vs. Recovered) (Section 3.3)
- Cable Management
- Regulatory
- Separation and
- Network Security

The principles proposed for the key topics identified above seek to find resolution to complex operational and technical unbundling issues that would otherwise take along time (or in some cases impossible) to resolve. The key driver of this chapter is to identify principles for smooth operations when implementing the unbundling process whilst at the same averting possible friction between different stakeholders.

The principles proposed in this chapter are based on work done by researcher to investigate and identify best practice principles already implemented in four counties (Portugal, United Kingdom and Austria [45]). The researcher identified and proposed only those principles that are practical and realistic to implement in the South African ICT sector.

3.2 Modelling Architecture and Co-location principles

It is critical for ICASA to work very close with all stakeholders to ensure fairness in the management of proposed architectures and space allocation. All stakeholders must be informed to make sure that they understand the different architectures and co-location options available to them. The researcher investigated best practices necessary to implement the local loop unbundling processes and has proposed the following recommendations (based on international case studies)[31][39]:

- ICASA must develop rules that require Telkom to keep records and reports on all interactions related to LLU.
- Exchange and provision of information should be agreed between all stakeholders in a non-discriminatory fashion, and the information should be updated at agreed, regular intervals.
- The process for provisioning of co-location space should be documented including agreed timescales for each stage of the process. Where these timescales are not met the party concerned should offer an explanation for delay and may be subject to pre-defined penalties and/or sanctions.
- Competitors requiring caged space must be allocated space inside a room (hostel). If any competitor requires more space than initially allocated, then a request for an additional space must be made. This process will be followed until all available space has been allocated. The principle of “first come, first serve” must be adhered to at all times to ensure fairness.
- If the competitor requests a space inside the hostel and Telkom realises that it can’t provide the required space, then Telkom must advise the competitor about this and also suggest alternative arrangements to the competitor (e.g. propose Cageless co-location where possible).
• It is the responsibility of all stakeholders to ensure that all operational processes are in place (e.g. partitioning of space, human resource, skills, machinery, etc.) to support the co-location process.
• In a case where a request for space is refused, Telkom must ensure that there is sufficient reasoning (technically or otherwise) to support the refusal of requests.
• Telkom will have to ensure that all minimum basic services (Electricity, Ventilation, Security, etc.) are available at co-located areas to enable competitors to provide services effectively.
• In a case where no hostel space is available, Telkom must be given permission to mount competitor’s equipment next to each other (or next to Telkom’s) without a physical partition between them (this process is known co-mingling).
• In a case where MDF extension is required (and it is possible), Telkom must provide additional space next to the MDF. The costs associated with this MDF extension will be recovered from the competitor requesting the extension.
• Remote co-location must be considered as the last alternative to Cageless and Caged co-location. ICASA must ensure that Telkom exhausts all Caged and Cageless co-location options before pursuing with remote co-location option.
• Remote co-location shall take different forms ranging from connecting of buildings owned by Telkom (and competitors) to connecting of newly installed street distribution cabinets.
• An external tie cable will be required for remotely connecting the MDF to the local loops. The external tie cable can be supplied by either the competitor or by Telkom.
• If Telkom is requested to connect to a remote site, it reserves the right to decline the request. Provided it can prove the challenges with the remote site.
• Telkom should be encouraged to implement electronic access systems within local exchanges which will permit control of access by competitors on an unescorted basis, including after hours access.

3.2.1 Co-location Lists

In order for all stakeholders (ICASA, Telkom and Competitors) to plan and make decisions about the local loop unbundling services they will need accurate information about the status of the local loop network. The co-location list addresses the level of information that needs to be made available and the pre-conditions of its availability (i.e. what contracts, if any, should be in place between the stakeholders).

This information must be as accurate as possible and must be readily available focusing on [32]:
• Location of each device on the local loop
• Location of exchanges
• Coverage of exchanges
• Size of MDF (i.e. number of lines on an MDF)
• List of street names covered by an exchange
• Information concerning line characteristics.
• Sites where local loop unbundling is available
• The electrical parameters of the local loop
• Any work underway on the Local loop
• Number of “unbundled” local loops and “shared” local loops per site
• Number of operators per site.
• Pending requests for sites and for lines
• Additional services (electricity, Security, Air-con etc.)
• MDF space available with extension
• Availability of material (e.g. Tie Cables).
It is the responsibility of Telkom to ensure that all this information is made available on the unbundling management website and updated on a regular basis. The researcher has developed a local loop unbundling management website (depicted on the Figure 13 below) similar to the one that will be required to manage the unbundling process. Stakeholders will use information from the site to base their rollout plans.

Where there is uncertainty about the availability of co-location at a particular MDF site competitors can obtain accurate and up-to-date information by requesting that Telkom conduct an onsite survey or competitors (or ICASA officials) being allowed to visit the sites.

3.2.2 Liabilities associated with Co-location.

Liability is defined as the state of being legally obliged and responsible [70]. As indicated earlier in the document (Section 2.5.2), during co-location risk of damage to competitor’s equipment is high. Co-location gives rise to a range of generic and inter-related liability issues.

Liabilities are used to help define obligations between stakeholders in the event that there is any damage or loss to one stakeholder as a result of actions or inactions by another. Liabilities must be clearly defined so that all stakeholders understand the extent of their liability in all situations and, therefore, adequately assess the level of risk that they face.

3.3 Modelling costs related to local loop unbundling

Two types of competitions exist in the ICT sector, namely service based competition and infrastructure based competition. Service based competition is where service providers compete with each other based on the type of offering (or Service) they provide (e.g. Internet Speed provided by Polka.com is faster than that provided by M-Web). Service offered becomes the main differentiator between service providers. Infrastructure based competition takes place where the stakeholder compete based on the infrastructure (or technology) deployed (e.g. Vodacom has rolled out fibre infrastructure to provide mobile TV service whilst MTN does not have the infrastructure) [33][10].

The underlying infrastructure (or technologies) will most likely determine the type of services the service provider is likely to offer. Infrastructure based competition allows for the creation of new networks based on the best possible use of the competitive opportunities offered by new technologies.
If more focus is placed on the service based competition, then ICASA runs the threat that acceleration of competition on services could minimize the chances of long term investment in alternative infrastructures. ICASA needs to collaborate with all role players in the telecommunication industry to develop a model for calculating costs of providing local loop unbundling (this includes interconnection) services.

In South Africa, the case for local loop unbundling was presented in economic terms as a means to bring competition in the ICT sector and the result thereof will be a reduction in communication costs. Simply put, unbundling of the local loop aims to stimulate competition in the local loop [15]. Whereas the roll out of alternative local networks requires huge investments and takes time, unbundling allows new entrants to enter the local market and win market share more quickly[5][10].

The terms and conditions of unbundling influence the market competition and, hence, alter industry profits. This is because Telkom can decide to adopt a costing model that discourages competitors to enter the market, by proposing ridiculous pricing structures. The other setback that might arise as a result of unbundling is where Telkom views the unbundling processes negatively and decides not to invest in the upgrading and maintaining its local loop network.

The following value propositions should be the target goals that must be targeted [33][39]:

- Encouraging the use of existing Telkom infrastructure where this is desirable, thereby avoiding duplication of infrastructure by other stakeholders. This process is known as Incentive to buy [33].
- Encouraging investment in new infrastructure where this is justified from an economic point of view. This can be done by either encouraging competitors to invest in new infrastructure or Telkom upgrading and expanding its existing networks (This process is known as Incentive to build).
- Increasing the transparency of cost calculations underlying the local loop services.
- Increasing predictability for both Telkom and competitors with regards to future determination of access and interconnection charges.

### 3.3.1 Modelling Cost incurred vs. Cost Recovered

Telkom will definitely incur costs associated with local loop unbundling. The only way to recover the costs incurred will be through prices Telkom charge to stakeholder. In return, competitors will recover the costs from their customers who will consume services. Pricing of services and products will differ depending on the type of unbundling architecture implemented by a stakeholder. For example, with line sharing unbundling, Telkom will remain the provider of voice telephony, thus competitors will only pay costs related to the use of higher frequency services such as ADSL.

Stakeholders will have to design and build new processes and systems in order to implement and manage the unbundling process. If take-up of unbundling is low in South Africa as it was in other countries, the set-up costs may never be recovered again. Costing and pricing principles for unbundling should be transparent, non-discriminatory and objective. Costing and pricing rules should encourage fair and sustainable competition and ensure that there is no distortion of competition. Setting such environment requires a regulatory muscle and an unquestionable participation from all stakeholders.

Although commercial negotiation is the preferred method for reaching agreement on technical and cost related issues for local loop access, experience in other countries has shown that regulatory intervention will be necessary due to an imbalance in negotiating power between the competitor and the incumbent operator.
The reader is referred to section 3.5 for information on international experiences related to LLU implementation. Charges that will be incurred from implementing the unbundling process include [36]:

- Unbundled loop charges
- Co-location charges
- Internal tie cables charges
- External tie cables charges
- Charges for additional Services (e.g. Security, Electricity, Ventilation etc.)
- Rental charges
- Connection charges
- Disconnection charges
- Local loop Maintenance charges
- Operational Support Service (OSS) charges
- Charges related to conversion between service providers
- Etc.

These costs can be grouped into the following four categories [33]:

- Once-off costs
- Co-location Costs
- Monthly recurring costs
- Interconnection Fees

Some of the costs will overlap between the different categories.

### 3.3.1.1 Once-off costs

Telkom should be allowed to pass on the costs incurred for the additional (construction and adaptation) work needed by other stakeholders. Care must be taken to ensure that the accounting approach adopted by Telkom is not misleading or distorted. Auditing of initial set-up costs may be required to ensure that all are costs are recovered without prejudicing stakeholders.

It is important that all construction and adaptation costs are declared upfront to enable stakeholders to draw future financial and network plans. The principle of cost-orientation will ensure that “once-off” costs are only recovered once for all unbundled services (e.g. the costs of MDF extension will be once off charges that must be shared by all involved stakeholders (Telkom included)).

Examples of once-off charges include (but not limited to) [36]:

- Service Connection charges
- Service Disconnection charges
- Tie cables (External an Internal)
- MDF Extension charges.

### 3.3.1.2 Monthly recurring costs

Monthly recurring costs will be paid to Telkom on a monthly basis. Examples of monthly recurring costs include (but not limited to) [33]:

- Monthly loop rental charges
- Costs relate to the maintenance of the local loop network
- OSS related costs
- Additional Support Services (e.g. Security, Electricity, Ventilation) costs.

### 3.3.1.3 Co-location Costs

Co-location costs must also be passed on to stakeholders requesting the co-location service [32]. Up front co-location costs incurred for setting up co-location facilities might vary largely with the situation at the different sites and different geographic areas.
Some of the co-location costs that will be passed on to the end customer include [33]:

- The cost of renting space
- Site preparation
- Space utilization in the rack (for Cageless co-location)
- Exchange site surveys and
- Utility usage.

### 3.3.1.4 Interconnection Fees

Interconnection refers to the linking of one stockholder’s equipment (or network) to that of the other stakeholder. Interconnection fees can then be defined as the fees associated with the linking of the equipment between different parties or fees that operators charge each other to connect calls to one another [37].

The regulation of interconnection between Telkom and its competitors is crucial for the management of the local loop unbundling process.

High interconnection fees will demoralise competition and the only benefactor will be Telkom and this will result in failure of the unbundling process. On the other hand, interconnection fees must not be very low in that they discourage investment in new network facilities or lead to the extinction of Telkom.

It is important to take into consideration issues such as how the level of competition will be affected by the level of interconnection fees as well as how the level of interconnection fees affect the level of competition infrastructure investment [38].

### 3.3.2 Modelling best practice costing principles

The researcher investigated best practices necessary to model costing for local loop unbundling and has proposed the following recommendations (based on research and interviews undertaken, on international case studies)[39][40]:

- Although care must be taken that Telkom recovers all its LLU implementation charges, ICASA (with the help of all stakeholders) must ensure that costs claimed by Telkom accurately reflect the costs incurred in offering access to its local loop. This is done to ensure that there is transparency and accountability from the side of Telkom.
- In a case where no new infrastructure is required, ICASA shall request Telkom to set charges on the basis of “Net replacement costs”. Net replacement cost’ means that costs already recovered, for example through depreciation, are excluded.
- When the loop is transferred between stakeholders, the disconnection charge must be borne by the operator who is gaining the customer.
- The agreement on the terms and conditions of the rental of a loop will be entered into by stakeholders and must be reflected in the SLA (Service Level Agreement).
- ICASA must introduce ceiling prices for all LLU related services. Any changes to the ceiling prices will have to be approved by ICASA and proposals for price changes must be submitted a month (or any feasible period) before the change required can be implemented. This will allow ICASA enough time to review and make a ruling on the changes requested.
- ICASA must keep LLU prices under review and may from time to time, where justified, impose changes on the prices where it deems it necessary. This will be done to ensure fair competition and maximum benefit for all stakeholders.
- Costing must be influenced by the type of unbundling architecture the competitor requests. For full unbundling, the competitor will install a new telephone line to the customer premises. In some cases customer might already have an existing line from Telkom. This might pose a challenge because customers wanting to retain their Telkom line and use competitor for broadband would require two separate lines.
• The biggest challenge with modelling line sharing is how to share costs between Telkom and the competitors. It is advisable that the costs of the loop be shared equally between voice and data with lines rented under line share being effectively treated as half lines.
• Charges related to support service (e.g. Electricity, Ventilation) must form part of the monthly or annual rental payments.
• Charges related to work done on behalf of the stakeholder (e.g. cases where a Telkom technician is dispatched to clear a fault on behalf of MWeb, etc.) must also form part of the annual or monthly payments agreed upon between Telkom and competitors.
• Local loop Maintenance and repair costs must be paid on a monthly or annual charge and be based on a contractual agreement between stakeholders.
• Costs related to OSS (e.g. testing of lines, resolution of faults, new orders, and performance Management etc.) must form part the service level agreements between parties. These costs will vary depending on the operations requested a stakeholder. OSS costs will vary per individual case and will be influenced by factors such as: average number of tests performed, faults cleared etc.
• Operating charges associated with end-user management and unbundling start-up cost must be investigated and be based on the research and interviews undertaken on international best practice.
• Telkom must request payment of all fees for the use of each loop for a minimum term of one year, regardless of whether the agreement entered into with the client remains in force or not.
• Competitor specific work must be undertaken and paid for by the relevant competitor and will not form part of the common set-up costs.

3.4 Modelling Separation for the LLU Management

The local loop unbundling task team has proposed that a separate entity (or company) be created that will oversee the overall LLU implementation and management process. This unbundling management structure will be controlled by ICASA and will ensure that the local loop process delivers as per expectation. The role of this unbundling management organisation will be [7]:

• Management of the rollout of the local loop unbundling process.
• Management of process of switching of customers from one provider to the other.
• Ensuring that there is fair access to the local loop.
• Optimising the unbundled loop for regulation and Management

The proposed unbundling management structure will guarantee non-discrimination practices and will prevent Telkom from discriminating its competitors. The unbundling committee further recommended that Telkom go through a separation process where the management of the local loop in the company is handled by a separate business unit separated from the rest of the company [6]. This form of separation (Functional and Accounting) entails the setting up of a new business unit within Telkom that will be responsible for managing access to the local loop for all stakeholders [42].

Accounting and functional separation models will enable Telkom to prepare and disclose information about local loop network independently of the rest of the company. The primary objective is to improve the financial and economic transparency of regulated activities. It is expected that this new Telkom business unit will work with the proposed ICASA third party organisation to ensure the unbundling process is implemented smoothly.
The table below briefly describes accounting and functional separation models that Telkom will have to adopt.

<table>
<thead>
<tr>
<th>Form</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting Separation</td>
<td>Individual Financial reporting for each of Telkom’s businesses in overall regulatory accounting</td>
</tr>
<tr>
<td>Functional Separation</td>
<td>Establishment of new, separate business unit with sufficient protection to differentiate it from other parts of Telkom</td>
</tr>
</tbody>
</table>

Table 3: different Types of separations

Separation will be considered successful if Telkom can implement the unbundling process based on the “Equality of access” principle, where Telkom offers:

- Same products & services to its competitors as it does to itself
- Same time-scales, terms & conditions to its competitors as it does to itself
- Same systems & processes to its competitors as it does to itself
- Same reliability & performance to its competitors as it does to itself and
- Same commercial information to its competitors as it does itself.

3.4.1 Challenges that result from Separation

Countries that have implemented separation have seen little if any investment in high speed broadband. In the UK, New Zealand and Ireland, separation has resulted in no significant new investment and imposed substantial costs that are ultimately borne by consumers [42]. The other challenge of separation is that it does not provide incentives for investment in infrastructure (and technology). Telkom might view the unbundling process negatively and be discouraged from investing in new access technologies.

3.5 Modelling Regulatory environment for Local Loop Unbundling

The market for telecommunications in South Africa is regulated by the Electronic Communications Act (ECA). Section 43(1) of the Act reads as follows: “...an electronic communications network service licensee must, on request, lease electronic communications facilities to any other person licensed in terms of this Act...” [44].

The ECA act defines communications facilities as facilities such as local loops, sub-loops and associated electronic communications facilities for accessing subscribers and provisioning services. ICASA is the regulatory body that is responsible for the regulation of Information Communication and Technology (ICT) sector. ICASA derives its mandate from four statutes, these are [43]:

- ICASA Act of 2005
- Independent Broadcasting Act
- Broadcasting Act and the Telecommunications Authority Act and
- ICASA Amendment Act.

Functions of ICASA include:
- Make regulations and policies that govern broadcasting and telecommunications
- Issue licenses to providers of telecommunication services and broadcasters
- Monitor the environment and enforce compliance with rules, regulations and policies
- Address disputes and complaints brought by industry or members of the public against licensees
- Plan, control and manage the frequency spectrum and
• Protect consumers from unfair business practices, poor quality services and harmful or inferior products.

“Universal Service and access: It is the policy of the Government of South Africa that all people should have access to basic communication services at affordable prices. The role of ICASA as a regulator is central to achieving this goal. The Authority promotes the attainment of universal service and access by putting requirements in operator’s licenses to roll out services in under-serviced areas and ensuring that licensees contribute to the Universal Service Fund” [43].

It is expected that Telkom (Like other operators around the world have done) is likely to introduce measures to delay the unbundling process. There is a likelihood that Telkom will start by denying competitors access to its local loop. And if the denial strategy doesn’t work, Telkom will in most likely adopt a method of delaying the implementation process.

The delaying part might be adopted by means of appealing against each and every regulatory decision seen to be in favour of competitors. And all of these might result in a climate of legal and business uncertainty. After exhausting the delaying process, Telkom might adopt a “discourage (or frustrate)” approach [45]. This approach will be adopted to frustrate competitors from entering the LLU market. One way to increase frustration of competitors is to ensure that competitors can’t afford the price of entering the LLU market.

The process of denying, delaying and discouraging competition has widely been adopted by incumbent operators around the world and is widely known in other countries as the 3D process [45]. The 3D process will help Telkom extend its grip on the customer base whilst the legal processes are still being fought in court or at the competition commissions.

Telkom will use the extended timeline to sign long term deals with their customers whilst they continue to appeal ICASA rulings. From research and interviews undertaken on international case studies, ICASA must embrace itself to deal with allegations relating to [45]:

• Predatory pricing
• Margin squeezes
• Delays in provisioning
• Failure to meet Delivery terms
• Absence or scarcity of information relating to networks or services
• Refusal to offer shared access and
• Quality of service issues.

The researcher identified four countries that are in the process of implementing (or have already implemented) the unbundling process and investigated the challenges that are being experienced in those countries. The four countries identified are [45]:

• France
• Portugal
• United Kingdom and
• Austria
The table below provides a summary of the challenges identified by international case studies:

<table>
<thead>
<tr>
<th>Country</th>
<th>Alleged Refusals to Supply Access  (Deny)</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>France Telecom is claimed to have refused to offer Co-location facilities in a large number of exchanges on the basis of space deficiencies, legal difficulties or security risks. No alternative solutions were proposed. It has been claimed that the refusals in Paris have been associated with areas in which France Telecom has already launched DSL services. It has also been alleged that France Telecom imposes questionable operational restrictions on the use of loops.</td>
</tr>
<tr>
<td>Portugal</td>
<td>It is reported that express refusals of physical Co-location by the incumbent in exchanges considered by new entrants to be priority and were Portugal Telecom is already offering ADSL services. The incumbent also restricts access to certain sites for Co-location purposes.</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>One respondent drew attention to British Telecom’s refusal to provide physical Co-location at one local exchange, claiming insufficient Co-location space.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Alleged Unjustifiable Delays  (Delay)</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>A process whereby the provisioning of local loops should be completed within 19-22 days has yet to be tested, although new entrants fear the process could be abused by France Telecom, thereby causing delays. In addition, operators consider that the process for the provision of Co-location does not facilitate the mass marketing of DSL services. The provisioning of Co-location facilities is completed within 4 months of the operator’s acceptance of a specific project.</td>
</tr>
<tr>
<td>Portugal</td>
<td>Operators have already experienced serious delays in relation to the three exchanges that have been operative since June 2001 as part of a pilot scheme. One operator complains about the delays associated with the supply of E1 backhaul capacity (required to provide connections to collocated facilities). Operators are already reporting infringements of these delivery times, despite the recent commencement of the local loop unbundling process were Portugal Telecom is already offering ADSL services. The incumbent also restricts access to certain sites for Co-location purposes.</td>
</tr>
<tr>
<td>Austria</td>
<td>One responding operator reports that the provision of a single unbundled line requires between four and six months. Meanwhile, another operator states that the waiting time for the provision of multiple unbundled lines is only about 3 weeks.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Alleged Tying to the contract (discouraging new entrants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>Operators claim that the quality of service offering of France Telecom does not permit them to replicate the incumbent retail offers. For example, they contend that the guaranteed repair time of four hours only applies in business hours.</td>
</tr>
<tr>
<td>Portugal</td>
<td>There is no experience in terms of line quality as the LLU process has just commenced. Nevertheless, operators allege important problems with repair times and highlight that Portugal Telecom is not obliged to offer access seekers the same repair schemes as it offers its own customers.</td>
</tr>
<tr>
<td>Austria</td>
<td>The majority view appears to be that Telekom Austria’s retail prices are artificially low, which significantly hinders new entrants’ ability to make a profit using unbundled local loops.</td>
</tr>
</tbody>
</table>

Table 4 : Local loop Unbundling: Research and Interviews -International Experience
Telkom was given four years to complete the Local loop unbundling process. The Unbundling process was commenced in 2007 and is expected to be completed by end of November 2011 [71]. The timeframe laid down for LLU to be completed by the Department of Communications has drawn criticism from many sectors of society, but the researcher believes that this is unfair criticism to the department considering the fact that other countries have actually estimated that the process will take more than 10 years to complete. It is anticipated that the 3D process will be used as a tool to extend the target date to go beyond the November 2011 target date.

“I wish people would not interpret things like this incorrectly. Unbundling the local loop can take between eight and 15 years and so we have set an ambitious target. The main challenge is to get everybody ready for a change and this includes telecommunications companies, corporations, the media and consumers,”[71] - Communications minister Ivy Matsepe-Casaburri

3.5.1 What ICASA needs to do to avoid these challenges?

It is expected that stakeholders will lodge complaints against each other and ICASA will resolve most of the complaints by means of having a dialogue with the stakeholders involved to try to reach a settlement. Many controversies and issues will be resolved this way, for instance through stakeholders voluntarily changing routines and procedures that are not working or deemed to be in their favour at the expense of their competitors. If a stakeholder fails to correct its actions, ICASA will issue a warning and ultimately a fine will be imposed. All stakeholders must be allowed to contest ICASA’s decisions at the court of law.

3.5.2 Modelling best practice Regulatory Principles for Local loop unbundling

The researcher investigated best practices necessary to model regulatory environment for local loop unbundling and has proposed the following recommendations (based on international case studies [39][36]):

- ICASA (with the help of all stakeholders) must ensure that there is equal treatment of all stakeholders. This will be done by enforcing the “equality of access principle” for services, processes, technologies and prices.
- ICASA must establish an unbundling management structure which will introduce a formal authorisation process ensuring that each new service and product be made available to all stakeholders at a fair price.
- Telkom is expected to prepare a RUO (Reference Unbundling Offer). The proposed Reference Unbundling Offer (RUO) must give details of the unbundling services on offer along with their associated tariffs.
- Telkom must be obligated to accept any reasonable request from competitors to gain local loop access. This obligation includes access to technical interfaces, protocols, Operational Support Systems and other key technology needed for local loop access.
- ICASA must take exceptional care when dealing with space allocation process because this issue is central to a rapid and effective implementation of unbundling services.
- If the space in the exchanges is not available, it is the responsibility of Telkom to propose alternative technologies (such as remote co-location) to competitors.
- In a case where no alternative technology exists for space allocation (and it is deemed feasible by all stakeholders) Telkom shall acquire new premises and infrastructure necessary to provide local loop services.
- Site preparation costs shall be assessed on a case by case basis in relation to external factors such as competitor’s requests and the specific features of each individual site.
- Co-location charges shall be assessed exclusively for the portion of site under the competitor’s control, therefore excluding common areas, which are deemed to be non essential by the operator for the delivery of its services.
- ICASA shall reserves the right to review service supply conditions in the light of the progressive development of LLU.
• Telkom reserves the right to decide how connection of co-located sites with the competitor’s premises is accomplished, i.e. whether connection is carried out through the use of leased lines or using dark fibre.
• In terms of delay, ICASA must introduce a penalty system, which is proportional to delays incurred and with no maximum limitation.
• If any of the stakeholders fails to perform contractual commitments (as promised on the SLA), that stakeholder will be forced to pay a rebate to competitors. The amount of compensation should also be based on an estimate of an average operator's resulting loss.
• For Full Unbundling, Telkom must offer a separate fully unconditioned local loop service, providing access to raw copper local loops, and sub-loops.
• All stakeholders must ensure that there are new processes and work practices in place for the implementations of the unbundling process. As a result it might be necessary to upgrade or acquire new OSS systems (for more information on OSS systems the reader is referred to section 4).
• ICASA must ensure that the introduction of local loop unbundling should not discourage investment in the local loop industry. It will be advisable for ICASA to reserve the right to review service supply conditions in the development of LLU.
• All operators must notify ICASA 30 days before introducing any tariff change. This will enable ICASA to appeal against any unjust tariff adjustment.

3.6 Conclusion

ICASA must play an interventionist role in the unbundling process between stakeholders by making informal, and if necessary formal, decisions, almost “on the spot”. The best practise implementation principles proposed in Chapter three must be adhered to at all times. A proposal is made that unbundling management structure be formed focusing on different technical and operational problems (e.g. Co-location, Regulation, Economics, etc.) under the supervision of ICASA. The unbundling management structure should be encompassed of Telkom, competitors and ICASA. The unbundling management structure must not only establish a process for resolving technical and operational issues, but also ensure that all stakeholders adhere to proposed principles. It will not be possible to resolve all issues relating to unbundling through this structure.

ICASA must also request Telkom to make public a project plan for implementation of LLU which will set the milestones for agreement on key operational and technical requirements, monitor progress against this project plan, ensure that each participant has made the resources available for the project. If implemented correctly, costing and regulatory principles for local loop unbundling will ensure that there is no distortion of competition between stakeholders.

Chapter 3 focused on technological and operational principles necessary to rollout the unbundling architecture and co-location models identified in Chapter 2. The next chapter (Chapter four) will focus on development of processes (and website) necessary to manage local loop unbundling.
4. Chapter 4 - Modelling Management of the unbundling using Operations Support Systems (OSS)

4.1 Introduction

Chapter three focused on technical principles necessary to implement the unbundling process. Chapter four will focus on the processes necessary to manage LLU services and products. It is important to note that management principles discussed in Chapter four are different from the implementation principles introduced in Chapter three as they focus more on the day to day management of unbundled products and services. A website has been developed by the researcher that is inline with the principles and processes introduced in both Chapter three and Chapter four.

The first part of Chapter four introduces the reader to systems (known as OSS systems) necessary for day to day management of the unbundling process. The systems identified are based in international case studies and the experience of the researcher. The chapter also introduces basic principles, processes and website that will make it possible to manage unbundled products and services.

Operations Support Systems (OSS) are systems used by stakeholders for management of services and products. OSS systems will allow stakeholders involved in the unbundling process the ability to perform Fulfilment (Installing), Assurance (fixing) and Billing local loop services. The researcher identified the necessary systems based on a research of international case studies and recommendations made by the TeleManagement Forum. The eTOM (Enhanced Telecom Operations Map) is a communications standard developed by the TeleManagement Forum (www.tmforum.org) to describe all the processes required by a communications service provider to successfully implement communications support systems and processes [49].

The eTOM also provides a neutral reference point for internal process reengineering needs, partnerships, alliances, and general working agreements with other stakeholders. For more information on the eTOM and TMF work, the reader is referred to the TMF website [48]). OSS’s focuses on the design, development and implementation of systems that perform [47]:

- Business/Partner Relationship Management
- Customer Order Management
- Service Installation and Activation Management
- Service and Resource Testing Management
- Network and Service Inventory Management
- Trouble Ticket Management
- Fault Management

The eTOM has defined a Business to Business (B2B) Business Operations Map (BOM) framework that defines the processes necessary to manage the day to day business interactions of ICT companies and their partners (or competitors)
The TMF’s eTOM processes can be divided into three functional areas (i.e. Fulfilment, Assurance and Billing Processes)[48] as depicted in the diagram below. The functional groups are explained in Sections 4.1.1, 4.1.2 and 4.1.3.

**4.1.1 Fulfilment**

The fulfilment process grouping (indicated in figure 15 below) is the first process grouping from the eTOM that the researcher focused on for the management of the unbundling process.

- Partner/Business Relationship Management Systems
- Inventory Management System and
- Order Management System.

The systems and processes necessary to fulfill services are explained in more details in subsequent sections of this dissertation document.

**4.1.2 Assurance**

The assurance process grouping (indicated in figure 16 below) is the second process grouping from the TMF’s eTOM the researcher focused on for the management of the unbundling process.

The Assurance process grouping is concerned with all the process activities that are needed to monitor and maintain resource and service quality [47]. The eTOM’s assurance process grouping details systems that must be in place for the assurance of services.
The four systems identified from the e-TOM that must be in place to ensure successful assurance of local loop unbundling services are the [47]:

- Fault Management System
- Performance and SLA Management System
- Test Management System and
- Trouble Ticket Management System.

The systems and processes necessary to assure services are explained in more details in subsequent sections of this dissertation document.

### 4.1.3 Billing

The Billing process grouping (indicated in figure 17 below) is concerned with all the processes that are needed to perform billing, from collection of billable vents from the Local loop network to the settlement of the bill. The Billing process grouping is the third process grouping from the TMF’s eTOM the researcher focused on for the management of the unbundling process.

![Business Operations Map](image)

**Figure 17:** Indicating the Billing process grouping on TMF’s eTOM

The figure below depicts a summary of OSS systems that the researcher believes are necessary for the implementation and management of the local loop unbundling process.

![Summary of OSS systems necessary for LLU implementation](image)

**Figure 18:** Summary of OSS systems necessary for successful LLU implementation
4.2 Modelling a Business/Partner Management Process for LLU

Different communication channels will be used to share information between stakeholders to ensure successful LLU implementation. Some of these channels include (but not limited to):

- Fax
- Email
- Telephone
- Post mail
- Electronic business-to-business interface (Web-based GUI).

It is expected that all stakeholders will have access to the same type of information regardless of their preferred channel of communication. Telkom (like other service providers) has realised that the channel that will be most suitable /favourable for information sharing between stakeholders is the Electronic business-to-business interface (Web-based GUI) [51]. This realisation has led Telkom and other service providers to start with projects related to development of Enterprise Portals (EP’s) that will enable all stakeholders access to systems and processes via business-to-business gateways [50].

The ability for competitors to access Telkom’s OSS systems will enable them to plan the roll-out of their service offerings and at the same time support functions required to provision unbundled lines. The Electronic business-to-business (Web-based GUI) interface that stakeholders are going to use needs to:

- Enable stakeholders to communicate information in real time
- Provide the capability to track orders, faults and any other form of interaction between stakeholders.
- Easily integrate to existing and future stakeholders systems and processes
- Be scalable and flexible to accommodate the increased volumes expected with LLU
- Be supported (or available) on 24X7.

As indicated earlier in the document the researcher developed a sample website similar to the one that will be required to manage the local loop unbundling process. Registration and logon pages were developed (depicted in the two figures below) to enable stakeholders to register, login and manage their services.
Figure 19: Local Loop Unbundling, Registration Page.

Figure 20: Local Loop Unbundling: Login Page
4.3 Modelling Pre-Ordering and Network setup requests

The objective of pre-ordering process is to ensure that competitors have the information required to make choices about infrastructure to provide the service required by a customer and plan service continuity. Pre-Ordering normally takes place when competitors want to connect new services to unbundled networks and systems [47].

A competitor can request information related to local loop setup from Telkom. This information will be required by competitors to help them plan ahead for rollout of new services and products. The information during the pre-ordering stage may include [39][12]:

- The composition of the loop
- The local loop length
- Work underway on the Local loop
- Location of exchanges
- Coverage of exchanges
- Size of MDF (i.e. number of lines on an MDF)
- List of street names related to exchange
- Information concerning line characteristics
- Sites where LLU is effectively available
- Sites where LLU is in use and number of operators per site
- Number of "unbundled" local loops and "shared" local loops per site
- Pending requests for sites and for lines
- Additional services (electricity, security etc.)
- MDF space available with extension
- Availability of material (e.g. Tie Cables).

As part of the pre-Ordering process stakeholders are expected to supply Telkom with an advanced capacity planning forecast [12]. This forecast details the orders the stakeholder wishes to place over a certain period. Using information from stakeholders’ forecasts, it will be easy for Telkom to calculate the average number of loops requested at each site, by each competitor. Correct network information is one of the key drivers to successful implementation of the unbundling process. The stakeholder should be provided with, on request, adequate, timely, updated information preferably via the Web-GUI.

4.4 Modelling the Order Management System

An ordering process is required to enable stakeholders to install, change, and disconnect local loop unbundling services. Some of the key functionalities that will be needed from the Order Management System include (but not limited to) [39][47]:

- Creation of a Quote – A quote must be generated before an order can be placed. Stakeholders must agree on the contents of the quote before an order can be placed on the management system.
- Creation of an Order- The order Management System must generate orders with unique order numbers.
- Cancellation of an Order – The order can be cancelled based on a number of factors (e.g. lack of space). If the competitor decides to cancel the order, Telkom must charge the competitor for all the work done until the point the order was cancelled.
- Query the Order Status – Any stakeholder must have ability to query the status of the order to see how far down the line the order is.
- Change Order – Any stakeholder must have ability to request that the order be changed (e.g. install 10 more lines )
- Closing an Order – The order will only be closed once confirmation has been received from the person who requested service (i.e. service installed).
- Escalation of an Order- Orders can be escalated for attention to someone who has higher authority in the organisation.
As indicated earlier, Stakeholders must be given the ability to submit order requests using the electronic Web-GUI interface. Orders that can’t be handled electronically must be created manually into the Order management System. Most of the Order Management Systems currently installed by stakeholders will have to be upgraded (or replaced) to support different ordering processes for LLU.

The Order Management System will have to be used during pre-ordering and ordering to support:

- Full unbundling
- Line Sharing
- Bitstream Access
- Caged co-location
- Cageless co-location
- Remote co-location
- Virtual co-location.

On the management site, the difference between services will be the processes (and screenshots) used for each product or service requested.

### 4.4.1 Modelling a Order Management Process

The researcher has developed a process to demonstrate how an Order Management System will be used for local loop unbundling. The researcher used an example of MWeb placing an order with Telkom for an unbundled line.

- A MWeb Agent will use one or more available channels (e-mail, fax, Telephone, Web-GUI) to place an order with Telkom.
- In a case were the preferred channel is the electronic Web-GUI interface, the MWeb agent will have the capability to electronically place an order on Telkom’s Order Management System.
- Otherwise the MWeb agent will use another channel (e.g. Fax, e-mail, Telephone) to contact the Telkom call centre.
- The Call centre agent will receive MWeb’s request for a service.
- The Call centre agent will check wether MWeb exist in the current Partner/Business Management database.
- If the MWeb doesn’t exist, a new customer record will be created in the Partner/Business Relationship Management database.
- Otherwise MWeb exists as a customer in the database.
- Once MWeb has been created as the new customer, the next step will be to capture order details in the Order Management System.
- Once all details have been captured an order can then be created in the system and a unique order number will be generated.
- A validation process will then take place to investigate the feasibility of completing the order (e.g. is there a need for new infrastructure before the order can be completed?).
- Once it has been established that it is feasible to complete the order, the order will then be approved.
- Otherwise the order will be escalated to the relevant stakeholder/system for their attention.
- The last step involves sending the customer a reference number that can be used to track the order status. The reference number will be exist until the order is closed.
The researcher developed a sample Order Management webpage (depicted in the figure below), which he believes that it be used to manage stakeholder orders.

Figure 21: Sample of Order Management System webpage

4.5 Modelling a Trouble Ticket Management System for LLU

A Ticket Management System is core to handling customer faults, planned maintenance and network failures affecting networks [52]. Whenever there is a network fault or service problem experienced, a trouble ticket describing the problem is opened until the fault is resolved. The trouble ticket management system must also have the capability to determine which stakeholders will be affected by which faults and how adversely they are affected. The status of a trouble ticket is considered open as long as the fault remains unresolved. Tickets will commonly be created by call centre agents or by
competitors via the Web-GUI interface. Once tickets are created then faults (or problems) can be easily managed and it will be easy to find out [52]:

- Who is affected by what fault?
- Which services are mostly affected?
- How quickly faults are resolved?
- How do these faults relate (Root Cause Analysis)?
- How was the fault resolved?
- When were tickets closed?

Ticket Logging will normally result in a fault being sent to the Fault Management System or a Technician being dispatched to investigate the problem. A progress report will be generated on how the fault was resolved.

4.5.1 Best Practice principles for a Trouble Ticket Management System to support unbundling.

The researcher investigated best practices necessary to implement a Trouble Ticket Management System for the unbundling process and has proposed the following principles (based on international case studies) [39][53]:

- The Trouble Ticket Management process must handle requests and notifications received via multiple channels such as [50]:
  - Email
  - Phone
  - SMS
  - Fax and
  - Electronic (Web-GUI)
- A trouble ticket must be unique across all platforms (including competitor platforms) and must only be used once.
- The Trouble Ticket Management System must allow stakeholders the ability to track ticket status and ticket history.
- The Trouble Ticket Management System must provide the capability to view tickets associated with a stakeholder (e.g. Show tickets related to MW eb).
- The Trouble Ticket Management System must provide the capability for escalation of tickets when cases are not resolved within defined period or to the stakeholder satisfaction.
- The Trouble Ticket Management System must flag when stakeholders have an SLA and the status of the SLA.
- The Trouble Ticket Management System must have the capability to link related tickets (e.g. all this tickets result from a failure of the external tie cable).
- The Trouble Ticket Management System must receive root analysis tickets from the Fault Management System.
- The Trouble Ticket Management System must allow for creation of bulk tickets. A bulk ticket is created when multiple services are affected on the same local loop network (e.g. MDF connecting multiple competitors fails).
- The Trouble Ticket Management System must allow for creation of tickets during planned work and maintenance.
- The Trouble Ticket Management System must provide a list of technician callout types and a counter per callout type indicating the number of dispatches that took place that is considered billable to the stakeholder. This information will also be used to resolve disputes.
- A ticket will only be closed once the fault has been cleared and confirmation has been received from stakeholder that the service is working as required.
- The Trouble Ticket Management System must provide the capability for additional text field to be created where the stakeholder (or call centre agent) can give a brief description of the fault/problem.
- The Trouble Ticket Management System must also manage access requests between stakeholders. Access requests will be used to provide access to Telkom (or competitor) sites and they normally result in financial implications.

Below is a sample of the trouble ticket that can be used for the local loop unbundling process. The trouble ticket was captured from the Trouble Ticket Management System which was developed by a communication services provider (www.clarity.com) to manage service provider tickets. The trouble ticket addresses most of the principles proposed by the researcher.

![Figure 22: Sample Trouble ticket](image)

### 4.5.2 Modelling a Trouble Ticket Management System Process for LLU

The researcher has developed a process to demonstrate how a Trouble Ticket Management system will be implemented for local loop unbundling. The researcher used an example of a customer whose ADLS service is provided by MWeb and his/her voice service is provided by Telkom (example of line sharing architecture).

- The MWeb Customer experiences a fault with his unbundled service (e.g. ADSL Service) and reports the fault to MWeb.
- MWeb agent creates a trouble ticket on its Trouble Ticket Management System.
- MWeb dispatches a technician who tries to resolve the fault.
- If fault is resolved, MWeb clears the fault. Otherwise MWeb escalates ticket to Telkom.
- MWeb logs fault with Telkom.
- A call centre agent receives a fault from MWeb. The agent who receives a fault verifies that the problem is real, and not just perceived. The agent ensures that enough information about the fault is obtained. This information includes when and how the fault occurred, and all other relevant circumstances related to the fault.
- A ticket related to that fault will be created on Telkom’s Trouble Ticket Management System.
- The Trouble Ticket Management System will send the created ticket to another system (Fault Management System) to resolve the fault.
- The fault will be fixed by the Fault Management System. In a case where the Fault management System can’t resolve the fault, the fault will be escalated to a technician to investigate and clear the fault.
- A technician will receive a SMS, email, fax or any other form of preferred notification from the Fault Management team about a problem he/she needs to attend to.
The technician fixes the fault and sends feedback back a report to the Trouble Ticket Management System for clearance purposes.

The Trouble Ticket Management System is updated with new data received from the technician. All information related to the fixing of the fault will be updated in the system.

Telkom informs MWeb about the resolution of the fault.

MWeb confirms fault resolution with customer.

The ticket is marked as closed in the system.

It is important to integrate the Fault Management System and the Performance Management systems to the Trouble Ticket management system (Figure 24: Trouble ticket Management Architecture). This will ensure that whenever a fault is reported (by Fault Management System) or there is degradation in service performance (Performance Management System) a ticket will automatically be created [52]. The Fault Management System will collect and correlate fault alarms and send them to Trouble Ticket Management System for analysis.

The Fault Management System will utilize the root cause analysis module to reduce open trouble tickets that are related to a single cause (e.g. failure in the MDF exchange). Trouble Ticket Management System will receive the correlated fault and will create a ticket to analyse and track it to resolution. The Trouble Ticket Management System will also receive service and SLA performance information from the Performance Management System and will generate tickets for any performance degradations [52].
As part of the local loop unbundling management site, the researcher has also developed a trouble ticket management webpage (depicted in the figure below), which will be used to manage stakeholder tickets.
4.6 Modelling a Fault Management System for LLU

A fault is defined as loss or degradation of service to a point that renders the service unusable. The primary objective of the Fault Management System is to gather all reported network alarm events and, through correlation, report on the probable root causes so that the necessary fault resolution can be initiated [55][65].

Fault Management System will be used to collect alarm events from the local loop network. Where local loop technologies do not electronically report on alarm events, probes and monitors shall be established so that unreported events may be gathered. Key features of a Fault Management System include [55][65]:

- Event Collection - Collection of fault events by means of probes and monitors.
- Fault Correlation- Correlation of multiple alarm events down to possible root cause events and the subsequent hand-over to Trouble Ticket Management System for resolution.
- Fault Resolution - Activities necessary to restore the services. These include localisation, correction, testing, re-assignments etc.
- Fault Closure - closure of the open trouble ticket and the hand-back to the originating system when necessary.

The Fault Management System will electronically process alarm events and hand them over to a Ticket Management System for fault resolution. ICASA must ensure that all fault management centres are available for 24 hours, seven days a week to enable fault reporting anytime of the day. ICASA also needs to ensure that all stakeholders implement record keeping rules of all service affecting faults (reported by competitors or detected) containing the following information [55][65]:

- Time and date the fault was reported (or was detected)
- Time it took clear the fault
- The nature of the fault and
- The time it took to notify the competitor that the fault has been cleared.

This information is necessary to ensure that none of the parties is in violation of the Service Level Agreements (SLA) entered into and will also be used during disputes. All stakeholders must be held responsible for fault detection and possible rectification of their customer faults. The stakeholder must be seen as the first line of defence of the local loop network to their customers.

The Fault Management System includes a test head that performs a series of tests on local loop. The test results are sent to the Fault Management system where they are then analysed with respect to a set of parameters to identify characteristics that would indicate that a fault is likely to occur on the associated loop within a predetermined period [65].

4.6.1 Best Practice principles for a Fault Management System to support unbundling.

The researcher investigated best practices necessary to implement a Fault Management System for the unbundling process and has proposed the following principles (based on international case studies) [39][12]:

- It is the responsibility of a stakeholder to record their customer faults. The stakeholder is the first point of contact to their customer and must try by all means to gather all relevant information related to the customer fault.
- Stakeholders must try by all means to resolve the fault from their side before escalating the faults to other stakeholders.
- Telkom must proactively notify all stakeholders about faults impacting its network which may impact unbundling services as soon as Telkom becomes aware of the fault.
- There should be an agreed set of fault categories for efficient processing and reporting purposes.
- It is the responsibility of all stakeholders to continue to communicate with their customers during a fault resolution process.
- All stakeholders must implement a simple and efficient means of fault reporting and fault status monitoring (e.g. Web based GUI).
- Escalations procedures must be in place the event the fault is not being rectified.
- Where possible, stakeholders should provide on commercial terms, options to accelerate responses to fault. This may include shorter response times, or response outside of normal fault handling periods.
- The fault handling and service repairing centre must be fully operational during normal working hours (08:00-1700 hours) on Working Days, and partially operational after normal working hours.
- Where a fault is reported outside normal working hours, the fault report will be treated as if it has been received by a stakeholder at the beginning of the next working day.
- If a stakeholder fails to repair a fault within the agreed period following receipt of a fault notification, the said stakeholder will be seen to be in violation of a Service Level Agreement (SLA) and will be required to pay penalties as agreed upon in the SLA.

4.6.2 Modelling a Fault Management Process for Local loop for LLU

The researcher has developed a process to demonstrate how a Fault Management system would work during local loop unbundling. The researcher used an example of a customer whose service is provided by MWeb.

- Customer experiences degradation in service.
- The customer reports fault with their service provider (Competitor to Telkom such as M-web).
- The competitor performs a fault diagnosis process and see if it possible to fix the fault.
- If the Competitor determines that the fault is within their network, the Competitor will fix the fault and clear it on the Fault Management System.
- After clearing the fault the Competitor will inform the customer that the service has been restored back to expected levels. Otherwise, if it is determined that the fault lies outside the competitor’s network (Within Telkom’s network), the competitor will report the fault to Telkom.
- As indicated earlier (ICASA enforcement), Telkom will be required to acknowledge that they have received the fault request.
- After the fault is received, Telkom will fix the fault and perform some form of testing to ensure that the fault is working as required.
- A message will then be sent to the competitor to inform them that the fault has been cleared.
- The competitor will communicate with their customer to notify them about the restoration of the service to expected levels.
- Once the customer has indicated that he/she is happy with the service, the fault will then be cleared from the competitors system.
As part of developing the local loop unbundling management process, the researcher developed a fault management webpage (depicted in the Figure 27 below), which can be used to manage stakeholder faults. Stakeholders will be allowed to log and track faults status from the management site. From the site, Stakeholders will also be able to track history of a fault.
Below is a sample of a fault reporting form that can be used to log and manage customer faults. The fault reporting form is used in Telkom to capture all necessary information related to customer faults.

![Fault Reporting Form](image)

**Figure 28**: Fault Reporting Form

### 4.7 Modelling an Inventory Management System for LLU

One of the biggest challenges with regard to the implementation of LLU will be inaccurate local loop network data. Without having accurate information of what is available at the local loop level will jeopardise the success of the implementation of LLU services.

Bad inventory can cause all sorts of problems (e.g. Customers can’t be guaranteed service as the service provider is unsure of what network resources they have in the network).

The Inventory Management System gives a view of network resources and capacity, providing network planners, managers and technicians a complete and accurate picture of network operations and availability at any time. A well maintained, centralized, accurate inventory is critical to for network design and enhancement [56].

The centralized inventory can be kept current by means of an auto discovery tool that discovers the network resources and automatically update the Inventory Management System or alternatively interface the Inventory Management System to the Order Manager System that is updated regularly during service provisioning.

Some of the key benefits of a well managed Inventory Management System includes (but not limited to)[56]:

- Service impact analysis will be facilitated by integrating the Inventory Management database with the Fault Management and Trouble ticket Management Systems.
- Network planners will benefit from an up-to-date Inventory Management solution covering all existing network resources in one system.
- Faster and more accurate service provisioning will be achieved.
The LLU Inventory Management System will enable stakeholders to capture all inventory moves, additions, changes, disconnects, and trouble tickets as they occur. This system will provide tools for inventory viewing, manipulation, optimization, and reporting. Some of the inventory data that will be managed for LLU includes [56]:

- Physical Network Inventory
- Logical Network Inventory
- Technical attributes of each service and product implemented
- Maps and all relevant information on sites
- History of inventory
- Inventory maintenance contracts amongst stakeholders.
- Inventory by location and type
- Competitor assigned inventory
- Inventory Maintenance Contract

![Sample network inventory](image)

Figure 29: Sample network inventory

### 4.7.1 Disadvantages that might result from bad Inventory

- Difficulty to fix network (or resource) problems- It will be more difficult to locate a network (or resource) failure without up-to-date records
- Poor planning - It will be more difficult to identify which part of the network requires investment.
- Poor Customer Relationship Management – (e.g. customers may be promised a service they are not eligible for due to the operator not knowing the quality or length of the local loop.)

### 4.7.2 Best Practice principles for an Inventory Management System to support unbundling.

- Telkom and Competitors must devise the ability to track inventory for logical and physical local loop data.
- Each inventory item must be assigned a unique identifier (e.g. circuit ID, port ID, etc.) to preserve uniqueness.
- Telkom and competitors must ensure that there is in place the functionality to capture changes to an inventory item automatically when such changes occur.
- Telkom and competitors must have the ability to relate one inventory item to another (e.g. port to a circuit)
- Telkom and competitors must ensure that there is security to ensure that only authorized users can view and modify inventory data.

4.7.3 Modelling a Inventory Management System Process for LLU

The researcher developed a process to demonstrate how inventory Management system would work during local loop unbundling. The researcher used an example of a customer whose service is provided by MWeb. The Inventory Management System enables stakeholders to capture all inventory moves, additions, changes, disconnects, and trouble tickets as they occur.

- Customer request a service from competitor
- MWeb updates its Order Management System to capture customer order
- MWeb’s Order Management System interrogates the Inventory Management System to check unbundling inventory status.
- If inventory is available, then MWeb can continue to fulfil the customer request.
- If there is no infrastructure available MWeb will request Telkom to rollout infrastructure
- Telkom will update its Ticket Management System to create a job ticket for the rollout of local loop infrastructure (also known as planned maintenance.
- Once the infrastructure is rolled out, the ticket will be closed and Telkom will notify MWeb (via the preferred channel) of the infrastructure rollout.

Figure 30: Inventory Management Process flow
As part of developing the unbundling management website the researcher developed an inventory management page (depicted in the figure below), which will be used to track inventory status.

![Figure 31: Inventory Management Webpage](image)

4.8 Modelling a Performance and SLA Management System for LLU

The goal of Performance Management is to measure and make available network and service performance so that performance can be maintained at an acceptable level. Performance management involves three main steps [57][58]:

- Gathering performance data of network elements of interest.
- Analysing data to determine normal (baseline) levels and
- Determining appropriate performance thresholds for each network element so that exceeding these thresholds indicates a network problem worthy of attention.

Service performance monitoring differs from network performance monitoring in that for service performance more than one network component is monitored to measure performance parameters for a particular service [58]. Performance Management can be used to determine whether a stakeholder is providing services and products performing to the acceptable level or services that are at least equal in quality in comparison to those provided to its competitors. A performance report will be drawn to highlight the performance measurements experienced versus those expected.

The customers of a performance report will be Telkom, Competitors and in some cases ICASA. Performance reports will be drawn to evaluate [57]:

- Performance of a Local loop service
- Performance of individual resources making up the local loop service
- Performance of all Local loop services
- Performance of Telkom’s (or Competitor’s) Local loop services

There is a need to define performance parameters that establish whether Telkom has satisfied the requirements to provide equivalent service to competitors as it has provided to itself. Performance parameters are defined to measure things such as timeliness, accuracy and availability of services.
The Performance Management System will also be used during service provisioning for:

- Prioritisation of exchange set up, space allocation in exchanges and main distribution frame connections between customers.
- Tenure- duration of access seeker location within exchanges
- design - configuration of racks and rows for access seeker equipment in exchanges, obligation to use the space within a certain period or lose it)
- Dispute resolution mechanism.

Different OSS systems will use performance management system data to achieve different objectives. Some of these objectives include (but not limited to):

- Billing system uses performance data to implement rebate rules. Different competitors will qualify for different types of rebates based on the SLA they have amongst themselves.
- Order Management System uses performance management data to prioritise orders (from most important to least important).
- Trouble Ticket Management System uses performance data to associate performance exception tickets generated. Problem tickets are prioritised based on factors such as type of customer (e.g. a Gold customer ticket will be cleared first before a bronze customer ticket is attended to).
- Fault Management System – Whenever there is degradation in service or resource performance, the Performance Management System will create a ticket on the Trouble ticket Management System and send it to the Fault Management System for fault resolution purposes.

4.8.1 **Best Practice principles for a Performance and SLA Management System to support unbundling.**

The researcher investigated best practices necessary to implement a performance management system for local loop unbundling and has proposed the following recommendations [58][59]:

- Performance data must be collected for:
  - The entire Local loop network
  - A resource on the local loop
  - Local loop traffic data
  - Exception data
  - Violation messages
  - Throughput
  - Response time
  - Network Utilization
  - Service Loss
- Collected data supplied to stakeholders should be used to report at any instance what the current situation in the network is, to inform and assist with complaints and queries.
- The Performance Management System must enable real time reporting and monitoring of local loop service and resource performances.
- All collected performance data shall be stored in a long term storage environment for a period of at least 5 years (prescribed by ICASA and Sarbanes Oxley act).
- The performance management system shall be able to notify all stakeholders of any degradation in service and resource performance. The notification shall be sent electronically via the Web-GUI or via any preferred channel.
- The Performance Management System must provide the ability to identify and display a unified end-to-end view of the local loop network.
- The Performance Management System must be aware of the association between different components that make up a local loop because if one component of the service fails the entire service will be affected.
• If the performance management system detects that a repair action is required, the performance management system will log a ticket with the Trouble Ticket Management System and then send fault events to the Fault Management System, which will in turn determine if there is a root cause, and associate the fault events received from the Performance Management System with a root cause.
• The Performance Management System along with the Fault Management System must provide all stakeholders with the ability to automatically and in real time determine how identified faults impact local loop services.
• The Performance Management System along with the Fault Management System must support the ability to provide an indication of what needs to be repaired.
• The Performance Management System must support proactive maintenance and performance assessment activities by predicting degradation of local loop service prior to the competitor’s service being interrupted.
• The Performance Management System must be able, in real-time, to analyse and monitor performance of SLA’s and report on probable SLA violations by stakeholders.
• The Performance Management System must be able prioritise faults based on SLA agreements signed between stakeholders.
• The Performance Management System must enable stakeholders to access a view of the ongoing local loop service behaviour, parameters and trends.
• The Performance Management System must provide security so that stakeholders only have access to their own SLA data.

4.8.2 Modelling a Performance and SLA Management Process for LLU

The researcher developed a process to demonstrate how performance management system would work during local loop unbundling. The researcher used an example of a MWeb is experiencing a service degradation on infrastructure provided by Telkom.

• MWeb experiences services problems on infrastructure provided by Telkom (e.g. during Telkom proving Bitstream bandwidth below expectation)
• MWeb reports service degradation to Telkom’s Fault Management system
• The Fault Management System will send a performance request to the performance management system.
• The Performance Management System checks service performance by comparing actual performance with expected performance (defined in the customer SLA).
• If service performance is above a defined threshold then a message is send back to MWeb to indicate that service is working correctly. Otherwise service performance is below the defined threshold defined in the SLA.
• In a case where service performance is below defined threshold a message will be send back to the Fault Management System to resolve the fault.
• Once the fault is resolved the service is tested to ensure it works according to thresholds defined in the SLA.
• If there are any violations of the SLA between the parties (e.g. time to resolve was not met) a penalty system will come into play. The Performance and SLA management system will send a message to the relevant platform for the next steps.
• A report on fault management and resolution can be drawn at any time
As part of developing the unbundling management website, the researcher developed a performance Management page (depicted in the figure below), which can be used to manage inventory.

**Figure 32: Performance Management System process**

**Figure 33: Performance Management Page**
4.9 Modelling a Test Management System for LLU

Testing is an important component for assisting with the repair of faults (Assurance) and the installation of new services (Fulfilment). The Test Management System will ensure that the activated and repaired services perform as expected. The MDF and other local loop equipment are tested to ensure they are operating within normal parameters, working correctly, and meeting the appropriate performance levels. The testing of resources can also be used to determine which specific resources are available for use and which are not available. During Service Installation different types of tests will be performed on different resources, these tests include: end-to-end data flow, soaking, redundancy testing, simulated failure tests etc [60].

During fault management, tests are performed to ensure that resources and services return to maximum operating efficiency. The Test Management System will facilitate service restoration to the expected level of performance. This is achieved by interfacing the Testing Management System with other systems for localizing of faults. The tests performed need to be inline with the accepted test procedures and deployment tests as recommended by different equipment vendors.

Benefits of a Test Management System include (but not limited to) [61]:
- Indicating “what is wrong” and “where it went wrong” on the local loop service.
- Facilitating the execution of different test types of tests (both reactive and proactive).
- Reduction of manual test procedures and hand-over processes.
- The ability to find and fix problems before the customer’s service is affected will serve as a competitive advantage for any stakeholder.
- Ability to administer and test multi-vendor, multi-protocol network elements and software applications on a single platform.
- Fewer dispatches and call backs, fewer resources (including network and human resources) will be required for service fulfilment and assurance purposes.

4.9.1 Modelling a Test Management System Process for LLU

The researcher has developed a process model to demonstrate how a Test Management system would work during local loop unbundling. The researcher used an example of a customer who orders an ADSL service from MWeb but owns a Telkom line.

- Customer orders ADSL service from MWeb.
- MWeb Order Management System captures the customer order.
- A ticket is created for service installation and activation on MWeb’s Trouble Ticket Management System.
- MWeb and Telkom agree on service provisioning and activation process.
- MWeb checks Inventory Management System for Inventory availability.
- MWeb performs several tests (e.g. line status, broadband friendly test, Speed test etc) before provisioning and activating the service.
- MWeb technician provisions the network elements that make up a service.
- MWeb technician tests installed service to ensure that it is working properly.
- MWeb technician updates the inventory management system.
- MWeb performs tests on activated service.
- If more (installation) work is required from Telkom, MWeb technician will escalate ticket to Telkom.
- Telkom will dispatch the technician to install service.
- Telkom technician tests service to ensure that is working as requested.
- Telkom technician informs MWeb that service is working.
- Telkom technician updates Inventory Management System.
- Telkom technician closes ticket.
- MWeb technician performs several tests to ensure that service is working as required.
- Once the customer has indicated that he/she is happy with the service, the fault will then be cleared from the competitors system.
4.10 Modelling a Billing Management System for LLU

Billing refers to a function whereby information generated from the network (e.g., usage of local loop by competitors) is transformed into bills requiring payment [62]. Implementation of LLU will lead to the billing of communication infrastructure, facilities and services provided to competitors. Currently different stakeholders (i.e. Telkom and competitors) have implemented different billing systems (and processes) for services they provide to their customers.

Key functions of a Billing Management System include (but not limited to) [63]:

- Collection of billable events from the Local loop network
- Associate billable events to a service being provided
- Rating of billable events
- Applying discounting rules
- Summation
- Presentment of a Bill to a customer and most importantly
- Collection of customer payments

Whenever more than one party is involved in a billing value chain, questions regarding revenue sharing and Service Level Agreements (SLA) become important. To realise a successful LLU implementation, Telkom and other stakeholders must enhance (or in the worst case scenarios, replace,) their current billing processes. As a result of local loop unbundling implementation, Stakeholders can expect:

- Complex billing processes
- Sophisticated billing models
- More billing records
- Frequent cycles of bill payment
- Individual rating rules.
4.10.1 Best Practice principles for a Billing Management System to support unbundling.

The researcher investigated best practices necessary to implement a Billing Management System for local loop unbundling and has proposed some recommendations (based on international case studies) [63]:

- A Business to Business (B2B) capability that will effectively manage relationships between stakeholders. This will make it easier for stakeholders to log into the Telkom’s self service portal and check the status of their bill or in some cases even log disputes on the bill information.
- A billing system that is capable of calculating, generating and updating billing information in batch and in real time.
- A billing system that supports advice of charge functionality - stakeholders may wish to know the price of using a particular service before they use it or may further wish to know the accumulated cost of a particular service whilst still engaged in the service usage session.
- A billing system that supports charging reservation - Stakeholders may wish to reserve either resources or funds prior to using a service to ensure uninterrupted usage of the service.
- A billing system that supports 3rd party billing (in cases of revenue sharing such as when there is implementation of line sharing).
- A billing system that is capable of consolidating or converging billing for services based on rating rules and billing of events as agreed upon by the stakeholders.
- A billing system that is capable to generate customisable reports as outlined by regulatory and financial reporting requirements (e.g. Sarbanes Oxley Act).
- A billing system that supports different bill formats. Bill formatting is the layout of the data on the bill. This includes:
  - What data is presented (detail or summary information, only billing data and/or inventory reports etc)
  - Layout
  - Summary page
  - Marketing messages
  - Pdf
  - Word
  - Spreadsheets
  - Csv etc.
- A billing system that is capable of presenting bills across different channels such as:
  - E-mail
  - Fax
  - Paper
  - Web based
  - SMS.
- A billing system that is capable of handling large volumes of complex data records.
- A billing system that has a discounting capability at rating, billing and settlement level.
- A billing system that is capable of hot billing. Hot billing is the processing of transactions in near real-time to facilitate the production of an invoice on demand.
- A billing system that is capable of handling different Settlement Agreements with Competitors. A settlement [63] is a reconciliation procedure comparing amounts invoiced with expected amounts that includes negotiations to reach agreement or a ‘netting off’ arrangement.
- A billing system that adheres to the following regulatory acts:
  - Lawful interception Act requirements
    - Capability of Interception of information as and when requested by officials
    - Storage – raw event information must be stored. The act specifies what and how the events must be stored.
    - Ability to extract and provide information to officials as and when requested.
    - Storage of customer identification documents.
  - Sarbanes Oxley Act (SOX).
- Proper archiving of invoices as per the VAT Act.
- SARS invoice requirements act.
- A billing system that supports integration with external competitors databases and systems.
- A billing system that supports ability to preview invoices and statements.
- A billing system that supports dispute management.
- A billing system that supports rapid rate plan creation and addition of new services, multiple rating units, real-time rating, re-processing, and re-billing.
- A billing system that supports different pricing models in a variety of rating units. The billing system will at least support the following pricing models:
  - Flat rate
  - Usage
  - Day and Time
  - Duration
  - Distance
  - Service Level Agreement
  - Quality of Service

4.10.2 Modelling a Billing Management System Process for LLU

- The first stage of the billing chain is the collection of billable event and generation of a bill. Raw events are collected from the local loop network elements.
- The next stage is event handling (or event procession). Event handling involves a number of stages such as:
  - Formatting – changing collected events into standardised formats.
  - Credit Vetting – Checking Customer credit profile
  - Guiding – Linking competitor to records.
  - Rating – guiding and pricing usage records based on SLA with customer
  - Credit Update - Updating competitor credit profile
  - Generation of Transaction - Bill Generation

- After event handling, the next stage is bill summation. Bill summation involves the selection and aggregation of processed events based on customer profile to produce data ready for presentment.
- After Bill Summation, then the bill is presented to the competitor in the format of their choice, and via their preferred channel.
- The bill will be presented for settlement purposes. Settlement is a process of comparing amounts invoiced with expected amounts.
- Once payment is made, the last stage is the reconciliation process where the payment made will be reconciled to the actual amount owed.

*Figure 35: Billing process for LLU*
As part of developing the unbundling management page, the researcher developed an example of a web page that displays a monthly bill for unbundling services provided by one of the Internet service providers (Polka.com).

Figure 36: Sample of a bill

4.11 Conclusions

Unbundling is an intrusive exercise that involves upgrading of processes and systems deep within Telkom’s network and organisation, many of which are legacy systems with which Telkom is still struggling. The researcher has identified that although Telkom delivers faster DSL speeds in the market; their biggest limitations are long lead times during service provisioning and poor service management which normally results in customer complaints. One of the biggest challenges that Telkom will face will be to modernise these systems and expose those systems for the first time to external competitors. Most of the OSS systems currently implemented in Telkom will need to be upgraded (or in some cases replaced) to cater for the new processes that will result from unbundling.

Replacing and upgrading of OSS systems will be a complex and expensive exercise and the cost related to these new processes and systems will be borne by the stakeholder responsible for those systems. As indicated earlier, ICASA must ensure that the unbundling management team is familiar with the necessary management processes and technologies required.
5. Chapter 5- Conclusions

The local loop that will be unbundled was build using South Africa’s taxpayer’s money and as a result must be seen as a national asset that must be beneficial to all South Africans. Successful implementation of the LLU process must result in consumers benefiting from lower prices, higher speeds and a variety of broadband offers increasing competition in the broadband market. New services are expected to boost broadband demand and contribute to the current migration from dial-up to broadband. Local Loop Unbundling (LLU) will become the main access option for competitors who want to rollout the ADSL service. This is inline with the objectives set out by the South African government when they introduced the local loop unbundling.

While local loop unbundling will contribute to a decrease in prices and an increase in broadband penetration it should also be expected that it will also contribute to a decrease in infrastructure investment. Telkom will be discouraged to invest in infrastructure that will be beneficial to its competitors.

Unbundling is a continuous process that is expected to span over a 4 year period. It is important to learn from mistakes and challenges experienced in other countries to ensure that stakeholders in South Africa do not repeat similar mistakes.

The shortfall of introducing the process is that unlike other economic liberalisation measures, LLU involves more, not less, regulation. This forces the regulator (ICASA) to play a more active role in the unbundling process and directly become part of the day to day running of the process itself. ICASA needs to be both firm and decisive when dealing with stakeholders around LLU implementation issues. Tip-toeing around issues will only delay and prolong the unbundling process.

As set out in the objectives, Chapter 3 of the dissertation proposed technological and operational processes to be followed to ensure success in the implementation process. It is to be expected that Telkom will see it fit and necessary to deny and delay the local loop unbundling process because the process will cannibalize its profit margins as and when new stakeholders are introduced in the market. International experience suggests that many of the technical and operational issues are likely to be resolved more quickly and more beneficially if Telkom can be encouraged to see the opportunities the unbundling process presents.

The researcher also found that if implemented correctly, the local loop unbundling process will meet its key objective of promoting an environment where technology is able to thrive whilst ensuring that price and quality offered to consumers are attractive. Quality and pricing are key drivers in achieving wide acceptance and use of ICT services. Consumers will benefit from lower prices, higher speeds and a variety of broadband offers due to increasing competition.

The proposed model and architectures (as set out in the objectives and covered in chapter 2 and 3 of the dissertation) must be managed by means of the local loop management website and processes outlined in chapter 4 of the dissertation. SLA’s (Service Level Agreements) are important for the successful management of the unbundling process. SLA’s should be decided upon to benefit all stakeholders with regard to cost saving or operational simplicity. Such agreements should be encouraged provided they do not impact adversely on competition or on other parties’ operations.

The impact of the recently concluded high court battle between ICASA and Value Added Network Service (VANS) providers (like Altech) over whether they should be entitled to roll out their own infrastructure will have an impact on the unbundling process. The court has given VANS licences to have the same capabilities as the bigger industry players, such as Telkom, MTN, Vodacom and Neotel, allowing them to build their own national communications networks.
6. Chapter 6- Findings and Recommendations

A number of findings and recommendations are made to highlight business (non-technical) practices that must be adhered to, to ensure successful deployment of the local loop unbundling process.

6.1 General Findings and Recommendations

- Unrealistic timelines - Telkom (and most industry experts) has hinted that the four years that has been set aside for the unbundling process is unrealistic and will not be met. This is a risk that all stakeholders will have to manage. ICASA will have to put in place processes and penalties to ensure that the proposed timelines are met. In Section 3.6 the researcher made a proposal that Telkom’s project plan outlining the implementation process be made available to the technical team that will oversee the unbundling process.

- Dealing with 3D (Discouraging, Delays and Denials) - The proposed technical team that will oversee the unbundling process must develop processes that will deal with 3D and disputes between stakeholder as outlined in chapter 3 of the dissertations.

- Ensuring that ICASA has resources - ICASA is currently under resourced and might not have the muscle (Skill and Capacity) to handle the local loop unbundling process. It is recommended that ICASA recruit resources skilful and knowledgeable to the local loop unbundling topic. This will help to smooth out the management of the unbundling process.

- Costing – Costing related to the unbundling process will put a financial strain on Telkom. There is a need to discuss the funding arrangements between all stakeholders. The third party organisation must ensure that Telkom doesn’t experience a financial strain (or benefit) from the local loop unbundling process.

- Technological limitations - Some ADLS services are dependent on the distance of the copper length between the MDF and the customer. For ADSL service it is recommended that the copper length between the customer and the MDF should not be more than 3.5 KM. This suggests that it will be difficult to realise benefits of the LLU for those customer in rural areas where the average copper reach is further than 3.5 KM. The average Telkom local loop length is 5 KM.

- ICASA must take extra caution when dealing with Bitsream access because this will require Telkom to huge make investments in hardware to make more lines DSL-enabled in the exchange, which implies a large financial requirement from Telkom. The second disadvantage is that competitors will be locked into whichever technologies are implemented by Telkom, and therefore can not provide customers with customized solutions or upgrade technology as it advances.

- Rural areas - Most competitors are planning to roll out the local loop in urban areas as there is more money to be made in those areas than in rural areas (economics of scale). And as a result, Local loop might not take off in rural areas and the customers in those areas might not enjoy the benefits of local loop unbundling. ICASA must ensure that the unbundling process doesn’t discriminate the rural and poor underdeveloped areas.
6.2 Service Provider Specific Recommendations

6.2.1 Telkom (The incumbent) must:

- Ensure that all equipment (including the MDF’s) at the exchanges are ready for the Local loop unbundling process. Upgrading all exchanges to support Local loop unbundling might not be feasible within the proposed timelines.
- Plan Infrastructure rollout with LLU in mind by making sure that new MDF’s and upgraded MDF’s are ready to support different types of LLU.
- Improve the current working relationship with all stakeholders (especially with ICASA). Since the liberalisation of the Telecommunication market, Telkom and ICASA have never enjoyed a good working relationship.
- Provide necessary information to competitors and regulator as and when required.
- Fair implementation of co-location process to allow competitors to install their equipment at Telkom sites.
- Address all technical limitations related to local loop unbundling.
- Implement Operational Support Systems (OSS) to deliver and maintain local loop unbundling.
- Have a financial plan for LLU rollout.

6.2.2 Competitors (ISP’s, Neotel, and Wireless Operators) must:

- Provide local loop unbundling planning information to Telkom and ICASA in time to enable them to plan successfully from their side.
- Buy technology that will easily integrate to Telkom’s access technology. This should include xDSL modems, DSLAM and other equipment compliant to Telkom’s access technologies.
- Have a financial plan for LLU rollout.
- Implement Operational Support Systems (OSS) to manage the Local loop unbundling services to be provided.

6.2.3 Regulator (ICASA) must:

- Establish a technical team that ensures that Telkom implements LLU as required within the proposed timelines.
- Make sure that there is a delivery schedule established which defines binding milestones.
- Ensure that there is enough knowledge of all relevant detail regarding the local network architecture and information concerning the locations of physical access sites and the availability of copper pairs in specific parts of the access network.
- Ensure that there is capacity and Skill needed to handle the local loop unbundling process.
- Establish a committee that will oversee the Local loop unbundling process.

6.3 Further Research

The focus of this dissertation was mainly on how (Model) local loop unbundling must be implemented in the South African ICT sector. Although the South African government views the unbundling process as a means to improve competition and reduce communication costs, the actual impact the unbundling process will have in the South African ICT sector still needs to be determined. According to Ovum Research (July 2002) Japan is the only country where full and fair local loop unbundling has successfully broadband take-up [64]. A research is needed to investigate the actual impact the unbundling process will have on:

- Entry Decisions of stakeholders (whether or not stakeholder enter the LLU market
- Preferred services by stakeholders and their customers
- Impact of penetration of ICT services (especially in rural areas) as a result of the unbundling process
- Level of competition (Has competition improved or stalled the unbundling process?)
- Change of market shares of competitors
- Preferred pricing structures
- Maintenance of existing infrastructures (or technologies)
- Investment on existing infrastructure (or technologies)
Other topics worth researching further include:

- Unbundling of alternatively technologies such as fibre
- Investigating the impact of Interference Management on services to be provided. This will be a key topic worth pursuing especially during the implementation of Line Sharing.
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8 Annexure
8.1 Annexure A - Local loop Unbundling Management website

A website was developed to demonstrate how the local loop unbundling process will be managed. Below are some of the screenshots competitors will encounter when managing their local loop services. Competitors can register in website by supplying details as shown in the screen below. Once registered, Competitors will have to supply their login name and passwords every time they visited the management site.

![Registration Webpage](image1.png)

**Figure 37: Registration Webpage**

![Login Page](image2.png)

**Figure 38: Login Page**

Once registered, the competitor will be directed to the official local loop management page. The local loop management page allows competitors to Manage their:

- Orders
- Faults
- Tests
- Performance of the network and their services
- Inventory and
- Their registration.

The local loop management page allows competitors to manage their orders. Orders are managed from the time they are placed until their closed.
Customers can also use the local loop management site to manage their bills. Competitors will use the site to check the status of their bill and in some cases dispute their bill.
As indicated earlier the local loop management page allows competitors also to check performance of their services.
Customers will also be allowed to log and track faults status from the management site. From the site they will also be able to track history of a fault.

Figure 45: Fault Management Site

Figure 46: Fault reporting form
Figure 47: Sample Fault history form

All faults will be tracked and managed as tickets and competitors will be able to track the status of the fault via the ticket management system.

Figure 48: Trouble Ticket Management Site
Competitors will use the inventory Management page to check status of inventory used for local loop management. The inventory system will also be used to check space availability at Telkom sites for Co-location purposes.

Figure 50: Inventory Management page
Figure 51: Sample Inventory Status
8.2 Annexure B: Processes

Figure 52: Order Management Process

Figure 53: Test Management Process
Figure 54: Inventory Management Process

Figure 55: Trouble Ticket Management Process
Figure 56: Fault Management Process
8.3 Annexure C
Source code developed for the LLU management site.

**Business Relationship Management Registration Page**

```html
<html>
<head>
  <img align=left src="22.jpeg" height=75><img align=top src="iburst.gif" height=75><img align=top src="Telkom.gif" height=75><img align=top src="neotel.gif" height=75><img align=top src="mweb.gif" height=75><img align=top src="quest.gif" height=75>
  <input type="button" value="About LLU" onclick="return redirectToPage('volc2.html')"
    style="width:96px"><input type="button" value="Contact US" onclick="return redirectToPage('icasa.html')"
    style="width:96px"><input type="button" value="Product LIST" onclick="return redirectToPage('volc2.html')"
    style="width:96px"><input type="button" value="Terms & Conditions" onclick="return redirectToPage('terms.html')"
    style="width:130px">
  
  <title>Registration Page</title>
  <script>
    function redirectToPage(page)
    {
      window.location.href(page);
    }
  </script>

  <body bgcolor="#f7ffce">
    <h1 align="center"><b>Local Loop Unbundling Registration Page</b></h1>
    
    <form name="contact" method="POST" action="">
      <div id="bv_Text1" style="position:left:10px;width:98px;height:16px;z-index:0" align="left">
        <font style="font-size:13px" color="#000000" face="Arial">Company Name</font>
      </div>
      <input type="text" id="Editbox1" style="position:left:118px;width:250px;font-family:Courier New;font-size:16px;z-index:1" size="20" name="name" value="">
      
      <div id="bv_Text2" style="position:left:10px;width:98px;height:16px;z-index:2" align="left">
        <font style="font-size:13px" color="#000000" face="Arial">Address</font>
      </div>
      <input type="text" id="Editbox2" style="position:left:118px;width:250px;font-family:Courier New;font-size:16px;z-index:2" size="20" name="address" value="">
      
      <div id="bv_Text3" style="position:left:10px;width:98px;height:16px;z-index:4" align="left">
        <font style="font-size:13px" color="#000000" face="Arial">City</font>
      </div>
      <input type="text" id="Editbox3" style="position:left:118px;width:250px;font-family:Courier New;font-size:16px;z-index:4" size="20" name="city" value="">
      
      <div id="bv_Text4" style="position:left:10px;width:98px;height:16px;z-index:6" align="left">
        <font style="font-size:13px" color="#000000" face="Arial">Code</font>
      </div>
      <input type="text" id="Editbox4" style="position:left:118px;width:250px;font-family:Courier New;font-size:16px;z-index:6" size="20" name="code" value="">
      
      <div id="bv_Text5" style="position:left:10px;top:320px;width:98px;height:16px;z-index:12" align="left">
        <font style="font-size:13px" color="#000000" face="Arial">Email</font>
      </div>
      <input type="text" id="Editbox5" style="position:left:118px;top:320px;width:250px;font-family:Courier New;font-size:16px;z-index:12" size="20" name="email" value="">
      
    </form>
</body>
</html>
```
Company Size

- Option 1: 1 - 5000
- Option 2: 5000 - 10000
- Option 3: 10000 - 20000
- Option 4: 20000+

Channel

- Option 1: e-Mail
- Option 2: Fax
- Option 3: WebPortal
- Option 4: Snail Mail
- Option 5: Web-based GUI
- Option 6: Telephone

Password

Comments

* Please ensure that you complete all fields of the form.

Business Relationship Management Login Page
<title>Local loop Business Relationship Management Page</title>

<h1 align="center">Local loop Business Relationship Management Page</h1>

<form name="contact" method="POST" id="Form1">
  <div id="bv_Text1" style="position:left;10px;width:62px;height:16px;z-index:0" align="left">
    <font style="font-size:13px" color="#000000" face="Arial">Customer</font>
  </div>
  <input type="text" id="Editbox1" style="position;left:82px;width:230px;font-family:Courier New;font-size:16px;z-index:1" size="20" name="Customer" value="">
  
  <div id="bv_Text2" style="position;left:10px;width:62px;height:16px;z-index:2" align="left">
    <font style="font-size:13px" color="#000000" face="Arial">Password</font>
  </div>
  <input type="password" id="Editbox2" style="position:left;82px;width:230px;font-family:Courier New;font-size:16px;z-index:2" size="20" name="email" value="">
  
  <input type="button" value="Submit" onclick="return redirectToPage('BRM2.html')" style="position;left:82px;width:96px;height:25px;z-index:4">
</form>

<h4>New customers, please click <a href="registration.html">here</a> to complete the registration purposes. For more information on Local loop unbundling please visit <a href="icasa.html">ICASA's site</a> or click on <a href="volc2.html">Introduction to Local Loop Unbundling</a>.</h4>
Welcome to the Local loop Unbundling Management page. Before you continue please familiarise yourself with the terms and conditions of this site. For more information on Local loop unbundling please visit ICASA’s site or click on the introduction to Local loop Unbundling link.

Please note the following:

- To change your company information please click on the tab below.
- To place an order, check status of Order or cancel an Order please click on the tab below. The tab below allows customers to see the product catalogue.
- To check your bill status, please here.
- To report a fault, check status of reported fault, cancel fault, check fault history please click on tab below.
- To check performance (and SLA related info) of the service and resource, please click on tab below.
- To check status of inventory and availability of space at the site, please click on the tab below.

Local loop Business Relationship Management Order Management Page
An Ordering Management System allows stakeholders to install, change, and disconnect services for customers of the competitors. The information required to complete a local loop order may include: The composition of the loop, The electrical parameters of the loop, Any work underway on the Local loop, Location of exchanges, Coverage of exchanges, Size of MDF (i.e. number of lines on an MDF), List of street names related to exchange, Information concerning line characteristics, Sites where LLU is effectively available, Sites where LLU is in use and number of operators per site, Number of "unbundled" local loops and "shared" local loops per site, Pending requests for sites and for lines.

This site allows competitors to:

- Request a Quote From Telkom
- Place an Order
- Escalate an Order
- Query/Track Order Status
- Cancel an Order
- Close an Order

Order Placement Page
<FORM action="..." method="post">

<FIELDSET>
<LEGEND>Order Placement Page</LEGEND>

Company Name: <INPUT name="company_name" type="text" tabindex="1">
Company Address: <INPUT name="company_address" type="text" tabindex="2">
City : <INPUT name="City" type="text" tabindex="3">
Code : <INPUT name="Code" type="text" tabindex="4">

Order Date: <INPUT name="Order Date" type="text" tabindex="1">
Order Number: <INPUT name="Order Number" type="text" tabindex="1">

<select name="Payment Method" size="1">
<option value="1">Cash</option>
<option selected value="2">Credit Card</option>
<option value="3">Debit Order</option>
<option value="4">Any (Specify)</option>
</select>

<FIELDSET>
<LEGEND>Order Status Page</LEGEND>

Order Status is: <SELECT name="Order Status is" size="1">
<option value="1">Active</option>
<option selected value="2">Pending</option>
<option value="3">Cancelled</option>
<option value="4">Closed</option>
</SELECT>

</FIELDSET>
</FIELDSET>
</FORM>
<FIELDSET>
<p>
<LEGEND>Order Cancellation</LEGEND>
Do you want to cancel the current Order?

<INPUT name= "Cancel Order" type="radio"
value="Yes" tabindex="35"> Yes

<INPUT name="Cancel the order" type="radio"
value="No" tabindex="35"> No.
If yes, Please provide reasons for order cancellation<br>

<TEXTAREA name="Extra Services"
rows="5" cols="15"
tabindex="40">
</TEXTAREA>
</FIELDSET>

<P>
<LEGEND>Order Closing</LEGEND>
Do you want to close the Order?

<INPUT name= "Close Order" type="radio"
value="Yes" tabindex="35"> Yes

<INPUT name="Close the order" type="radio"
value="No" tabindex="35"> No.
If yes, Please provide reasons for closing the order<br>

<TEXTAREA name="Extra Services"
rows="5" cols="15"
tabindex="40">
</TEXTAREA>
</P>

<P>
<LEGEND>LLU Product Catalogue</LEGEND>

<FIELDSET>
<INPUT name="Caged Co-location" type="checkbox"
value="Caged Co-location" tabindex="24"> Caged Co-location

<INPUT name="Cageless Co-location" type="checkbox"
value="Cageless Co-location" tabindex="25"> Cageless Co-location
</FIELDSET>
<FIELDSET>
  <INPUT name="Virtual Co-location"
     type="checkbox"
     value="Virtual Co-location" tabindex="26"> Virtual Co-location
</FIELDSET>

<FIELDSET>
  <INPUT name="Remote Co-location"
     type="checkbox"
     value="Remote Co-location" tabindex="26"> Remote Co-location
</FIELDSET>

<FIELDSET>
  <INPUT name="Full Unbundling"
     type="checkbox"
     value="Full Unbundling" tabindex="31"> Full Unbundling
</FIELDSET>

<FIELDSET>
  <INPUT name="Line Sharing"
     type="checkbox"
     value="Line Sharing" tabindex="32"> Line Sharing
</FIELDSET>

<FIELDSET>
  <INPUT name="Bitsream Access"
     type="checkbox"
     value="Bitsream Access" tabindex="33"> Bitsream Access
</FIELDSET>

<FIELDSET>
  <INPUT name="Sub-Looping"
     type="checkbox"
     value="Sub-Looping" tabindex="34"> Sub-Looping
</FIELDSET>

<FIELDSET>
  <INPUT name="PSTN line"
     type="checkbox"
     value="PSTN line" tabindex="27"> PSTN line
</FIELDSET>

<FIELDSET>
  <INPUT name="OSS Services"
     type="checkbox"
     value="OSS Services" tabindex="28"> OSS Services
</FIELDSET>

<FIELDSET>
  <INPUT name="Internal Tie Cables"
     type="checkbox"
     value="Internal Tie Cables" tabindex="26"> Internal Tie Cables
</FIELDSET>

<FIELDSET>
  <INPUT name="External Tie Cables"
     type="checkbox"
     value="External Tie Cables" tabindex="26"> External Tie Cables
</FIELDSET>

<FIELDSET>
  <INPUT name="Security"
     type="checkbox"

<html><head>
<title>Billing Management Page</title></head><body>

<FIELDSET>
<LEGEND>Security</LEGEND>
<INPUT name="Security" type="checkbox" value="Security" tabindex="27"> Security
</FIELDSET>

<FIELDSET>
<LEGEND>Power</LEGEND>
<INPUT name="Power" type="checkbox" value="Power" tabindex="28"> Power
</FIELDSET>

<FIELDSET>
<LEGEND>Air-Con</LEGEND>
<INPUT name="Air-Con" type="checkbox" value="Air-Con" tabindex="29"> Air-Con
</FIELDSET>

<FIELDSET>
<LEGEND>Extra Cabling</LEGEND>
<INPUT name="Extra Cabling" type="checkbox" value="Extra Cabling" tabindex="30"> Extra Cabling
</FIELDSET>

<FIELDSET>
<LEGEND>Extra Services</LEGEND>
Are you interested in any other LLU related services?

<INPUT name="Extra Services" type="radio" value="Yes" tabindex="35"> Yes

<INPUT name="Extra Services" type="radio" value="No" tabindex="25"> No

If yes, please indicate it in the space below:<br>
<TEXTAREA name="Extra Services" rows="5" cols="15" tabindex="40">
</TEXTAREA>
</FIELDSET>

</form>
</body></html>
function redirectToPage(page)
{
    window.location.href(page);
}

<body bgcolor="#f7ffce">
<h1 align="center"><b>Billing Management Process Page </b></h1>
<h2 align=center> Billing Management Process for LLU </h2>

Billing refers to a function whereby information generated from the network (e.g., usage of local loop by competitors) is transformed into bills requiring payment. Implementation of LLU will lead to the billing of communication infrastructure, facilities and services provided to competitors. Interconnect billing which can be defined as the process of identifying and rating telecommunications traffic between operators for the purpose of accounting, settlement and reconciliation also forms part of LLU billing.

The basic functions of a billing management system include:

- Collection of events from the Local loop network
- Associate events to a service being provided
- Rating of billable events
- Applying discounting rules
- Summation of results
- Presentation of a Bill to a customer and most importantly
- Collection of customer payments

To Request your latest Bill statement please click on Tab below:<br>
<input type="button" value="Bill Statement & Payment" onclick="return redirectToPage('Billing.html')" style="width:260px" />

To dispute your Bill Please click on Tab below:<br>
<input type="button" value="Bill Dispute" onclick="return redirectToPage('Billing.html')" style="width:260px"/>

<LEGEND>Bill Presentment </LEGEND>

The Bill will be delivered via:

- <INPUT name="Fax" type="checkbox" value="Fax" tabindex="24"> Fax
- <INPUT name="E-Mail" value="E-Mail" tabindex="24"> Fax
The format the bill will be delivered is:

Example of a Bill

```
<html>
<head>
<title>CustomerBill</title>
</head>
<body bgcolor="#f7f7f7">
<hr>
<h1 align="center"><b>Local Loop Unbundling Bill for Polka.com</b></h1>
<br>
```

<table>
<thead>
<tr>
<th>Event #</th>
<th>Service Description</th>
<th>Amount (in R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Loop Rental</td>
<td>R 2000</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Cost</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>2</td>
<td>Monthly Line Rental</td>
<td>R 4000</td>
</tr>
<tr>
<td>3</td>
<td>Local loop Maintenance and repair costs</td>
<td>R 8000</td>
</tr>
<tr>
<td>4</td>
<td>Co-location Costs</td>
<td>R 2000</td>
</tr>
<tr>
<td>5</td>
<td>Costs related to OSS (e.g. testing of lines, Resolution of Faults, New Orders, Performance Management etc.)</td>
<td>R 2000</td>
</tr>
<tr>
<td>6</td>
<td>Network Utilisation Costs</td>
<td>R 3000</td>
</tr>
<tr>
<td>7</td>
<td>Interconnection Costs</td>
<td>R 8000</td>
</tr>
<tr>
<td>8</td>
<td>Disconnection charges</td>
<td>R 3000</td>
</tr>
<tr>
<td>9</td>
<td>Conversion (between operators) charges</td>
<td>R 2000</td>
</tr>
</tbody>
</table>
Fault Management Page

A fault is defined as loss or degradation of service to a point that renders the service unusable. A Fault management is the set of functions that detect, isolate, and correct malfunctions in a telecommunications network. The primary objective of the Fault Management System is to gather all reported network alarm events and, through correlation, report on the probable root causes so that the necessary fault resolution can be initiated. It is expected that the competitor will be responsible for fault detection and possible rectification in most cases as the competitor is responsible for the day to day running of the local loop.

Key features of a Fault Management System include:

- Event Collection: Collection of the event by means of probes and monitors.
<li>Fault Correlation - Correlation of multiple alarm events down to possible root cause events and the subsequent hand-over to Trouble Ticket Management System for resolution

<li>Fault Resolution - Activities necessary to restore the services. These include localisation, correction, testing, re-assignments etc.

<li>Fault Closure - closure of the open trouble ticket and the hand-back to the originating system when necessary

To Report a Fault please click on Tab below.

To check Fault History Please click on Tab below.

Performance Management Page

Network performance management consists of measuring, modeling, planning, and optimizing networks to ensure that they carry traffic with the speed, reliability, and capacity as expected. Performance Management can be used to determine whether Telkom is providing services and products performing to the acceptable level or that are at least equal in quality in comparison to those provided to competitors. A performance report is drawn to highlight the performance measurements experienced versus those expected.

The Performance Management System provides a web portal that allows competitors to monitor the health and status of local loop and view alarm history and SLA report cards.
Network performance characteristics that are measured include:

- The entire Local loop network across all technologies.
- Local loop traffic.
- Exceptions.
- Performance of individual resources making up the local loop service.
- Performance of all Local loops and Services belonging to Competitors and Telkom.
- Comparison (in performance) between competitor and Telkom Service.
- Threshold crossing data.
- Violation messages and
- Response Time.

The Performance Management System will be an important tool used for:

- Prioritisation (of exchange set up, space allocation in exchanges and main distribution = frame connections – essentially ranking competing claims among access seekers)
- Tenure (duration of access seeker location within exchanges and notice of cabinetisation)
- Design (configuration of racks and rows for access seeker equipment in exchanges, obligation to use the space within a certain period or lose it)
- Dispute resolution mechanism

To see performance of the Local loop Network please click on graphic.

| ![Image](PMSample.html) |
| ![Image](pms.gif) width=30 height=20 |

Inventory Management System

```html
<html>
<head>
<title>IMS</title>
<script>
function redirectToPage(page)
{
window.location.href(page);
}
</script>
</head>
<body bgcolor="#f7ffce">
...<br>
```

<table>
<thead>
<tr>
<th><img src="22.jpeg" alt="Image" /> height=75</th>
<th><img src="iburst.gif" alt="Image" /> height=75</th>
<th><img src="Telkom.gif" alt="Image" /> height=75</th>
<th><img src="neotel.gif" alt="Image" /> height=75</th>
<th><img src="mweb.gif" alt="Image" /> height=75</th>
<th><img src="quest.jpeg" alt="Image" /> height=75</th>
</tr>
</thead>
</table>
A well maintained, centralized, accurate inventory is critical for network design and enhancement. The inventory management system gives a view of network resources and capacity, providing network planners, provisioners and technicians a complete and accurate picture of network operations and availability at any time.

From this site the competitor can request:

- The composition of the loop
- The loop length, including the length and location of each type of transmission media
- The electrical parameters of the loop
- Any work underway on the Local loop
- Location of exchanges
- Coverage of exchanges
- Size of MDF (i.e. number of lines on an MDF)
- List of street names related to exchange
- Information concerning line characteristics
- Sites where LLU is effectively available
- Sites where LLU is in use and number of operators per site
- Number of "unbundled" local loops and "shared" local loops per site
- Pending requests for sites and for lines
<FIELDSET value="Sub-Looping" tabindex="34"> Sub-Looping
</FIELDSET>

<p>
</p>

<FIELDSET>
<LEGEND>Co-location Products</LEGEND>
<INPUT name="Caged Co-location" type="checkbox" value="Caged Co-location" tabindex="24"> Caged Co-location
<INPUT name="Cageless Co-location" type="checkbox" value="Cageless Co-location" tabindex="25"> Cageless Co-location
<INPUT name="Virtual Co-location" type="checkbox" value="Virtual Co-location" tabindex="26"> Virtual Co-location
<INPUT name="Remote Co-location" type="checkbox" value="Remote Co-location" tabindex="26"> Remote Co-location

</FIELDSET>

<br>

<FIELDSET>
<LEGEND>Other LLU related Products</LEGEND>
<INPUT name="PSTN line" type="checkbox" value="PSTN line" tabindex="27"> PSTN line
<INPUT name="OSS Services" type="checkbox" value="OSS Services" tabindex="28"> OSS Services
<INPUT name="Internal Tie Cables" type="checkbox" value="Internal Tie Cables" tabindex="26"> Internal Tie Cables
<INPUT name="External Tie Cables" type="checkbox" value="External Tie Cables" tabindex="26"> External Tie Cables

</FIELDSET>

<br>

<FIELDSET>
<LEGEND>Support Services</LEGEND>
<INPUT name="Security"


Page | 93
<FORM>
  <FIELDSET>
    <INPUT name="Security" type="checkbox" value="Security" tabindex="27"> Security
    <INPUT name="Power" type="checkbox" value="Power" tabindex="28"> Power
    <INPUT name="Air-Con" type="checkbox" value="Air-Con" tabindex="29"> Air-Con
    <INPUT name="Extra Cabling" type="checkbox" value="Extra Cabling" tabindex="30"> Extra Cabling
  </FIELDSET>

  <input type="button" value="Inventory Status" onclick="return redirectToPage('IN2.jpeg')" style="width:200px">

  <hr>
</FORM>