



Guidelines on Interconnection in SADC

First Edition: May 2000

TABLE OF CONTENTS

1	INTRODUCTION	2
1.1	Background	2
	Abbreviations and Acronyms	3
	Definition of Terms	4
2	SCOPE OF INTERCONNECTION.....	7
3	OBJECTIVE: OPEN NETWORK PROVISION (ONP)	11
4.0.	POLICY.....	12
4.1.	Non-Discrimination and Transparency	12
4.2.	Safeguard Protecting ONP	13
4.3.	Number Access	14
4.5.	Point of Interconnection and Collocation.....	16
4.6.	Quality of Service and Technical Standard	17
4.7.	Network Upgrading	18
4.8.	Operator Directory and Emergency Services	18
4.9.	Interconnection Charges.....	19
4.10.	Interconnection And Universal Service.....	20
4.11.	Accounting Separation	21
4.12.	Resale.....	22
4.13.	Responsibilities Of National Regulatory Authority	23
4.14.	Procedures And Disputes Resolution.....	24
	APPENDIX	27
	A DISCUSSION ON COST AND PRICING PRINCIPLES	28

1 INTRODUCTION

1.1 Background

The SADC Protocol on Transport, Communications and Meteorology is a fundamental document which is intended to provide direction to development of telecommunications, among others, in SADC and the SADC Telecommunication Policies & Model Telecommunication Bill is a guideline to develop telecommunications at national level.

SADC Protocol on Transport, Communications and Meteorology provides that National Regulatory Authorities (NRAs) shall have the responsibilities to determine harmonized interconnection guidelines.

SADC Telecommunication Policies & Model Telecommunication Bill specify the principles governing interconnection between operators, including providers of value-added services, within a national boundary, to allow for inter-operability and inter-communications.

These documents have been instrumental in the adoption of institutional reforms in SADC such that the establishment of national regulatory bodies has reached an advanced stage. This progress has brought in its stride new service providers particularly in mobile cellular and Internet. As further implementation of national laws takes place, more service providers are likely to be interested in offering services in the growing economies of SADC. In this environment, regulation on interconnection between service providers is essential to ensure transparency and non-discriminatory practices, thereby ensuring fair competition in the interest of consumers. Moreover, regulation on interconnection should take account of the evolution in technology to be able to respond to demands of any service provider at any point in time, maintaining inter-operability at all times.

Recognising this necessity, the Telecommunications Regulatory Association of Southern Africa (TRASA), in pursuance of its primary goal to ensure accelerated development of an efficient and reliable telecommunications infrastructure for provision of universal service, has produced a "Guideline on Interconnection". Through this guideline, TRASA aims at facilitating the task of NRAs in developing country-specific principles, although harmonisation should remain a key objective as far as practicable in the building up of regional integration. The application of effective country-specific Interconnection principles will greatly serve to develop a pro-competitive environment to expand diverse services to the population in an equitable manner. NRAs are adequately geared to meet this challenge within a reasonable time frame.

Abbreviations and Acronyms

The following abbreviations and acronyms have been used throughout this document:

TRASA	-	Telecommunications Regulatory Association of Southern Africa
CLI	-	Calling Line Identification
GMPCS	-	Global Mobile Personal Communications by Satellite
ICT	-	Information and Communications Technologies
IP	-	Internet Protocol
ISP	-	Internet Service Providers
IT	-	Information Technology
ITU	-	International Telecommunication Union
LRIC	-	Long Run Incremental Cost
MCN	-	Mobile Cellular Networks
NRA	-	National Regulatory Authority
ONP	-	Open Network Provision
Pol	-	Point of Interconnection
PSTN	-	Public switched telecommunications network
QoE	-	Quality of Experience
QoS	-	Quality of Service
SADC	-	Southern African Development Community
SMMEs	-	Small, Medium and Micro Enterprises
UA	-	Universal Access
US	-	Universal Service
USA	-	Universal Service Agency
USF	-	Universal Service Fund
VoIP	-	Voice over Internet Protocol

Definition of Terms

Terms for entities used in this document are defined as follows:

'Basic telephone service' - the provision of domestic or international telecommunications service over the public switched telephone network;

'CSSN7' - a modern signalling system, based on standards set by the CCITT (the former name of the world telecommunications standards-making body), for the transfer of messages between entities in telecommunications networks that enables the setting up, routing and clearing of calls and the transfer of other relevant information related to the operation of these networks. The CSSN7 signalling system is used for the transfer of such messages between different networks as well as within individual networks;

'Customer' - a person who receives and pays for a telecommunication service over a period of time under an agreement with or pursuant to terms and conditions established by the operator with approval of the NRA a notional point identified as a point of interconnection Authority;

'Data communications' - digital transmission of information usually between computers;

'Dominant operator' - a regulatory classification of a telecommunications operator that has the largest market share in a given market segment or that is otherwise able to exercise market power in the same or other market segments;

'Facilities leasing' – means the use by an operator of the facilities belonging to another operator, subject to commercial and legal conditions concluded between the parties for commercial purposes;

'Global Mobile Personal Communications by Satellite' – Geo-stationary or non-geostationary satellite technology possessing the capability to offer telecommunications services directly through a mobile handset to a user;

'Incumbent Operator' - the existing operator in a market which is opened to competition;

'Interconnection' -the physical and logical connection of two operators' networks thereby allowing customers of one system to connect with customers of the other, or to access services provided from the other system;

'Interface' - the technical characteristics that allow two operators networks that are interconnected to understand the technical

operation of the other for services to interoperate across the interconnection boundary;

'Interoperability' -the technical features of a group of interconnected networks which ensure end-to-end provision of a given service in a consistent and predictable way;

'Non-discrimination' - a condition by which an operator, engaged in the provision of telecommunications services, shall not apply less favourable technical and commercial conditions on any competitor than what it would apply to itself, its subsidiaries or its affiliates in delivery of services;

'National Regulatory Authority' - an agency empowered to regulate and monitor the activities of telecommunications operators or any other info-communications providers in the public interest;

'Operator' - a person that operates telecommunications facilities;

'Paging' – a service that provides selective calling from any telephone through a base station to one or a predetermined group or radio receivers, which emit an audible, visual, or tactile alert and sometimes then record a numeric, alphanumeric, or even a short verbal message;

'Point of Interconnection'- a notional point identified as the centre at which different networks are connected with each other;

'Public switched telecommunications network' - a fully interconnected and integrated system of telecommunications consisting of various means of transmission and switching, utilised to provide basic telephone services to the general public;

'Public telecommunications services' - telecommunications services provided to the general public or to a class of persons so as to be generally available;

'Resale' -the offering to users or customers for profit of telecommunication services obtained from another telecommunication service provider;

'Telecommunications' - any domestic or international transmission of information by wire, radio waves, optical media or other electromagnetic systems, between or among points of the user's choosing;

'Telecommunications Infrastructure or Network' - an integrated system of facilities, which comprise the facilities, used to provide one or more info-communications services;

'Transparency' - requires that network operators will make publicly available either the interconnection agreements or reference interconnection offers;

'Universal access' – a policy of government to make telecommunications services available, at affordable prices, to as many people as possible through common points or end-user facilities such as libraries, schools, health-centres, community centres, public call offices and pay-phones. This policy also applies to advanced information services, for instance the provision of Internet services and applications such as tele-education, tele-medicine and electronic commerce;

'Universal service' – a policy of government to make telecommunications services, including advanced telecommunications services, available throughout the country at affordable prices so that they are either available or easily accessible to anyone whenever they are needed, regardless of geographical or physical locations, with due regard to people with special needs;

'Universal Service Agency' - an institution recommended to be established under either the Ministry or the Regulatory Authority to design universal service strategies and policies and monitor their implementation;

'Universal Service Fund' - a fund into which contributions from operators and/or other sources are paid for the purpose of providing basic and advanced telecommunications services to underserved areas, communities or individuals who cannot afford such services on their own, in the pursuit of universal service/access;

'Value-added services' - means (i) the manipulation of the format, content, code, protocol, or other aspect of information transmitted via telecommunications by a customer (ii) the provision of information to a customer, including the restructuring of information transmitted by a customer or (iii) the offering of stored information for interaction by a customer;

2 SCOPE OF INTERCONNECTION

In general, interconnection refers to a physical link that is set-up to connect two (2) separate entities so that the two (2) entities are interoperable allowing traffic from telecommunications services to flow from either end to the other end without the desired transmission quality level being impaired. The entity may be either an integrated network that constitutes a standalone telecommunications infrastructure or an unbundled element of a network that constitutes a part of an infrastructure. This part can be activated on interconnection to an integrated network. The two (2) entities may possess either the same or different technologies and may belong to either the same or different operators. The traffic, which is transmitted by customers terminated on any of the two (2) different entities, can be voice, text, data, video or image.

Interconnection involves a commercial contract between providers of networks and services (operators). Any operator, existing or new entrant, requires a connection to the Public switched Telecommunications Network (PSTN) to fulfill licensing requirements and for commercial motives. By experience, the relationship between any new operator and the incumbent operator has never been an easy one, especially due to the dominant position that a fixed line operator occupies in the telephone service market. An interconnection guideline establishes procedures and conditions to harmonise the relationship among operators, existing and new, that the NRA has the responsibility to oversee.

In a multiple-operator environment, the application of effective interconnection principle is a key success factor for ensuring a coherent development of an integrated and robust national telecommunications network. In the evolution from a monopolistic to a competitive environment, various types of networks, technologies and systems have to co-exist in tandem. In this environment, new opportunities to achieve US have surfaced.

Firstly, new technical possibilities have facilitated the emergence of new categories of network and service providers that can bundle network elements from different operators, separately and partially, to provide a service. This multitude of service providers expands the supply capacity that can cover uncharted territories to serve a larger proportion of the population.

Secondly, technological innovations are uncovering more cost-effective methods of delivering the traditional voice and text services as well as a whole range of new services, such as Internet, electronic mail, and electronic commerce, Voice over Internet Protocol (VoIP) and administrative transactions.

The regulatory challenge is to harness technological possibility to reinforce communications flow within the economies of SADC as well as between SADC and global economies to raise social and economic development. This challenge can be met by an interconnection regulatory regime that copes with the new technological realities of the day and makes provision for the different types of networks, both traditional and new ones, to inter-operate for effective service delivery to the population.

The interconnection regulatory regime must achieve a network that is fully open to allow for inter-working of all types of technologies and services, and their subsequent expansion to reach a larger proportion of the citizens of SADC, along the principle of universal service. Furthermore, both the traditional and new providers of networks and services (operators) will run these technologies and services in a pro-competitive environment. Accordingly, the scope of interconnection on a national scale cannot be limited to telephone service only but it must extend to all information and communications services that technology can possibly provide in each context.

On this basis, there can be four broad classes of interconnection arrangements:

(a) Class 1: Interconnection of switched systems

Interconnection is usually established between networks having either similar interface characteristics or similar services, according to international technical standards, such as CCSN7. The most common is interconnection between PSTN, between Mobile Cellular Networks (MCN), between the PSTN and the MCN, and between the PSTN and paging networks.

Other international standards that provide interfacing between traditional circuit switched networks (PSTN) and packet-switched based Internet are surfacing to allow voice, facsimile and video traffic to be exchanged between these two networks.

Therefore, the switched systems that must be inter-operable at a desirable quality level, are the circuit-switched fixed networks, the packet-switched Internet Protocol (IP) networks and the mobile cellular systems, including satellite-based mobile systems.

Furthermore, interconnection can take place at either one or more of four possible hierarchical levels to allow local connection, metropolitan connection, national connection and international connection. The metropolitan, national and international switches are referred to as higher level switches. Depending on the locations of the point of interconnection and the calling parties, there may be several switching

stages and inter-exchange links involved in delivering a call, with impacts on the tariff structure.

The following categories of interconnection can be identified without being exhaustive:

- Between local fixed PSTN access networks;
- Between fixed PSTN access and such networks as VSAT and Global Mobile Personal Communications by Satellite (GMPCS);
- Between mobile cellular access networks;
- Between local fixed PSTN access network and mobile cellular network;
- Between either the local fixed PSTN access or the mobile access to a higher-level transit switch;
- Between every two switches in the four hierarchical levels;
- Between cell switched/ packet-switched IP-based networks; and
- Between circuit switched networks (fixed and cellular) to packet switched IP-based networks.

In these arrangements, charging based on usage may be applied.

(b) Class 2: Leased transmission circuits

A leased circuit is a non-switched circuit, which is an element of an integrated network. It is leased by an operator, from a network provider, for either creating his own separate private or public network to generate telecommunications services. This leased circuit can include basic telephone access line, a radio channel, transmission circuits/capacity on a microwave system, transmission circuits/capacity on satellite and transmission circuits/capacity on an optical fiber cable. This requires the network elements to be unbundled to allow the establishment of private networks (e.g private banking network) or interconnecting remote servers to Internet Service Providers (ISP) (public Internet network). Capacity charging may be warranted.

(c) Class 3: Switched transmission circuit

This involves the connection of call/message routing equipment, including PABX, pay-operated phone, facsimile, server and personal computer, to either a direct exchange line or a high-capacity trunk line for the purpose of offering telecommunications services to the public. Traffic volume that is generated can warrant charging the owner of the equipment at wholesale rates.

(d) Class 4: Information Databases

Value-added networks generally rely on the use of computers to store and transform messages and send an audio message or a data display when accessed. These value-added networks require interconnection with the PSTN to provide services.

The first application is services such as audiotext, data processing, as well as public and personal information from a database. The other application is public operator directory services, used as call-centres. These centres offer information on directory numbers and addresses to the public on call.

Capacity charging and wholesale rates are applicable depending on application.

3 OBJECTIVE: OPEN NETWORK PROVISION (ONP)

Network operators shall reach agreement for establishing interconnection between their respective networks to create a countrywide distributed information infrastructure, composed of inter-operable telecommunications networks inclusive of information databases. This infrastructure shall guarantee transparent, symmetrical 'any-to-any' connectivity and shall supply services on non-discriminatory terms and conditions underpinned by reciprocal settlement arrangements, such that:

- a) Each network operator offers required interconnection to other network operators, supplying similar services, on conditions that meet technical and economic specifications in terms of functionality, quality and performance;
- b) Any operator shall be able to route calls or other information-based services between telecommunications networks from any user at cost-based price to any other user;
- c) Many users may access the services offered by a more countrywide integrated telecommunications network in line with universal service goal;
- d) Any user of any network operator shall be able to call, or transmit information-based services to, any other user of another operator without inconvenience and disadvantage;
- e) Call progression between and within networks shall be seamless to both the transmitting and receiving parties;
- f) A customer to an operator, through the addressing system available, can select an alternative operator for using a mobile, long distance and/or international service, and the originating operator fulfils this requirement on adequate commercial terms and quality standards;
- g) All operators shall provide each other access to directory assistance and, where applicable, to emergency services on reasonable and cost-based commercial conditions; and
- h) Operators should incorporate in the interconnection agreement an arrangement for the users of their respective networks to access seamlessly operator directory information and emergency services (Police, Ambulance etc).

4.0. POLICY

4.1. Non-Discrimination and Transparency

Fair and effective interconnection arrangements are essential to the development of a telecommunications services market. For this purpose, operators shall provide interconnection in a timely fashion, at any technically feasible point, under non-discriminatory terms and conditions, and at cost-oriented rates.

Transparency entails that either the interconnection agreements or a reference interconnection offer will be made publicly available.

Non-discrimination is a condition by which an operator, engaged in the provision of telecommunications services, shall not apply less favorable technical and commercial conditions on any competitor than what it would apply to itself, its subsidiaries or its affiliates in delivery of services.

Discriminatory practices in interconnection are visible in respect of time of provision, capacity, quality and prices. As a prevention measure, non-discrimination is highlighted under four aspects: any-to-any connectivity, equal access, fair and equal treatment of messages/calls, and quality of service.

- (a) Any-to-any connectivity refers to the ability of any network operator to be able to interconnect with any other operator at cost-based interconnect tariffs. No operator with market power over essential facilities and services shall preclude a potential competitor from terminating calls on its network.
- (b) Equal access denotes a state where a subscriber to an incumbent's local network can choose an alternative provider of mobile cellular, long-distance and/or international service without suffering disadvantages such as long dialing sequences, dial tone delay, and differential charges.
- (c) Fair and equal treatment of messages/calls exists when a user does not experience any difference between messages/calls originated or terminated on a competitor's network and that on an incumbent's network.
- (d) Quality of service refers to the level of intelligibility of the message/call that is delivered by a telecommunications network. The public may interpret lower intelligibility, arising out of inadequate capacity provided by an incumbent in his interconnection with a new entrant, as an inferior lower quality offering by the entrant. This may provide unfair advantage to the incumbent.

For interconnection to public telecommunications networks:

- (a) The organisations concerned adhere to the principle of non-discrimination about interconnection offered to others. They shall apply similar conditions, including commercial and technical, in similar circumstances to interconnected organisations providing similar services. They shall provide interconnection facilities and information to others under the same conditions and of the same quality as they provide for their own services, or those of their subsidiaries or partners.
- (b) All necessary information and specifications are made available on request to organisations considering interconnection to facilitate conclusion of an agreement. The information provided shall include changes that the solicited organisation is planning in a period not exceeding fifteen months, unless otherwise agreed by the NRA.
- (c) Interconnection agreements are communicated to the relevant NRAs and made available on request to interested parties. The NRA shall determine the parts that deal with the commercial strategy of the parties, that ought not be declared or made available. In every case, details of interconnection charges, terms and conditions and any contributions to universal service obligations or to similar purposes shall be made available to interested parties.
- (d) Information received from an organisation seeking interconnection is used only for the purpose for which it was supplied. It shall not be passed on to other departments, subsidiaries or partners for whom such information could provide a competitive advantage.

4.2. Safeguard Protecting ONP

In ensuring ONP, organisations involved in an interconnection agreement must ensure:

- (a) Security of network operations: The availability of public telecommunications networks and publicly available services is restored in the shortest possible time in the event of technical breakdown or in exceptional cases of force majeure, such as extreme weather, lightning, flood or fire. In the event of such circumstances, the bodies concerned shall endeavour to maintain the highest level of service to meet any priority, laid down by the NRA.
- (b) Maintenance of network integrity: The integrity of public telecommunications networks is maintained, entailing that no party to an interconnection agreement will have its public telecommunications network physically disjointed.

- (c) Interoperability of services: The imposition of conditions to achieve interoperability of services. These conditions include implementation of specific technical standards, provision of equipment and plant capacity, and codes of conduct to ensure the sustained availability and flow of services as exchanged between the involved parties, according to a specified standard agreed with the NRA.
- (d) Protection of data: The data, including commercial and technical, that are in stored in technical systems and that are deemed confidential by either party shall be barred from access. The NRAs shall determine the validity of the submission by either party and ensure that the interconnection agreement makes adequate provision for data protection.
- (e) Requirements: The need to meet any of these requirements shall not constitute valid reasons for refusal to negotiate terms for interconnection. The NRAs shall ensure that any conditions of interconnection are non-discriminatory in nature and are based on objective criteria identified in advance.

4.3. Number Access

Numbering is an essential condition to fulfil Equal Access to telephone services. In this respect, a national numbering scheme shall identify every network in a country by a specific number. The number system shall be structured with a standard numbering length, consisting of uniform number of digits over the national territory, and different operators are differentiated by a prefix. Where geographic code form part of a number, they should be the same in all cases. As far as technically and economically feasible, a user wishing to use a network other than the incumbent needs not dial more digits than he would be required if the call were to be carried by the incumbent's network. To meet these requirements, telecommunications numbers are to be administered by an impartial administrator so that numbers are made available on an equitable basis. Accordingly:

- (a) NRAs should have the responsibility for developing, assigning, administering and controlling national numbering plans and addressing aspects of telecommunications services where coordination at national level is required so as to ensure effective competition.
- (b) Numbering schemes should be developed in full consultation with all the parties involved and in harmony with a SADC numbering framework within the framework of international numbering schemes.

- (c) NRAs shall ensure that the procedures for allocating individual numbers and/or number blocs are transparent, equitable and timely, and the allocation is carried out in objective, transparent and non-discriminatory manner.
- (d) In allocating numbers, NRAs shall ensure that numbering plans and procedures are applied in a manner that gives fair and equal treatment to all providers of publicly available telecommunications services.
- (e) The number system provided to any operator shall facilitate carrier pre-selection.
- (f) Number portability is an important facility for users, allowing them to switch suppliers of services. NRA shall encourage the installation of intelligent network capabilities in the SADC region within a medium time frame as far as it is economically and technically feasible.

4.4. Network Access

An existing operator possesses an infrastructure that enables it to serve new customers at a much lower incremental cost than a facilities-based new entrant that must install its own switches, transmission and loops to serve its customers. This facility has allowed the operator to enjoy economies of density, connectivity and scale that represent an advantage over new competitive entrants. To foster the development of competition and to improve over the economic usage of national resources, sharing of infrastructure and facilities, needed to supply telecommunications services, shall apply. In particular:

- (a) Sharing of facilities and/or property with other operators shall take place where a telecommunications operator has the right under national legislation to install facilities on, over or under public or private land and where physical, technical and economic constraints deprive other operators of access to viable alternatives.
- (b) Any operator shall provide access to the poles, towers, ducts, conduit, land and building as part of his rights-of-way to any other operator for such reasons associated with, but not limited to, town-planning, environmental, technical and economic reasons.
- (c) Infrastructure, facility and property sharing, and access to rights-of-way shall be a matter for commercial and technical negotiation and agreement between the parties concerned. The NRA shall intervene to resolve dispute.
- (d) In conducting the negotiation, an operator shall unbundle the elements of his infrastructure, facilities or property so to reach

commercial agreement on the element or elements that is or are required by the other party in the negotiation.

- (e) In effect, any operator has the duty to provide non-discriminatory access to network elements on an unbundled basis to any requesting operator at any technically feasible point on rates, terms, and conditions that are just, reasonable, and non-discriminatory for the provision of a telecommunications service. An operator shall provide such unbundled network elements in a manner that allow requesting carriers to combine such elements to provide such telecommunications service.
- (f) The minimum unbundled elements include rooms in buildings; network interface device; main distribution frame; towers; local loops; local and tandem switches, including switch-based features; cable and radio-based transmission systems; signalling and call-related database facilities (such as CSSN7); operations and support systems functions; operator services and directory assistance facilities.

4.5. Point of Interconnection and Collocation

Operators access each other's network through Interconnection, giving rise to an open network. They do so by providing links, via wire, radio or other means between the different networks, thereby extending the services on one network on all other interconnected networks. The different networks are connected at a notional point identified as a point of interconnection (POI). This point of interconnection can be at a central point and all involved operators must meet the cost of provisioning. Alternatively, it can be located at a designated place, belonging to anyone of the operators, and the involved operators, except the host, must meet their share of cost. This alternative arrangement is termed as collocation. In determining the most cost-effective arrangement, the incumbent operator will have the duty to:

- (a) Agree with the operator/s seeking interconnection a meet-point. It involves designating a location for interconnecting the networks.
- (b) Provide, on rates, terms, and conditions that are just, reasonable, and non-discriminatory, for physical collocation of equipment necessary for interconnection or access to unbundled network elements at his premises. This may include, but not limited to, main distribution frame, interconnection gateways, and transmission equipment such as optical terminating equipment microwave equipment and multiplexing equipment.
- (c) Resort to virtual collocation, requiring interconnection at a place outside his usual premises such as switching, transmission or main

distribution frame room, if he demonstrates that physical co-location is not practical for technical reasons or because of space limitations.

- (d) Agree with the operator/s seeking interconnection on facilities that must be dedicated in the central office to complete the transmission.
- (e) Charge a fee of physical collocation or virtual collocation facilities according to a filed tariff.

4.6. Quality of Service and Technical Standard

In implementing interconnection, foremost the parties involved have the obligations to ensure that the calls and messages flowing through their respective networks are delivered end-to-end at a specified level of quality. One of the determining elements is the type of interfacing equipment between the different networks. The interfacing equipment shall possess the characteristics to process the message exchange between the interconnecting networks and the capacity to handle the intensity of traffic at the busy hour. In reaching an agreement, both the quality of service and the standard interfacing equipment will have to be specified in comprehensive and definitive terms to ensure the interoperability of networks end-to-end. In the absence of a reference that specifies both quality level and interfacing standard, the relevant standards of the International Telecommunications Union (ITU) shall prevail.

In general, the quality of service of one party (e.g interconnection recipient) should not be impaired by an inferior provision by the other party (e.g interconnection provider). The NRA will have to institute and enforce a Quality of Service (QoS) standard that shall direct the operation of the parties in delivering their services and these standards shall be incorporated in the Agreement. QoS standards shall specify, but not limited to, the level of availability and reliability of the service that the interconnected parties are offering to the public. The related quality of service standards is indicated, as a minimum by two-way free traffic flow; access delay; congestion and blocking; fault rate; restoration period; noise; distortion; attenuation; overall transmission loss; crosstalk; errors; and over-metering.

One of the conditions to achieve a satisfactory level of service, in line with standard, is to provide a technically compatible interface at the POI between the operators involved in an interconnection. The interface must be compatible both at hardware (physical) level and software (process) level to allow reliable signaling and protocol exchange in the setting up of circuits, and consistent flow of messages and traffic. Such exchanges include Calling Line Identification (CLI) and all necessary signaling data which shall be passed between interconnecting parties. These standards shall be referenced and documented in terms of

functionality, service level, capacity, operational routine, reporting and maintenance procedures, and location.

4.7. Network Upgrading

To sustain the quality of inter-operability to the desired level:

- (a) Any of the parties involved shall notify the other party of any planned change in network capacity, technology, structure and configuration, including changes in standards, signaling and protocol, or elements thereof. These changes shall be brought to the notice of the other parties well in time, which is a period not less than fifteen months or any shorter time that the parties may agree to.
- (b) The initiating party shall communicate his plan together with justification elements, such as traffic forecast and technology status, to the national telecommunications authority right after the planning process with a detailed implementation programme to ensure full coordination and harmonisation. The NRA must satisfy itself that the change is being proposed in good faith and its sole objective is a normal process of network capacity and/or quality upgrading and is non-discriminatory.
- (c) The NRA shall ensure that the initiating party does not compromise the interoperability of the networks and that end-to-end communications is not impaired, and along with it the associated operation and management functions, such as billing and quality of service measurement.
- (d) The NRA shall ensure that the other parties adjust their own interfaces so as not to affect service delivery to public. In the event of conflict between/among the involved parties arising out, but not limited to, financial resource requirements, the NRA shall encourage negotiations, failing which it shall rule on a course of action to sustain both inter-operability and improvement in the standard of service. The decision of the NRA shall be final.
- (e) Any change that is abrupt by a party will cause that party to meet the cost of change to the interconnection structure.

4.8. Operator Directory and Emergency Services

Every operator will be deemed to have an operator directory service and a set of emergency numbers. It is also possible that not all operators have this facility. The operators shall reach a commercial arrangement with other national operators possessing the desired facility so that all users have access to telephone numbers, unless qualified by restriction, public administration numbers and emergency numbers.

Accordingly:

- (a) All operators and, principally the dominant operator, have the duty to permit the customers of each other to have non-discriminatory access to telephone and facsimile numbers, operator services, public administration numbers, emergency services, directory assistance and directory listing without any unreasonable dialing and other delays.
- (b) Access to these numbers shall be provided with adequate grade of service.
- (c) To ensure adequate accessibility, the operator assistance center shall be unbundled from the rest of an operator's network to allow the served operators to interconnect with appropriate trunking capacity.
- (d) These operator assistance services will not discriminate among customers in extending the facilities that are requested.
- (e) The same terms and conditions will apply to all customers, indiscriminately.

4.9. Interconnection Charges

Operators shall negotiate and agree on prices for the delivery of a menu of interconnection services. This menu may comprise of, but not limited to, systems for continuity of traffic between the users connected to operators involved, facility for accommodating equipment for interconnection, transmission component, and any other system for common use. These interconnection services will be adequately unbundled in terms of network and service elements. Unbundling pricing will facilitate competition by ensuring that an operator can purchase only those elements that are necessary to offer designed services without having to meet charges that it does not require. Pricing for interconnection is a key factor in determining the structure and the intensity of competition in the transformation process towards an open and expanded market in the pursuit of universal service and universal access goals. Accordingly, the outlined principles will guide the setting of prices:

- (a) Operators generally, and those with significant market power specifically, must demonstrate that they can negotiate interconnection charges based on objective criteria and cost orientation.
- (b) Compensation arrangements shall be reciprocal for the transport and termination of traffic to allow each operator to recover the portion of investment dedicated to providing interconnection. In recovering their costs, each operator shall use the same costing and

pricing methodologies and may reach an arrangement for asymmetrical settlement. The differences will arise solely from the cost of individual operators and the exchanged traffic.

- (c) The price shall cover the incremental cost of providing physical inter-network links and associated equipment, the processing of the additional traffic arising out of the interconnection, and its servicing as well as the associated common cost attributed to the interconnection activity. In reaching this price, an operator shall base his valuation on Long Run Incremental Cost (LRIC) that is required to handle this additional future traffic demand.
- (d) Furthermore, to reach a pricing level that promotes productivity and encourage efficient and sustainable market entry and that is not higher than a limit set by LRIC, various forms of pricing are encouraged, including capacity-based charging and wholesale. In this context, capacity-based charging entails a flat rate for using a specified capacity of an operator's network, as opposed to periodic charging of usage. Wholesale price is the price for delivering services to a high-volume customer, which will be expected to benefit from economies of scale and lower costs, as opposed to servicing the retail category comprising of individual users. In this regard, discounted retail prices can be used as proxy for wholesale prices.
- (e) Different prices, terms and conditions may be set for different categories of organisations which are licensed to provide networks and services, where such differences are objectively justified based on type of interconnection and/or the relevant licensing conditions. Similarly, interconnect prices may be uniform or may vary depending on geographic region (hierarchy of interconnection), distance to point of interconnection and traffic volume. However, the NRA authorities shall ensure that such differences do not result in distortion of competition and that the organisation applies the appropriate interconnection prices, terms and conditions when providing interconnection to its own services or those of its subsidiaries or partners.

4.10. Interconnection And Universal Service

One of the key objectives in deployment of telecommunications network infrastructure is the realisation of universal service goal with respect to basic telephone service and universal access goal to more modern information-based services. To this end, universal service obligation on network providers is one of the determinant policies and universal service fund is a key instrument to realise the goals. Universal service and universal access entail reaching a larger proportion of a population in a country by a broader coverage of telecommunications systems through possibly a greater number of operators. The achievement of universal

service and universal access can be measured by the availability of services, in equal importance, in both urban and rural areas. Interconnection plays a key role in providing of adequate networking capacity and is therefore associated with universal service obligation. Accordingly:

- (a) Those operators designated to fulfil universal service obligations in specified zones will introduce a predetermined portion of relevant costs related to such obligations in their interconnection charges. If such amount does not cover the total cost, the universal service fund will contribute to the short fall.
- (b) Where all licensed operators are required to fulfil universal service obligations across the country, each operator will introduce a predetermined amount of its relevant costs. If such amount does not cover the total cost, the universal service fund will contribute to the shortfall.
- (c) As universal service and universal access, when they are achieved, will bring prosperity to under-privileged zones which will benefit all providers of networks and services, all of them will be required to contribute to the universal service fund.
- (d) The NRA shall decide on the amount to be contributed by each operator towards the universal service fund as universal service obligation.

4.11. Accounting Separation

NRA will be able to act in interconnection-related matters if precise information on the breakdown of costs, current and future, is available in regard to distinct services and network elements. To this end, all providers of networks and services shall put in place systems of cost accounting which provide separate accounts for underlying services, supplemented by adequate cost accounting systems to facilitate the attribution of relevant costs to the interconnection service in question. To this effect:

- (a) NRAs shall establish a standard accounting format as a guide that shall be used by network operators and service providers to structure their accounts. In this format, costs shall be grouped under distinct categories to reflect the unbundling of networks and services, and structurally separating the independent telecommunications activities. By breaking down costs of fixed assets and other operations costs, it shall be possible to identify all the elements of costs and revenue, and their causal relationship.
- (b) NRAs shall ensure that a description of the cost accounting system, showing the main categories under which costs are grouped and the

rules used for allocation of costs to interconnection, is available on request and is suitable for the implementation of interconnection requirements. Compliance with the cost accounting system shall be verified and approved by the national regulatory body or verified by a competent body, authorised by the national regulatory body, and approved by the authority.

- (c) Providers of networks and services shall provide financial information to the NRA promptly on request and to the level of detail required. NRAs shall exercise due care in processing the information to avoid creating a situation of unfair advantage, taking into account the commercial confidentiality requirements.
- (d) The NRA shall ensure that the cost accounting systems in use are suitable for implementation of the requirements and that information requested to determine the price of interconnection is submitted within a reasonable time frame such that no hardship is caused to any of the parties involved.
- (e) In the absence of required information in time, the NRA shall rule in favour of the interconnection recipient. In an event where the deemed interconnection provider has notified, in advance to the NRA, a date for submission of required information, but which is longer than a period reasonable enough not to affect the recipient, the NRA shall issue a temporary ruling in favour of the buyer party. This ruling may be modified at a later stage, to ensure that all parties benefit from an impartial decision.

4.12. Resale

Resale is a way of using existing infrastructure or separate and distinct elements of that infrastructure to provide a service, which is like one offered by the incumbent network provider or modified for delivery to users. Resale therefore improves network utilisation while providing a possibility to reach a larger portion of the population, particularly in the unserved area. In addition, it is more cost-effective to use an existing infrastructure because it can serve new customers at a much lower incremental cost than a new installation from a zero baseline. Furthermore, if capacity exists to meet foreseeable future demand, it avoids over-provisioning of capacity on national scale while providing a quick way of delivering service. Accordingly:

- (a) All operators involved in the provision of public services must allow resale of their telecommunications services on a non-discriminatory basis.
- (b) In this event, while rates are negotiable, the network provider shall ensure that the applicable prices are based on wholesale rates.

Depending on requirements, capacity-based charging, with adequate discount, may be considered.

- (c) The operators shall file the agreement with the regulatory authority.

4.13. Responsibilities Of National Regulatory Authority

The NRA has key responsibilities in adapting the country to an evolutionary telecommunications technology context in an open and competitive environment. The authority must encourage supply of new services and, therefore, must lower barriers to entry by promoting the use of efficient technologies and their interconnection to achieve low-production cost and higher service penetration to meet universal service/access goals. NRA shall:

- (a) Secure adequate interconnection in the interests of all users, exercising its responsibility in a way that provides maximum economic efficiency and gives the maximum to users, taking account for satisfactory end-to-end communications at adequate quality at prices that would prevail in a competitive market.
- (b) Encourage direct negotiation among providers of networks and services to reach reasonable agreement in such a way that end users are not unnecessarily burdened by excessive prices resulting from higher than necessary interconnection charges. It may, on its initiative at any time or if requested by either party, set time limits within which negotiations on interconnection must be completed. If agreement is not reached within the allowed time, the authority shall take steps to bring about an agreement, including imposing a rule that resolves cases of either delay or unreasonable charges that impedes the realisation of universal service/access goals.
- (c) Intervene on their own initiative at any time, and shall do so if requested by either party, in order to specify provisions that must be covered in an interconnection agreement or lay down specific conditions to be observed by one or more parties to such an agreement. It shall approve the agreement before it comes into force. However, it may, under exceptional cases, require changes to be made to interconnection agreements already concluded, where justified to ensure competition and/or interoperability of services for users.
- (d) In the event of an interconnection dispute between the providers, the NRA shall, at the request of either party, take step to resolve the dispute within a period that does not affect the aggrieved party. The resolution of the dispute shall represent a fair balance between the legitimate interest of both parties and shall consider the development of the development of telecommunications services market.

- (e) In the interest of users, the NRA shall require, as a solution of last resort, the providers concerned to interconnect their facilities to protect essential public interest and, where appropriate, shall set the terms of interconnection.
- (f) Put in place the required capacity to deal with interconnection issues in time. This capacity, which consists partly of human resources, must acquire the experience to manage an interconnection regime in an effective manner.
- (g) Gradually develop an interconnection regime at the regional level for users to benefit from a wider range of services at lower regional tariffs and facilitating the growth of industrial production and trade. To do so, the current settlement system will have to be replaced by a system that will benefit all countries of SADC.

4.14. Procedures And Disputes Resolution

Notwithstanding any of the provisions of these guidelines, the NRA shall apply the following procedures with respect to interconnection between any two entities. These procedures apply to both a new interconnection requirement and one where additional capacity is required in line with demand.

- (a) The NRA shall require any licensee to interconnect with other network and service providers with a view to achieve an open network.
- (b) A licensee who is seeking an interconnection, shall apply with all necessary technical details and the time frame for interconnecting to an interconnect provider. A copy of the application shall be submitted to the NRA.
- (c) The deemed interconnect provider shall fix a date within one month, following the receipt of the application, to open negotiation with the interconnecting operator and shall use their best endeavors to reaching a technical and commercial agreement within three (3) months of application for an interconnection.
- (d) In the event of delay to fix a date for opening negotiation, the aggrieved party shall lodge a complaint with the NRA, which shall determine a resolution to the problem. Furthermore, any party who has a complaint during the negotiation shall refer the matter to the NRA, who shall make a fair ruling, considering economics of interconnection in relation to demand and the interest of users.
- (e) The NRA shall not take more time than is necessary to determine a solution in the interest of both parties where either or both parties

have appealed to him/her. Such time shall in no case exceed three (3) months.

End//.....

APPENDIX

A DISCUSSION ON COST AND PRICING PRINCIPLES

1. Pricing of Interconnection Services

When two networks interconnect, each operator seeks to charge the other a price for resources provided. Interconnection aims at providing a call termination service, at a price, to the operators who interconnect their networks. Call termination refers to the delivery of a call that originates on one network to its destination on another network.

Pricing of such services, including interconnection, falls in the category of a strategic decision as it affects the future operation of the ongoing concern. Accordingly, price determination is situated in the future in relation to investment that is necessary for pursuing profitable operation. Price determination is however constrained by market structure, demand and cost structure of the firm, itself.

2. Pricing and Market Structure

In a monopoly environment with a powerful operator and where service scope and demand are limited, the operator would use the fully allocated cost principle uniformly for all the services on offer to determine their price. In this principle, the operator makes use of capital and operation costs incurred in the past, grouping them as direct and overheads, and apportioning the overheads based on activities.

This cost-accounting exercise, which would be done independently of consumer requirement and demand, had a sole objective of producing a total revenue (TR) higher than his total costs (TC), to achieve a desired profit. As a price-maker, the monopolist operator is able to adjust his prices according to social and political considerations. As a result, prices in some areas could be very high targeting a very small proportion of the population while in other areas, the prices would be low supposedly within the reach of a larger population.

The unchecked inefficiency caused by this approach ended in prices that would be above the affordability of a larger proportion of the population, as evidenced by low telephone density and high profits of national operators. The regulatory approach to deal with this problem has been to introduce a price-cap in local and national telephone service, but which is difficult to apply in the absence of adequate statistics.

In an ideal competitive multi-operator environment, market determines price, and each operator becomes a price-taker and adopts the prices according to the equilibrium between demand and supply forces. In this environment, pricing becomes a strategic issue and inadequate price with respect to that equilibrium price, accepted by the market, could threaten the future existence of an operator.

Operators, in this environment, will also work for a profit by ensuring that their TR is higher than their TC by an amount that at least meets their cost of capital. To do so, they unbundle their service offerings to ensure that, as far as possible, the cost is relevant to the activity in question. In addition, they use future costs, as a basis to realise prices that are accurate to sustain future investment. This approach opens their scope to consider alternatives, and therefore measure their opportunity cost, closing the gap between their targeted return and their cost of capital.

3. PRICING AND DEMAND

Price elasticity is the most important measure of sensitivity of demand in relation to a price change and it is indicated by $\%Q = E * \%P$. Being an essential service, the quantity of telecommunications services demanded (or volume) varies with price. If a price change is substantial enough so as to tend to a level which population can afford, the demand for telecommunications services is expected to rise. The higher efficiency brought about by competition in cellular and ISP market has driven prices down, with the result that of spectacular growth in adoption rate. This phenomenon is also observed on international voice traffic.

In the transition from a monopoly to a competitive market, the high surplus of price over average cost ($P = C [1+m]$) will attract competitors, causing prices to reduce and demand to grow. The high price elasticity of demand impacts on the marginal revenue, which will continue to reduce with a reduction in price ($MR = P [1 + 1/E]$). The reduction in prices will continue until prices are reduced to a marginal cost level ($P=MR=MC$), characteristics attributed to a perfectly competitive market.

If this notion of increment is applied to two different levels of demand and revenue, it can be referred to incremental demand and incremental revenue. As investment to meet demand and the pricing to be used is dependent on cost of capital and, therefore, are future decisions, the decision algorithm is limited to a relationship between market-determined prices and the incremental cost. In this algorithm, supply of services will be provided according to incremental demand on condition that incremental revenue exceeds incremental cost.

4. Incremental Cost

The notion of opportunity cost is implicit in incremental cost methodology. Incremental cost refers to the change in total costs from implementing a particular business decision, such as adding capacity to meet additional demand. In such a case, the decision is taken on consideration of different alternatives. For example, consider the two alternative scenarios as a baseline scenario for reference and an alternative scenario planning an addition of capacity. Compared with the baseline, the implementation of the alternative scenario creates a

capacity increment and a corresponding cost increment. The difference between the cost of the alternatives is the incremental cost. Decision to implement the scenario if the related incremental revenue (IR) is higher than the incremental cost (IC). It, therefore, entails that the selected price has to be based on the incremental cost.

5. Relevant Cost

In computing the incremental cost, only costs relevant to a decision under consideration are chosen. Decision-making relates to the future and is a process designed to choose between alternatives in the pursuit of an objective. Every decision is made in the context of the circumstances unique to that decision. When circumstances vary, the costs to be chosen also vary.

By relevant, therefore, is meant the costs that are unique to the decision under examination, and relate to activities that are to be implemented in future, like investment to be undertaken to add capacity for interconnection. In this regard, past costs incurred on existing equipment that have no relation with the decision on hand are irrelevant.

Differential costs principle is used to determine relevant costs, facilitating the elimination of costs that are common (and equal), in alternative scenarios. It can be used for both short run and long run decisions. Long run decision concerns investment and in evaluation of such decision, discounting techniques have to be applied to take into account the time value of money.

The relevant costs in a telecommunications expansion project are determined by considering two scenarios: a baseline scenario and an expansion scenario. The relevant cost increment takes place by obtaining the differential cost between the two scenarios.

6. Short Run and Long Run Costs

The short run, in this context, refers to the period during which the productive capacity remains unchanged. During this period, service-output is obtained from fixed existing capacity and the total cost comprises of fixed cost and variable cost. If incremental cost were computed in the short run, fixed cost will be eliminated even if it were relevant because it is independent of any activity/output level. Only the change in variable cost resulting from a change in output can be accounted for.

The long run refers to a planning horizon within which an optimum capacity can be added to cope with higher level of demand. During this period, service-output will be provided by flexibly adjusting the capacity. Once capacity has been added in the long run, operational activities take place in the short run. Cost in the long run is totally variable, in relation

to expansion activity. Incremental cost in the long run measures only the change in variable cost from a change in output, as there is no fixed cost.

The primary purpose of determining these costs is to determine prices that are sufficient to recover investment in future. Incremental cost is different when calculated for a short run situation and for a long run situation respectively.

Short run refers to a period during which there is no investment and most input is fixed in quantity. Accordingly, short run cost comprises of additional operational (running) cost that will be incurred in providing additional service. By assessing costs in the short run, the cost that will be incurred in future to produce a required level of output to meet demand is not evaluated and related derived prices will not be high enough to cover costs of future investment.

On the contrary, being highly capital intensive, the telecommunications network is expanded by resorting to long run investment streams to supply capacity in line with demand. Prices that are derived taking into account both the additional operational costs as well as the investment costs in equivalent present value terms at adequate cost of capital. The level of prices is therefore more accurate to support a decision.

Accordingly, the cost methodology that is appropriate to determine effective price in a competitive environment is the forward-looking long-range incremental cost (FL-LRIC).]

6. Application of FL-LRIC to Interconnection

The FL-LRIC is applicable to interconnection for the simple reason that the entire investment that is required to provide capacity for interconnection, including switching and transmission capacity to handle increased traffic due to interconnection, is avoidable and therefore captured by long run incremental measure.

Given that measures based on long run are assessed by using discounted cash flow (DCF) techniques, suggesting the following method for determining FL-LRIC and its average:

- (a) Generate two scenarios, a baseline scenario and an expansion scenario. The baseline scenario may have no interconnection and the expansion may consider putting interconnection capacity for ten years.
- (b) Determine the outflows from the two scenarios over the ten-year identifiable period of time. In the first scenario, for example, the outflows will be nil, whereas in the second scenario, the outflow for

the next ten years is the annual charges consisting of payment of loans, maintenance charges and taxes.

- (c) Assess the cost of capital. This cost may either be equivalent to a return that the firm could earn by a best possible placement or it may be a weighted average of what the firm pays for its capital.
- (d) Use the DCF to determine the present value of providing interconnection. In the base scenario, the present value is zero and in the second scenario, it is PV. The LRIC is PV ($PV - 0 = PV$).
- (e) To determine the LRAIC, divide LRIC by the effective added capacity.
- (f) Based on this LRAIC, price is determined.

In general, if the baseline scenario is a growing output, and the alternative scenario is a higher rate of growth, the increment present cost includes both relevant investment and operating expenses, such that:

$$\text{LRAIC} = \text{PV2} - \text{PV1} / \text{Capacity Increment}$$