CRASA
Wireless Technologies Policy & Regulations

GUIDELINES

Table of Contents

Part C – Recommendations

PART D. Annexes, Appendix and Glossary of Terms

Acknowledgements

Members of CRASA Sub-Committee on Wireless Regulation that contributed to this document:

Mike Kuntiya, MACRA
David Railo, ICASA
Mamodupi Mohlala, ICASA
Mlindi Joe Kgamedi, ICASA
Sipho Tsotetsi, ICASA
Hilario Tamele, INCM
Thapelo Mogopa, CRASA
Nicodemus Mwazya, SATA
Johan Smit, Telkom SA/SATA
Lishan Adam, CATIA

The Subcommittee would like to thank the following:
Claire Sibthorpe- CATIA Programme Manager
Mike Jensen – Independent Consultant
Geoff Daniell, SSA Correspondent, GVF
and
The CATIA Programme of the Department for International Development for the Financial Assistance

List of Acronyms

3G	3rd generation [cellular system]
AP	Access Point
bps	bits per second
BS	Base Station
CDMA	Code Division Multiple Access
CEPT	European Conference of Postal and Telecommunications
DBS	Direct Broadcasting Satellites
DCF	Distributed Coordination Function
DCS	Dynamic Channel Selection
DECT	Digital Enhanced Cordless Telecommunications
DFS	Dynamic Frequency Selection
DS	Direct Sequence
DSSS	Direct Sequence Spread Spectrum
DTH	Direct to Home
DVB	Digital Video Broadcasting
DVB-RCS	DVB Return Channel via Satellite
EAP	Extensible Authentication Protocol
EDGE	Enhanced Data for GSM Evolution
EIRP	Effective Isotropic Radiated Power
ETSI	European Telecommunications Standards Institute
ERC	European Radiocommunications Committee
FCC	Federal Communications Commission
FDMA	Frequency Division Multiple Access
FSS	Fixed Satellite System
FWA	Fixed Wireless Access
Gbps	Gigabits per second
GEO	Geostationary Earth Orbit (satellite)
GHz	Giga Hertz
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile
HIPERLAN	High Performance Radio Local Area Network
IEEE	Institute of Electrical and Electronics Engineers
IMT-2000	International Mobile Telecommunications-2000
IP-VSAT	IP-based VSAT systems
IP	Internet Protocol
IR	Infrared
ISM	Industrial, Scientific and Medical
ISP	Internet Service Provider
ITU	International Telecommunications Union
kbps	kilobits per second
kHz	kilohertz
LAN	Local Area Network
LMDS	Local Multipoint Distribution System
LOS	Line of sight
MAC	Medium Access Control
MAN	Metropolitan Area Networks
Mbps	Megabits per second
MHz	Mega Hertz

MMDS	Multi-channel Multipoint Distribution System
MPEG	Motion picture expert group (video compression standards)
MSS	Mobile Satellite Systems
PAN	Personal Area Networks
PCS	Personal Communications Services
PDA	Personal Digital Assistant
POTS	Plain Old Telephone Service
PTT	Public Telecommunications Operator
QoS	Quality of Service
RA – UK	Radio-communications Agency
RLAN	Radio Local Area Network
RF	Radio Frequency
RFT	Radio Frequency Transceiver
SIP	Session Initiated Protocol
TDM	Time Division Multiplexing
TDMA	Time Division Multiple Access
TPC	Transmit Power Control
TVRO	Television Receive Only
UMTS	Universal Mobile Telecommunications Services
VoIP	Voice over IP
VSAT	Very Small Aperture Terminal
WAN	Wide Area Network
WCDMA	Wideband CDMA
WRC	World Radio Conference
WAS	Wireless Access Systems
WEP	Wireless Equivalent Privacy
WiFi	Wireless Fidelity
WiMax	Worldwide Interoperability for Microwave Access Forum
W-ISPs	Wireless Internet Service Providers
WLAN	Wireless Local Area Network
WMAN	Wireless Metropolitan Area Network
WSIS	World Summit on the Information Society
WTO	World Trade Organization

PART A

Background

Executive Summary

The purpose of these guidelines is to outline policy and regulatory recommendations for wireless technologies deployment in the SADC region. Special emphasis is made on the VSAT technology and wireless LAN due to their implications for providing access to information and communication in the region. The guidelines propose a policy and regulatory regime that would enable SADC countries to extract the maximum economic and social benefits from the use of wireless technologies and make recommendations for the review of policies spanning issues such as the authorization of the use of the radio spectrum, registrations, licensing and other measures that would encourage innovation, investment and use of these technologies.

Terrestrial Wireless and satellite technologies have shown considerable potential for economic development as they promise the delivery of information to people who needs it most “everywhere all the time.” The lack of affordable access to telephone and Internet connectivity for the sparsely scattered majority in Africa, who are not close to even small urban centers, has been a problem because, it is now well-established, the productivity of poor households must increase if they are to rise out of poverty. Increasing productivity is difficult without timely access to information, the ability to network and learn from others, or the ability to interact with markets, governments, and other resources. Economic growth cannot be achieved without improving the efficiency of institutions, markets and businesses through ongoing learning.

Also, the delivery of information and communication by government alone cannot be sustained due to lack of resources and competing priorities. Given the challenge and the limited resources available for investment in ICTs for development, private approaches that can be sustainable and self-supporting, or even profitable, have an obvious strategic value. By creating an enabling environment governments can allow anyone to set up their own “hotspots” or satellite-based Internet communications and information platform, thereby increasing possibilities for entrepreneurship and flow of knowledge and resources.

Innovative low cost VSAT technologies and terrestrial wireless extensions such as WiFi and WiMax have a substantial role in increasing access to opportunities in Africa. VSATs are easy and quick to set up and maintain, distance insensitive and promote efficient spectrum use. WiFi andWiMax technologies offer the advantage of lowering the cost of upgrading and expanding backbone data networks in underserved areas with point to point wireless transmissions available up to 50 km and inexpensive last mile distribution or neighborhood networks. As the technology evolves wireless has become a very effective, low cost “last mile” solution for those who need universal access most.

Experiences in Asia and Latin America have proven that virtually any village community, entrepreneur, small enterprise, public institution or member of the public (e.g. via a rural cybercafe) can immediately get connected, no matter where they are, or how far they are from fixed infrastructure. New and creative enterprises can make rural areas more profitable, affordable and sustainable and served in a way to meet national development objectives. However, this requires creativity and innovation in terms of universal access as well as enabling public policies.

It means regulations have to keep up with these developments. Governments should create conducive environments that promote access to wireless technologies for development focusing on managing spectrum and power emissions, fostering the implementation of standards for communications protocols and supporting research and development in new communication technologies.

As demand grows for an established standard in wireless technologies such as WiFi, regulations will need to change to allow their use and broad acceptance. Standards provide international interoperability and the opportunity to achieve economies of scale and scope, but none of this is possible without the necessary spectrum. The success of wireless products can be impeded by the restrictions placed upon their use by government regulations. Terrestrial wireless technologies present several regulatory challenges ranging from importation, sales and installation of wireless equipment, fees, power limits and to effective frequency band usage that need to be addressed by the policy makers. In general:

- Regulations and decisions should be made on licensing fees of various wireless technologies.
- Import or production of related radio and telecommunications terminal equipment for resale requires registration of suppliers and regulations on sales restrictions – whether the technologies be sold with any restrictions or none at all
- Regulators should legislate the amount of Effective Isotropic Radiated Power (EIRP) the equipments, either 2.4 GHz WLAN or 5 GHz RLAN is permitted in order to ensure the continued use and availability of these bands for its use.

- Regulations should also be clear on licence exempt bands and the free use of ISM bands for commercial purposes. The European Commission issued a recommendation to encourage member states to provide licence-exempt WLAN access to public electronic communications networks and services in the available 2.4-GHz and 5-GHz bands. This is not binding on member states, but it is consistent with the (binding) Authorization Directive, which requires all member states to allow licence-exempt access to the spectrum when the risk of harmful interference is negligible.

In addition connection to satellite services is increasingly being provided using Very Small Aperture Terminal (VSAT). The falling costs and increasing bandwidth is driving the demand for VSAT terminals for business, home users and institutions and lifting up the associate policy and regulatory issues. Other driving factors include:

- The desire of governments to ensure that all their citizens are able to obtain equivalent ICT services regardless of their geographical location. This is also driven by a desire to stop the urbanisation process that is so destructive, especially in the developing world.
- The desire by large corporations for redundant and alternative networks, independent of terrestrial infrastructure.
- The need for connectivity that is always available, regardless of geographical and political constraints.
- The increasing need for high-speed services and multimedia connectivity direct to end-users

The needs for more connectivity using VSATs presents regulatory challenges ranging from radio frequency management, licensing, equipment type approval, setting licensing fees and provision of transparent information on licensing procedures.

- VSAT terminals operate in three major bands namely: C-band (4-6 GHz), Ku-band (10-20 GHz) and Ka-band (20-30 GHz) that require different licensing approaches. Most VSAT and DBS television systems in operation today use portions of the Ku-band.
- Typically, any satellite system would comprise of four major entities, which may have to be authorized before a service can be delivered to an end user. The entities to be authorized for each of these parts include a) the Space Segment operator; b) the satellite network operator, who operates one or more Gateway Stations or Network Control Stations (Hubs) or other ground stations; c) the Satellite Service Provider; d) entities that are licenced to use individual VSAT equipment. These require different licensing regimes.
- Mutual recognition of type approval has become important to facilitate the deployment of VSAT terminals across borders.
- Information on licensing issues should be readily available and applications should be easy and transparent.

These guidelines propose recommendations for the removal of structural barriers for the diffusion of wireless communications technologies and services. The issues discussed include protection of public safety, managing spectrum, licensing, landing rights, transparency and enforcement. Guidelines provide suggestions to establish procedures for a regional policy harmonization including blanket exemption and for mutual acceptance of test results and type approvals for radio equipment in conformity with national type approval regulations and international best practices. Moreover, the guidelines outline strategies to simplify and streamline licensing procedures through the creation of a one-stop-shops (OSS) that organize information on regulation and licensing requirements and provide an overall blue print to facilitate administrations' efforts to develop and enforce policies and regulations in wireless systems and services based on the experiences of regional organizations such as the Inter-American Telecommunications Commission (CITEL) in the Americas, the Asia Pacific Telecommunications (APT) and Asia Pacific Economic Co-operation group (APEC) in Asia and the Conference European Posts et Telecommunications (CEPT) in Europe.

I. Introduction

The purpose of these guidelines is to outline policy and regulatory recommendations for wireless technologies deployment in the SADC region. Special emphasis is made on the VSAT technology and Wireless LAN due to its implications for Internet diffusion in the region. These guidelines review the regulatory environment shaping the use and licensing of wireless and VSAT technologies in CRASA member states. CRASA and SADC have approved a series of policy and regulatory principles, subsequently implemented through the development of proposed regional guidelines addressing such areas as tariff, interconnection, radio spectrum management, numbering, universal service and universal access. The present guidelines build on existing model laws, policy guidelines and regulation and address regulations in wireless technologies built on experiences around the world, particularly in Europe, Australia and Latin America. The first part of the guidelines provides an overview of the wireless technologies, regulation, policy trends and experiences at national, regional and international levels. The second part of the guidelines provides policy recommendations.

II. Implications of Wireless Technologies

It is widely recognized that access to information and knowledge through affordable communications represents a significant opportunity for social and economic development, for regional cooperation and integration, and for increasing the participation of all in the emerging global information society. Addressing deficiencies in access to low cost communication services is regarded as an urgent imperative for improving the quality of life of people in the SADC region, especially in the remote and rural areas where the bulk of the population still resides.

However, the regional market is fragmented into many small national markets, and limited economies of scale have combined with low-income levels to reduce the incentives for telecommunications operators to provide widespread services. Compounded by low levels of competition in the sector, this has resulted in low levels of investment in infrastructure. The cost of more advanced services such as Internet bandwidth is generally 10-100 times higher than in developed countries. As a result, even where access is available, costs often remain extremely high, especially outside urban areas. Although there are a growing number of initiatives to expand terrestrial infrastructure, these are usually confined to the major cities and along trunk routes.

Fortunately, wireless technology presents an important solution to this bottleneck. Wireless technologies can immediately improve access to communications, even in the vast inaccessible terrains in the region. For example, satellite-based systems using the Ku-band satellites over Africa now make it possible to obtain bandwidth anywhere in the region about ten times more cheaply than previously available from the older C-band systems. Prices for some Very Small Aperture Terminals (VSATs) are now less than $2000, and monthly charges can be as low as $150 for Internet access. With the economies of scale available from the satellites that cover the entire continent, these terminal prices could shrink to $750, and monthly charges to less than $100. Although these costs are attractive and acceptable to high-end customers living in the rural areas (e.g. game farms, businesses, schools, etc.) these costs are still far beyond the reach of the majority of low-income communities. Concerted universal access strategies that combine innovative rural private sector initiatives (e.g rural cooperatives) and advanced wireless technologies could ultimately make access to information possible even to the rural poor.

Satellite technologies make it possible to provide universal access to high-speed Internet services within a reasonable timeframe at an affordable cost. Compared to cable solutions, satellite technologies offer the advantage of wide coverage, point-to-multipoint transmission capabilities and seamless transmission independent from terrestrial infrastructure. Thus, on an affordable and timely basis, satellite technology could bring broadband Internet services to SADC countries and to rural and remote areas where terrestrial infrastructure is practically non-existent or its rollout is prohibitive. Moreover, the satellite industry already has considerable resources and the potential to provide universal broadband services.

Local broadband fixed wireless extensions of satellite such as WiFi and WiMax promise the creation of Village Area Networks that enhance economic development of rural communities raising their living, medical and educational standards.[1] For example, new WiMax technologies offer the advantage of lowering the cost of upgrading and expanding backbone data networks in underserved areas with point to point wireless transmissions available up to 50 km while point-to-multipoint over a 5 to 7 km radius allows for inexpensive last mile distribution.

Experiences in Asia and Latin America have proven that virtually any village community, entrepreneur, small enterprise, public institution or member of the public (via a rural cybercafe) can immediately get connected, no matter where they are, or how far they are from fixed infrastructure. New and creative enterprises can make rural areas more profitable, affordable and sustainable and served in a way to meet national development objectives. However, this requires creativity and innovation in terms of universal access as well as enabling public policies.

Regulations have to keep up with these developments. As outlined below, national policies vary considerably and the majority of regulations are less enabling to the expansion of innovative services. Governments should create conducive environments that promote access to wireless technologies for development focusing on managing spectrum and power emissions, fostering the implementation of standards for communications protocols and supporting research and development in new communication technologies.

Currently there are few if any regional policies on satellite and little regulatory harmony on wireless in SADC, apart from the SADC frequency band plan. Although a few countries, such as Mozambique, and Botswana have liberalized their satellite markets, even in these cases, there is often either a restriction on the number of operators or on international traffic, or there are burdensome licensing fees on the equipment. Recent

---

[1] Best, Michael. The Wireless Revolution and Universal Access, in ITU (2003), Trends in Telecommunications Reform

analysis also shows that, there is limited experience in the area of wireless regulation [2]particularly the Industrial, Scientific and Medical (ISM) bands.

Rationalizing licensing fees is another key issue in the region. High satellite equipment licence fees may have made sense when equipment cost upwards of $20,000, and bandwidth cost thousands of dollars per month, being mainly used for multinationals and large corporate branch offices. Given the potential for ubiquitous deployment of low-cost satellite services to small businesses, appropriate licensing strategies are needed across the region, if the potential of the technology is to be quickly realized. To achieve this, many of the restrictions on private use of wireless technologies and international VSAT will need to be reviewed as per these guidelines and national telecommunication regulators will need to adopt common licensing frameworks for satellite and terrestrial services based on worldwide experiences.

Moreover, the process for obtaining licences both in terrestrial and satellite service provision has been cumbersome. To eliminate time-consuming bottlenecks in the submission of multiple licence applications, and to ensure that economies of scale across the region are achieved, regulators can make use of the Internet to collaborate in the creation of a regional One-Stop-Shop (OSS) for licence applications and information dissemination. By building on existing experience in common licence arrangements in Europe and the Americas, and by adopting the new standards in web-based software, it is now possible for each country to have an online licence request system, managed by its own national regulator, while information dissemination and licence applications can be consolidated at sub-regional and continent-wide levels. For example, all relevant regulators could receive a copy of a satellite service provider’s licence application.

There is no one particular wireless technology that can solve all Internet development problems in the region. The future will see a mix of various technologies and the market should be permitted to determine, over time, which ones best suit particular applications. Therefore, it is important to maintain general regulatory policy principles that would facilitate the expansion of wireless services in the SADC region. These guidelines aim to propose general policy recommendation to facilitate the diffusion of satellite technologies in the region.

III. Scope of Wireless Services and their Regulation

Providing access to communications, particularly to the Internet, requires two complementary network infrastructure components: a backhaul connection to bring an Internet connection to the town or region, and a distribution mechanism to make the backhaul connection available to individual locations. Satellite technology is the prime mechanism for getting backhaul Internet connectivity to many African countries; although fiber optics is becoming increasingly available. DSL is becoming available in some urban areas, but, for the majority of rural areas, satellite and terrestrial wireless broadband links are often the only choice for distribution of access to homes.

[2] Maria Isabel A. S. Neto, 2004, Wireless Networks for the Developing World: The Regulation and Use of Licence-Exempt Radio Bands in Africa, An MSc. Thesis, Massachusetts Institute of Technology, http://itc.mit.edu/itel/students/papers/neto_thesis.pdf

There are a large number of satellite and terrestrial wireless implementations and the technology is evolving by the day. Article 1 of the ITU Radio Regulations lists the different service categories, which comprise the Radiocommunication services. The ITU definition of a radio communication service is listed as "*a service involving the transmission, emission and/or reception of radio waves for specific telecommunication purposes".* A total of forty radio services are defined, ranging from *fixed service* as listed in Article 1.20 up to Article 1.60 defining *special services.* Article 1 essentially subdivides the radiocommunication services along terrestrial and satellite boundaries, and it is this boundary distinction that is further elaborated in this section.

Not all forty individual services listed in Article 1 are discussed in these guidelines, although emphasis is placed on those services, which do have widespread, and a ubiquitous-like worldwide/regional deployment. The better-known services, which include fixed services, fixed satellite services, mobile services and mobile satellite services are discussed in this document.

Since the Member states within the SADC are physically located within ITU Region 1, it follows that spectrum allocation for the radiocommunications services are aligned to the ITU Radio Allocations as published for Region 1. Furthermore, since Europe falls within Region 1, the common allocations adopted by SADC exploit the European position to gain the benefits associated with having common allocations – these include economies of scale on equipment costing, equipment availability and maintaining a technology edge, to mention but a few.

The following section provides an overview of satellite and wireless technologies and services and related regulatory issues.

1. Fixed Services

The definition of a fixed service is that of a radiocommunication service between specific fixed points in the form of directed radio beams. Fixed services can be further categorized as being point-to-point or multipoint services, which includes Fixed Wireless Access, point-to-multipoint and multipoint-to-multipoint (also known as a meshed network).

a. Point-to-point

Point-to-point (PTP) links are generally referred to as fixed links and are used in numerous applications including backhauling cellular network elements such as base stations within the cellular telecommunications network or into the PSTN (Public Switch Telecommunication Network), providing communications for utilities such as electricity distributors, building trunking routes which act as diversity routing to fibre for disaster relief in the event of flooding, and many more.

PTP links vary in bandwidth capacity and frequency band of operation. The Medium

Frequency[3] and High Frequency[4] bands are generally limited to international and intercontinental links for voice and very low speed data (few hundred bits per second). The VHF[5] band is traditionally not used for PTP links.

In the lower end of the UHF[6] band, typically just above 1 GHz, low and medium capacity links are deployed which range from fractional E1 to multiple E1 capacities. Although some older analogue systems still exist in the radio network, digital systems dominate in the high capacity, higher frequency bands. Medium and high capacity links are widely deployed in both the access and transport layer of the network.

At mid UHF frequencies of 2 GHz right up to the high end of the UHF range at 3 GHz multiple E1 (e.g. 16E1 or E3) used in PDH systems are predominately used, STM-1 to STM-16 in SDH systems, Fast Ethernet/Gigabit Ethernet FE/GE, ATM over SDH (AoSDH) or Ethernet over SDH (EoSDH) are more commonplace in the SHF[7] and EHF[8] frequency range.

Although digital modulations dominate and prevail in most telecommunication systems of today, analogue systems are still prevalent for narrowband, low frequency applications. Low capacity PTP links are usually deployed in the access layer of the network, particularly in rural areas, where lower subscriber density is commonplace. Although there is a tendency in the developed countries to move fixed links to frequency bands above 3 GHz, Africa has unique requirements in terms of few people scattered over very large areas, making the need for low capacity PTP links below 1 GHz essential.

Fixed service PTP wireless links will become an important transport media in the architecture of 3G UMTS mobile networks. PDH capacities apply for rural areas to backhaul 3G base stations. Higher capacity PTP STM-1-4 can be used to connect smaller base stations to larger base stations acting as traffic concentrations points – these larger base stations then deploy ATM switches which transport the concentrated traffic in more dense population areas via STM-4-16 back to the base station controller known as a Radio Node Controller (RNC)[9]. Since new wireless standards are packet based, user data is not always constant- the "bursty" nature of packet data results in E1 or T1 backhaul circuits from base stations that are only moderately utilized, resulting in inefficient bandwidth usage. Since Time Division Duplex-based (TDM) backhaul circuits currently used in 2G/2.5G network lack "optimized" multiplexing capabilities inherent in data networks, a

---

1 Medium Frequency , referring to the frequency range 300 kHz to 3000 kHz

4 High Frequency , referring to the frequency range 3 MHz to 30 MHz

5 Very High Frequency, referring to the frequency range 30 MHz to 300 MHz

6 Ultra High Frequency, referring to the frequency range 300 MHz to 3000 MHz

7 Super High Frequency, referring to the frequency range 3 GHz to 30 GHz

8 Extremely High Frequency, referring to the frequency range 30 GHz to 300 GHz

9 CEPT ECC Report 19, "*Guidance material for assessing the spectrum requirements of the fixed service to provide infrastructure to support the UMTS/IMT-2000 networks*"

better solution is to use ATM or IP for backhaul. This enables the network operator to over-subscribe as these interfaces can efficiently handle the bursts of data traffic. In short, 3G networks will require ATM and IP based backhaul of base stations, compared to TDM based circuits such as E1/E3 currently used on 2G networks.

In the Internet era, the backbone networks will increasingly migrate towards IP from existing legacy systems such as PDH/SDH, ATM, Frame Relay, etc. The new network architecture is based on TCP/IP and Ethernet. Newer wireless IP radio systems take advantage of the IP infrastructure, typically consisting of IP switches and routers, and are designed to fit the IP traffic resulting in maximum usage of spectrum resources and acceptable Quality of Service (QoS) performance. Wireless IP radio allows IP transmission over an RF air interface for Internet access.

PTP links are mostly bi-directional and are able to offer full-duplex communications although unidirectional, simplex links are also possible as found in video links. Point-to-point links make use of all available access schemes, which share the RF resource in time, frequency or code division method amongst users – these are respectively TDMA, FDMA and CDMA (which includes Direct Sequence CDMA and Frequency Hopping CDMA). Another category of multiple access for packet networks are the “Aloha” like protocols. A Media Access Control (MAC) layer arbitrates contention of the RF resource to prevent users from transmitting packet data simultaneously. For terrestrial wireless media, Collision Sense Multiple Access with Collision Avoidance (CSMA-CA) applies as opposed to Collision Sense Multiple Access with Collision Detection (CSMA-CD) for wired networks.

In full duplex PTP links, Frequency Division Duplexing (FDD) is the most popular duplexing method used to compose the transmit and receive links. FDD requires a pair of frequencies and allows the transmitter and receiver to transmit simultaneously. Time Division Duplexing (TDD) is also available for PTP although less frequently used than FDD. TDD is used in half duplex mode, requiring only a single frequency to transmit and receive – the receiver has to wait for the transmitted payload from the transmitter before it is able to deliver its own payload.

b. Point-to-multipoint

Point-to-multipoint (PTMP) systems are able to allow multiple customers (multipoints) to have service via a central distribution base station (point) over a wide area, thus the network is able to handle a number of simultaneous PTP links, hence the term point-to-multipoint.

Just as PTP systems employ different technological characteristics to realize a designed deployment, so too are PTMP systems: PTMP systems differ in capacities and frequency band choice to achieve varying distance coverage, access methods, system architecture (PTMP and MP-MP), duplex arrangements (FDD or TDD) and asymmetric up/down-stream traffic flow as encountered for IP based access. Most of the open standards, such as those published by ETSI and IEEE categorise the PTMP services according to frequency band range. Regulators need to decide how the different standards can be adopted within their respective countries, spectrum allocations, equipment type approval certification standards, type of licensing e.g. nomadic, mobile or limited mobility or national/localized licence and traffic type allowed e.g. voice, voice and data or data only.

PTMP services will also be applied to 3G, UMTS/IMT-2000 network architecture, for use as a transport media:- specifically PTMP is more frequency efficient than PTP in urban denser population areas where PTMP is used to collect from multiple 3G base stations for collection and transport at higher concentration base stations. Regulators will have to consider the possibility of opening up new frequency bands not currently used, so that operators can apply for the relevant frequency spectrum licences to enable the use of the relevant technology to assist in building the infrastructure for 3G networks.

c. Fixed Wireless Access (FWA)

The evolution of FWA has meant that the latest available systems that offer tens of megabits of EDT, are better classified as Broadband FWA or BFWA. These systems are able to offer differentiated services that enable carriers to target a mix of residential, SOHO and SME markets. BFWA has the ability to offer a variety of bandwidth demands and differentiate between the qualities of service needed for different applications. Thus applications such as voice, DSL connections that compete bandwidth-wise with wired ADSL offerings, multiple E1 delivery, real-time video streaming, etc are readily available on these technologies.

Various reports are available which consider the issues of improving co-existence of PTMP systems in various bands and for different duplexing methods used (FDD and/or TDD).[10] [11] [12]

To allow for different FWA deployments by different operators to co-exist without suffering from degradation caused by interference, guidelines are available, which will assist regulators and operators to best proceed in licensing spectrum to each operator. Licences to operators should be awarded to allow for block allocation(s) depending on duplexing method allowed, or can be geographically awarded to allow for regional deployment.

d. Multipoint-to-Multipoint

As PTMP systems have evolved, newer versions of PTMP system specifications have incorporated what is known as multipoint-to-multipoint (MP-MP) for optional implementation. A MP-MP network is also known as a meshed network and differ significantly from PTMP networks – in a MP-MP network, all the terminals are similar and equal in position and transmissions may take place between any two stations. The

---

10 CEPT ECC Report 32, "Mechanisms to improve co-existence of multipoint (MP) systems", Oct 2003

11 CEPT ECC Report 33, "The analysis of the co-existence of FWA cells in the 3.4-3.8 GHz band", May 2003

12 CEPT ECC Report 99, " The analysis of the co-existence of two FWA cells in the 24.5-26.5 GHz and 27.5-29.5 GHz bands

only exception is the terminal, which forms the access point to the backbone network (mesh injection point), which could in some implementations control the scheduling of data transmissions within the network.

All meshed network variants consist of a cluster of stations, each of which can have a radio connection to one or more other stations. The stations are referred to as nodes, and may act as repeaters with local access for packet data. Most of these stations can be located at the customer premises. Traffic routing is via one or more nodes (typically not more than 3) to a node, which is associated to the core network access point. At the initial phase a mesh network may need a number of seed nodes to generate a certain level of coverage. Every node within the network increases coverage for potential new subscribers and existing terminals can be more often re-routed in this "adhoc" established network thereby better optimizing the network. If the loading on the network increases, especially on hops near the access point, loading relieving can be accomplished by adding an additional node with a new backhaul link to turn it into a new core network access point. This action will divide the mesh network into two mesh clusters with more capacity available near the access point, which possibly can result in shortening the individual hops lengths.

Within PTMP specifications the MP-MP option is generally defined as optional for implementation. The antenna options for a meshed network are 1) Omni-directional or sectored antennas which allow for simple and economical network evolution without the need for re-directing antennas when a new node is added. Besides omni and sectored antennas, there is the possibility to use groups of directional antennas to better control interferences and also to increase system gain and 2) directional mesh networks antennas, which display moderate directivity similar to stations used in PTMP networks. Since these directional antennas need re-pointing as the network grows, it is not practical to do this manually, so a remotely controlled mechanism is required. The three options to achieve remote controlling could be a) by remotely switching between a series of fixed antennas, b) by electro-mechanical steering of directional antennas c) by electronically steered arrays.

Regulators will eventually have to focus on how the spectrum management of these MP-MP "ad hoc" networks is regulated and managed, especially for a national "Register of Assignments" (ROA). Power limits and interference criteria will also have to be considered and some limits implemented. Technical specifications of equipment complying with harmonized standards for MP-MP must be considered.

2. **Mobile services**

Article 1 of the ITU Radio Regulations defines a mobile service as "*a radiocommunication service between mobile and land stations, or between mobile stations"*.

Broadly speaking mobile communications are between mobile subscribers and a fixed network or communications between mobile subscribers themselves. Mobile communications offer many services and can be sub-divided into the following categories[13]:

- Land Mobile – communications between fixed base station and a moving mobile station. An example is cellular mobile communications and Wireless Local Area Networks (WLAN)+ or Radio Local Area Networks (RLANs). Other examples of land mobile services include Public Access Mobile Radio (PAMR) and Private Mobile Radio (PMR)
- Maritime mobile – communications for Safety of Life at Sea (SOLAS)/Global Maritime Distress and Safety System (GMDSS), general communications between land and vessels at sea and vessel to vessel communications
- Aeronautical mobile – communications between land and aircraft, and between two aircrafts

a. Mobile cellular

Since mobile communications as outlined in point 1 above has experienced the highest growth in recent years and had a significant impact on telecommunications services, focus is placed on this category of mobile communications.

2G and 2.5G mobile cellular services are provided on GSM and CDMA[14] networks in SADC countries, and in one case 3G mobile is already being deployed (Angola, CDMA2000 1X). In South Africa the Mobile Cellular Operators (MCO's) has begun trials with UMTS WCDMA and EDGE systems. In most cases, operators have mobile cellular licences that allow national roaming, while regional roaming licences, which confines mobility to a certain area, are also possible.

2G mobile services are narrowband services, which are typically regarded as providing voice and basic data services such as SMS. 2.5G mobile services tend to provide greater functionality and higher data rates. 2.5G technologies use the same spectrum as 2G networks but are still limited by data throughput for real time services such as video calls or downloading full Internet graphics. 3G mobile services provide for wideband communications capable of conveying multimedia, video and other bandwidth thirsty applications. The bandwidth capability of 3G mobile allows for full broadband services such as full colour screens, video conferencing and Internet access. 3G networks do not solely originate or terminate on a traditional switched circuit, but includes content sourced from the Internet and other packet-based networks.

An important aspect for Regulators to manage is that of the migration path to be followed towards a Third Generation mobile network. The ITU has defined five technologies for 3G mobile services:

- IMT-DS , which is a CDMA Direct Spread (DS) , W-CDMA , FDD technology
- IMT-MC, which is a CDMA Multi-Carrier (MC), CDMA2000, FDD technology

[13] Australian Radiocommunications Inquiry Report No.22, 1 July 2002, Chapter 2

[14] www.cdg.org lists Angola, Mauritius, DRC and Zambia as having 2G CDMA IS-95A/B services. Angola also has a 3G CDMA2000 1x service.

- IMT-TC, which is a TDMA/CDMA, Time Code (TD), TD-SCDMA, TDD technology
- IMT-SC, which is a Single Carrier (SC), UWC-136, FDD technology
- IMT-FT, which is a TDMA/FDMA Frequency Time (FT), TDD technology

Since as stated the largest 2G and 2.5 G deployments worldwide and also in SADC states are based on GSM and CDMAone (IS-95a,b) standards, the eventual migration on a 3G level will respectively be IMT-DS and IMT-MC. GSM evolves to UMTS via EDGE and High Speed Circuit Switched Data (HSCSD), while CDMAone evolves to High Speed Downlink Packet Access (HSDPA) via CDMA20001x /CDMA2000 1x EV-DO or CDMA2000 1xEV-DV. Clearly some harmonization of technology choice can be beneficial to the economic development of the SADC region, although prescribing any specific choice is not mandatory and should be left up to Telco Operators. Regulators still have to foresee the possibility of one or more of the IMT-2000 technologies having to co-exist, probably in block allocated spectrum, with co-existence sharing mechanisms for interference avoidance.

From a Regulator point of view the following are important to ensure fair competition in mobile services:

i. Spectrum access in the frequency bands: Duplex Method is also to be determined i.e. TDD or FDD for each operator. The internationally allocated IMT-2000 core bands for terrestrial and satellite operation must be cleared of older 2 GHz PTP or other systems. Furthermore, the expansion bands for IMT-2000 such as the 2500 – 2700 MHz band should be considered for 3G services if not used nationally by SADC member states. This band has already been allocated by Europe as an expansion band for the high growth of 3G mobile services foreseen in the future – see ECC Decision(02)06[15] and further elaboration on sharing studies of the band with adjacent band services as reported on in ECC Report 45 [16]. The require The requirement for these additional frequency bands will vary from country to country and should taken local requirements into consideration.

ii. 3G licence type offered to operators (IMT-2000 technology type, mobile, limited mobility, national, regionally bounded).

b. WLAN and RLAN in the 2.4 GHz and 5 GHz bands

Wireless Local Area Networks (WLANs) were originally employed to allow network elements to roam in manufacturing and warehouse facilities, providing a cost savings alternative or complement to wired networks. WLANs are isolated networks, usually centred on a base station or access point, which creates "last mile" connectivity. The service area of the access point (AP) is known as a "hotspot". Within this "hotspot" users

---

15 CEPT ECC Decision ECC/DEC/(02) 06, 15 November 2003, "Designation of frequency band 2500-2690 MHz for UMTS/IMT-2000"

16 CEPT ECC Report 45, Granada February 2004, "Sharing and adjacent band compatibility between UMTS/IMT-2000 in the band 2500-2690 MHz and other services"

are allowed access by the access point to the connected network and access to the Internet.

The Institute of Electrical and Electronic Engineers (IEEE) 802 LAN/MAN Standards Committee produces the series standards referred to as 802.x, which encompasses LANs, WANs and PANs. The committee is currently divided into Working Groups (WGs) numbered 802.1 through to 802.21[17]. 802.11 WG creates standards that apply to both wired and wireless LANs. The original 802.11 standard for WLAN technologies was published in 1999 and provides for data rates up to 2 Mbps at 2.4 GHz, using either Frequency hopping Spread Spectrum (FHSS) or Direct Sequence Spread Spectrum (DSSS). Since then many task groups have been formed to create supplements and enhancements to the original standard. At present there are task groups "a" through "k", which are working on various methods to standardize improvements to the 802.11 standard. WLANs are widely deployed within Industrial, Scientific and Medical (ISM) bands of 2400 – 2500 MHz (2.4 GHz) and 5725 – 5875 MHz (5.8 GHz). In the 5 GHz band (5150 – 5350 MHz and 5470 – 5725 MHz) licenced/unlicenced blocks have also been allocated by the ITU at WRC-03.

The 802.11b Task Group (TG) created a supplement to the original 802.11 standard, called it 802.11b, which has now become the industry standard. 802.11b is capable of nominal data rates of 1-2 Mbps using DSSS and 5.5 and 11 Mbps in a modified mode called Complementary Coded Keying (CCK). Another supplement to the 802.11b standard is the 802.11g release, which offers higher data rates up to 54 Mbps using Orthogonal Frequency Division Multiplexing (OFDM), while remaining backwards compatible to 802.11b. The 802.11b/g standards occupy 83.5 MHz between 2400 MHz and 2483.5 MHz and provide 13 channels at 5 MHz intervals. An access point and its associated devices occupy a single radio channel using approximately 25 MHz of the 83.5 MHz. Therefore, at any single location, no more than three APs (3 x 25 MHz) can operate without interfering with each other. The 802.11b/g standards allow nearby access points to use channels whose centre frequencies are separated by less than 25 MHz such that their channel usage partially overlaps. For Europe (and therefore Africa), 13 centre frequencies are defined while the United States uses 11 centre frequencies. In 802.11b/g nomenclature, channels with full separation in frequency are referred to as *non-overlapping* channels, meaning that channels 1, 6 and 11 can be used in one area without interference degradation.

The 802.11a supplement to 802.11 was published in 1999, and allows for OFDM to provide data rates up to 54 Mbps in the 5 GHz band (5150 – 5350 MHz and 5470 – 5725 MHz) and the 5.8 GHz ISM band. In contrast, the 802.11a standard accommodates up to 19 non-overlapping channels in the 455 MHz in the 5 GHz band. There is no need and no provision in the 802.11a standard for *overlapping* channels. This band is therefore less susceptible to interference or degradation due to other WLANs operating in its vicinity. It is also worth noting that ETSI also has a standard similar to 802.11a known as HiperLan.

European regulators set aside 455 MHz of spectrum for HiperLan use in the 5 GHz band and protected other services of the 5 GHz band by specifying power limits and

[17] IEEE 802 LAN/MAN/PAN Standards Committee , http://grouper.ieee.org/groups/802/index.html

indoor/outdoor designations that vary in the sub-bands. WRC-03 concluded on RLAN parameters in the 5 GHz band (see ITU Resolution 229 (WRC-03)).

c. Other Wireless Technologies

From Internet Access Point of View, there are also other wireless technologies such as Bluetooth, wireless local loop, LMDS and MMDS and emerging mesh networks and WiMAX that aim to extend traditional 802.11x networks.

i. Bluetooth

Bluetooth is an IEEE 802.15.1 standard for the transmission of data at a rate of about 1.5 Mbps between portable devices in a secure and reliable manner. It uses unlicenced spectrum at 2.4 GHz over ranges of 0-10 meters. Bluetooth replaces short wire connections (of a few meters) with wireless connections; its short range and very low power means that it cannot be a last mile broadband communications Service. It is generally driven by mobile phone manufacturers who want lower-powered implementations of greater flexibility and simplicity and with a definite need to ensure the privacy of all those who use it. Bluetooth has limited regulatory implications since it specifies wireless personal access network limited to 10m.

ii. WiMax

The 802.16x IEEE standards define wireless networking protocols geared toward metropolitan area networks with a range of about 50 km. The standards are in varying stages of development; 802.16a was ratified in January 2003 and holds a lot of promise for rural and developing world scenarios with non-line-of-sight connectivity. 802.16 starts from the premise of delivering broadband data to fixed points. For example, it generally assumes a reasonable wide channel allocation. To this it is adding mobility capabilities via 802.16e, which will allow it to support at least a nomadic model; that is, one where an end station doesn't move much while operating but may move around between sessions.

Except for Bluetooth and WLAN/RLAN the rest of wireless services utilize bands that require licensing and coordination. However, ISM does not mean regulation is not necessary. Entry of a number of commercial providers in delivery of services using the ISM band means that restriction on power and range are necessary to contain interference and improve quality of services. Table 1 shows frequency bands of the most popular terrestrial wireless networks.

From regulators point of view, wireless technologies present the following regulatory challenges:

- importation
- sales and installation
- fees
- power limits
- effective frequency band usage

Table 1 Frequency bands for the most popular territorial wireless networks

Technology	Frequency range	Status
WiFi/WLAN	2.4 –2.4835 GHz 5.725-5.875 GHz	ISM Band
Bluetooth	2.4 – 2.4835 GHz	ISM Band
3G Core Bands	1900-1920 MHz (TDD) 1920-1980 MHz (FDD) 2010-2025 MHz (TDD) 2110-2170 MHz (FDD)	Licenced
3G (additional bands)	2520-2670 MHz 1710-1785 MHz 1805-1880 MHz	Licenced
WiMax	10-66 GHz (e.g. 2.6 GHz, 3.5 GHz and 5.8 GHz	Licenced
LMDS MMDS	27.5–28.35 GHz 29.10–29.25 GHz 2500 MHz-2700 MHz	Licenced Licenced Licenced

- Import or production of radio and telecommunications terminal equipment for resale requires registration of suppliers and regulations on sales restrictions – whether the technologies be sold with any restrictions or none at all
- Regulations and decisions should also be made on licensing fees of various wireless technologies.
- Regulators should legislate the amount of Effective Isotropic Radiated Power (EIRP) the equipments, either 2.4 GHz WLAN or 5 GHz RLAN is permitted. Implementations of power levels for WLAN in 2.4 GHz could be defined as those published for European Union member states in the ETSI standard EN 300 328 V1.4.1. For the 5 GHz RLAN band EN 301 893 has been harmonized in Europe, so the published limits could be adopted within SADC member states. (These ETSI standards are available at: http://www.etsi.org/services_products/freestandard/home.htm)

- The amount of spectrum in the 5 GHz band to be nationally allocated for RLAN indoor (unlicenced) and outdoor (licenced) services, needs to be determined. In Europe for example 200 MHz of spectrum has been allocated from 5150 – 5350 MHz for indoor use, and a further 255 MHz for indoor/outdoor use between 5470 – 5725 MHz. A very recently published ECC Decision concerning some of the 5 GHz RLAN issues was published – relevance of this Decision to SADC member states should be investigated.[18] Of the decisions adopted in the document includes the use of Dynamic Frequency Selection (DFS) as well as Transmit Power Control (TPC) for indoor/outdoor use in the different 5 GHz bands. Regulators should implement the mandated power limits and conditions as published in ITU Resolution 229 (WRC-03).

- Regulations should also be clear on licence exempt bands and the free use of ISM bands for commercial purposes. The European Commission issued a recommendation to encourage member states to provide licence-exempt WLAN access to public electronic communications networks and services in the available 2.4-GHz and 5-GHz bands. This is not binding on member states, but it is consistent with the (binding) Authorization Directive, which requires all member states to allow licence-exempt access to the spectrum when the risk of harmful interference is negligible.

3. Satellite Services

Satellite services are used to provide basic telecommunication services, international links, broadcasting and lately Internet services. Satellite services are particularly effective over large distances and in remote or rural areas. Satellite services used for telecommunications can be sub-divided into Fixed Satellite Service (FSS) and Mobile Satellite Service (MSS). Two different types of satellites can also be used to provide the required satellite service, namely Geostationary Satellite Orbit (GSO) satellites and non-Geostationary Satellite Orbit (NGSO) satellites.

GSO satellites orbits around the earth at approximately 36000 km. Their orbital speed equals the rotational speed of the earth, and therefore for an observer on the earth, they appear to be stationary. They can be accessed by a fixed antenna (no tracking needed on small antennae) which tends to make them a more affordable solution. Their round trip delay (±250ms) cause no concern to broadcasting and little concern to internet services, but limits its use for voice or video conferencing.

NGSO satellites orbit the earth much lower than GSO satellites. They do not appear stationary for an observer on earth, and therefore need a tracking antenna to establish a communication link. The earth station antenna also needs a handover strategy to enable it to select a new satellite when the current tracked satellite move beyond the horizon. Since NGSO satellites are much closer to the earth, the round trip delay is much smaller than with GSO satellites. They are also capable of higher power delivery (due to their smaller footprint and shorter propagation path) which make small handheld receivers a possibility. Deployment of NGSO satellites, especially for internet and broadband type services, was not very successful due to many reasons but in particular due to economic viability.

Satellite services represent a viable option to providing telecommunications to areas

[18] CEPT ECC Decision ECC/DEC/(04)08, 09 July 2004 "Harmonized use of the 5 GHz frequency bands for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs)"

having limited infrastructure or areas having inaccessible terrain. Acting as a "repeater" in the sky, a satellite relays information from a central Earth Station or hub to a coverage area defined by the antenna directivity. Satellites can be used for either point-to-point or point-to-multipoint networks. In the point-to-multipoint network, various sub-network configurations can also be used like star, mesh or central hub configuration.

a. Fixed Satellite Service

A Fixed Satellite Service is defined in ITU Radio Regulations Article 1 as: "*A radiocommunications service between earth stations at given position, when one or more satellites are used; the given position may be a specified fixed point or any fixed point within specific areas; in some cases this service includes satellite-to-satellite links, which may be incorporated in the inter-satellite service; the fixed-satellite service may also include feeder links for other space radiocommunications services*".

Many of the FSS services available today are realized from GSO satellites. They operate mainly in the C band (4 GHz downlink / 6 GHz uplink) – and Ku-band (14 GHz uplink/11 GHz downlink), although Ka-band (30 GHz uplink / 20 GHz downlink) applications are currently also being deployed in the USA.

Connection to satellite services is increasingly being provided using Very Small Aperture Terminal (VSAT). The falling costs and increasing bandwidth is driving the demand for VSAT terminals for business, home users and institutions and lifting up the associate policy and regulatory issues could be required. Other driving factors include:

- The desire of governments to ensure that all their citizens are able to obtain equivalent ICT services regardless of their geographical location. This is also driven by a desire to stop the urbanisation process that is so destructive, especially in the developing world.
- The desire by large corporations for redundant and alternative networks, independent of terrestrial infrastructure.
- The need for connectivity that is always available, regardless of geographical and political constraints.
- The increasing need for high-speed services and multimedia connectivity direct to end-users.
- The needs for more connectivity

VSATs have also advantages that can be exploited for the provision of connectivity. They are easy to deploy and upgrade, provide reliable services and unrestricted ubiquitous coverage of large geographic areas. The incremental cost per unit is low and they allow a single platform for delivery of voice, video and data.

VSAT describes a small satellite terminal with antenna size between 1.2-4.5 meters that can be used for one-way and/or two-way interactive communications via satellite. One-way systems use powerful (large antennas with high power transmitters, 100's of Watts) at central hub stations, transmitting information to a large number of low sensitivity VSATs (small antennas with low sensitivity) receiving stations. TVRO (television receive only) or DTH (direct-to-home) systems fall into this category. Two-way systems using remote

VSATs are able to transmit and receive, but the transmit power at the remote terminals is limited to a few Watts. All VSAT systems used by corporate or any network for providing two-way services such as voice, data, fax, fall into this category.

The term "hub" is typically used to describe networks that require one of the earth stations in the network to manage and control the services provided. Users of star networks have two choices: They can design them with a new dedicated hub, or they can "lease" their services from an operator of a "shared hub". In a closed-user-group star network providing services to only that group, the hub could refer simply to the station that monitors and controls the services being provided. That same station would in most cases also be the central station in a star network. In a "shared" VSAT service, the term "hub" is used almost exclusively to describe the station that manages the services provided. A "controlling hub" is another way to describe the management hub.

The VSAT comprises of two modules - an outdoor unit and an indoor unit. The outdoor unit is generally ground or even wall mounted and the indoor unit, which is the size of a desktop computer, is normally located near existing computer equipment in your office. The outdoor unit consists of an Antenna and Radio Frequency Transceiver (RFT). Typical antenna size is between 1.2 m and 2.4 m in diameter, although smaller antennas are also in use. The indoor unit functions as a modem and also interfaces with the end user equipment like standalone PCs, LANs, telephones or a PABX.

During the past 20 years, satellite systems have continually evolved to provide more flexible and affordable services. Some of the recent developments have been in the area of improved bandwidth efficiency by combining satellite coding schemes and modulation systems with TCP/IP protocols, which have resulted in a new family of IP-based VSAT systems (IP-VSAT). These are generally based on hybrid network topologies and have been designed to deliver a variety of communications services on a single platform based on direct connectivity to LANs, with voice services delivered via VoIP. IP over Digital Video Broadcasting (DVB) has become the *de facto* standard for broadband communications via satellite, and such systems clearly demonstrate their greatest cost-effectiveness by matching the asymmetric nature of Internet traffic. Satellite services can provide 35-45 Mbps for backbone connections, with significantly greater data rates available for key business applications, e.g. videoconferencing. Multicasting speeds routinely reach 2-3 Mbps and delivery of Internet to consumers can be achieved at 400 Kbps or more.

Further, new standards are being introduced, such as DVB Return Channel via Satellite (DVB-RCS), which combines with TCP/IP to provide fully integrated high-speed services. In the mobile sector, the success of GSM showed that it is possible to create an open standard to which many suppliers could build equipment and thereby create higher economies of scale and cost reductions. The same dynamic has now begun with the development of the DVB-RCS standard, which was developed by the same organization that developed GSM: The European Telecommunications Standards Institute (ETSI). For the first time, inter-operability between VSAT equipment from numerous suppliers is possible, although manufacturers have only recently started to produce systems based on these standards.

A large range of services are available from VSAT networks: broadcast and distribution services for data, image, audio and video, collection and monitoring services for data, image and video, two-way interactive services for computer transactions, data base inquiry and voice communications. VSATs are becoming small, cheap, and easy to install and are used for all kinds of telecommunications applications such as: corporate networks (for example connecting fuel station pay systems), rural telecoms, distance learning, telemedicine, transportable and satellite news gathering uplinks.

Regulatory issues pertaining to VSAT involve:

- radio frequency management
- licensing
- equipment type approval
- setting licensing fees and
- provision of information

- VSAT terminals operate in three major bands namely: C-band (4-6 GHz), Ku-band (10-20 GHz) and Ka-band (20-30 GHz) that require different licensing approaches. Most VSAT and DBS television systems in operation today use portions of the Ku-band.
- Typically, any satellite system would comprise of four major entities, which may have to be authorized before a service can be delivered to an end user. The entities to be authorized for each of these parts include a) the Space Segment operator; b) the satellite network operator, who operates one or more Gateway Stations or Network Control Stations (HUBs) or other ground stations; c) the Satellite Service Provider; d) entities that are licenced to use individual VSAT equipment. These require different licensing regimes.
- Mutual recognition of type approval should be encouraged
- Information on licensing issues should be readily available and applications should be easy and transparent.

b. Mobile Satellite Service

ITU Radio Regulations Article 1 defines a mobile satellite radiocommunication service as being:

- "*Between mobile earth stations and one or more space stations, or between space stations used by this service or between mobile earth stations by means of one or more space stations*
- *This service may also include feeder links necessary for its operation."*

GSO satellites have been offering Mobile Satellite Service on a world-wide and regional basis for many years, predominately in the L-band (1.5/1.6 GHz). For example, Inmarsat uses GSO satellites to provide mobile satellite services. Companies such as Iridium, ICO and Globalstar, use NGSO satellites to provide mobile satellite services. The next generation of GSO and NGSO satellites will be able to offer IMT-2000 compatible personal voice and data communications. Services are also available from new mobile satellites systems operating in frequency bands below 1 GHz. These are commonly known as “Little LEO” systems, and offer global store-and-forward data communications of general low capacity for a number of applications.

Table 2. summarizes the most widely used wireless technologies used for broadband Internet Access.

Technology	**Description**	**Strength**	**Weaknesses**
VSAT	Small satellite terminal that can be used for one-way and/or two-way interactive communications via satellite	Can be installed virtually anywhere High bandwidth available	High costs Latency affects voice quality
Fixed Wireless Access	Use of wireless radio signals to provide voice or both voice and data services to fixed-point subscribers (primarily residential).	Infrastructure built and maintained by telcos normally for voice Ease of deployment Reasonable data rates Proven in rural settings	Costs do not scale well Limited bandwidth Technology is somewhat immature Proprietary systems Requires licences
Broadband FWA	Provides mixed TDM and IP type of services of multiple Mbps per subscriber. Includes what was previously referred to as MMDS and LMDS: MMDS generally refers to fixed microwave data distribution systems below about 10 GHz. LMDS generally refers to microwave data distribution systems operating above 10 GHz, generally in the range 24-32 GHz .	High data rates Future proof for IP Easily expandable	Limited to line of sight Potentially expensive in higher frequency bands Not good range at higher frequency band
WiFi	WiFi (802.11x) are a relatively mature set of IEEE standards for wireless networking of a local area network (LAN) in unlicenced bands.	Open standard Ideal for distribution within a small geographic area (like a village)	Limited range (200 meters) for standard hardware Interference problems in ISM bands

		Relatively low-cost No communications infrastructure required Mature technology	Crossing long distances requires special hardware at higher cost
WiMAX	WiMAX (802.16x) defines family of wireless networking standards for Metropolitan Area Networks (MAN)	Open standard High data rates (up to 70 Mbps) Covers distances up to 50 kilometers Due to adoption of OFDM can work NLOS Evolution to mobile environment	Not yet available Uses licenced and unlicenced band, no mobility
Bluetooth	Bluetooth is an advanced personal area network (PAN) protocol for the transmission of data at a rate of about 1.5 Mbps between portable devices in a secure and reliable manner.	Indoor or personal use Does not require licensing	Limited distance Lower data rate ISM interference
3G	Third generation mobile system as defined by ITU IMT-2000. Capable of voice and broadband data access. Consists of five family air interface standards including CDMA2000 and WCDMA (UMTS).	Mobile extension Good mobile data rates	Slow uptake Expensive infrastructure High frequency cost in Europe
Mesh Networks	Mesh networks are wireless networks composed of autonomous nodes that are able to self-organize. Each node is a wireless (often 802.11-based) radio unit that contains software that enables it to act as a mini-router. Requires initial "seed" nodes. By creating a multi-hop network that spans many	Extends the range of wireless technologies Lower Tx power results in lower interference problems Small scale-up increment	Except for WiFi, limited implementation in other technologies More suited to dense subscriber deployments

	nodes, a mesh network can effectively extend the range of a traditional 802.11 network.	Creates a more robust distribution network	

IV. Overview of International Satellite Policy and Regulations

There have been significant developments at international level to coordinate scarce resources such as radio frequency spectrum and orbital slots and to promote the removal of technical barriers to trade in goods and services. Regulation for access to and use of the scarce resource of radio frequency spectrum is not only an issue for ITU and national administrations, but is also covered in other international treaties such as the regulations of the IMO (International Maritime Organisation), ICAO (International Civil Aviation Organisation), WTO/GATS and TBT rules. Consequently, new conditions on non-discrimination, transparency, objectivity, proportionality and legitimate objectives have entered the world of wireless regulation, rule setting and application. This section provides an overview of major international players.

1. United Nations

The United Nations plays a key role in promoting the use of satellite and wireless technologies. The recent WSIS Plan of Action and Declaration of Principles[19] renewed the need for increasing access to ICTs in support of the Millennium Development Goals and called for facilitating growth of a global broadband satellite system capable of providing high speed Internet access on a global and non-discriminatory basis, in accordance with the provisions of Resolution 1721 (XVI)[20]. Resolution 1721 (XVI) and the International Telecommunication Union Resolution 64[21] mandate non-discriminatory access to modern telecommunications facilities and services. The UN considers that wireless technologies can facilitate the attainment of the Millennium Development Goals and other international developmental initiatives such as the Monterrey Consensus and Johannesburg Declaration on social development are among several to which all countries in the region aspire.

2. International Telecommunications Union

Wireless communications regulations, by their very nature, must recognise international co-ordination if they are to succeed. The International Telecommunication Union (ITU) is the primary organ that oversees orbital and spectrum resource allocation and co-

---

[19] WSIS Plan of Action and Declaration of Principles, http://www.itu.int/wsis/documents/doc_multi.asp?lang=en&id=1104%7C1106

[20] UN Resolution 1721 (XVI), http://www.oosa.unvienna.org/SpaceLaw/gares/html/gares_16_1721.html

[21] ITU Resolution 64, http://www.itu.int/publications/cchtm/dec_res_rec/res64.html

ordination. ITU Radio Regulations govern the use of spectrum on an international basis and enable nations to coordinate satellite networks in order to avoid harmful interference and to allow for maximum efficient utilization of the orbital resources. Exclusive or non-exclusive bands are allocated for FSS, BSS and MSS services and spectrum sub-segments are assigned to different operators through coordination. The ITU Radio Regulations presently serve as the optimum means for efficiently and fairly discharging such intersystem coordination activities.

Besides these, the ITU and SADC countries have endorsed other important declarations: These include:

- The Buenos Aires declaration that called for restructuring regulatory frameworks to create a stable and transparent environment for investment, ensure competition and universal service, promote innovation and new services and guarantee the right of users and investors.
- ITU Memorandum of Understanding on Global Mobile Personal Communications by Satellite (GMPCS-MoU) that guides global roaming of GMPCS terminals.
- The Valetta Plan of Action that emphasized the need for bridging the access gap in developing countries.
- The World Radiocommunication Conference held in June 2003 adopted, amongst others new allocations for the mobile services in the 5 to 6 GHz range, to be used for Wireless Access Systems including RLAN.

3. World Trade Organization

The World Trade Organization (WTO) is dedicated to lowering or removing trade barriers in order to provide open and competitive markets. The General Agreement on Tariffs and Trade (GATT) forms the basis of the WTO process. Key WTO issues include non-discriminatory market access, open borders for competitive access, "Open Skies" policies, transparency in telecommunications regulation, and licensing. WTO Members are subject to the General Agreement on Trade in Service (GATS) requirements and pro-competitive regulatory principles. In effect, the WTO Reference Paper on Pro-Competitive Regulatory Principles obligates governments to adopt measures that prevent anti-competitive conduct, ensure fair, non-discriminatory and cost-oriented interconnection, and administer universal service obligations in a competitively neutral manner.

Despite broad support from governments in Africa, only seven countries have so far made commitments in the WTO Agreement on Basic Telecommunications services and bound to these principles. However it is prudent for SADC countries to align themselves with several international proclamations such as the afore mentioned WSIS Declaration, the WTO Regulatory Reference Paper and the GATS and other instruments to ensure infrastructure development and innovation for digital inclusion.

IV. Trends in Wireless Technologies Regulations

1. Asia and the Pacific

Asia and the Pacific have strong regional/sub-regional players, such as Asia Satellite, APT Satellite, and Shin Satellite that facilitate the regulatory harmonization in the region. Several countries in the region - Australia, China, India, Indonesia, Japan, Philippines, the Republic of Korea and Russia have their own domestic satellites, and some of them are making the transition to the regional/sub-regional domains. Forums like ASIAN and APEC are used for harmonization of regulation in wireless services.

2. Europe

Europe is the most advanced region when it comes to wireless/satellite regulations. The regulations pertinent to wireless technologies in Europe are carried out through collaboration between the European Union and the European Conference of Postal and Telecommunications Administration (CEPT). The European Union legislations operates within the framework of the Treaty of Rome[22] and the measures may be binding on Member States. The measures, which are drafted by the European Commission in consultation with Member States and come into force once endorsed by the European Parliament and the Council of Ministers, are all in furtherance of single market aims.

CEPT is the key and well developed institution that promotes wireless and satellite technology regulations across Europe. It was established in 1959 by 19 countries and expanded to 26 during its first ten years. Original members were the incumbent monopoly postal and telecommunications administrations. CEPT Administrations co-operate, in close consultation with their industries. CEPT produces regulatory frameworks that are conducive to the promotion of the European communication industries while giving a fair deal to consumers.

The binding nature of European Community Regulations and Directives makes the drafting of such measures a relatively slow and painstaking business. In contrast, the Decisions and Recommendations of the CEPT can be developed more quickly and implemented. A series of recommendations, guidelines and frameworks have emerged since the 1980s to promote competitive frameworks, interconnection, inter-operability, and trans-border facilitation of the use of satellite and wireless equipment and services in Europe. Among the key initiatives were:

1. setting up of an OSS procedure for satellite licences and authorisations
2. setting up a due diligence process whereby Administrations could evaluate the progress of companies which had notified to the ITU orbital slots and frequencies for satellites for the provision of SPCS services
3. regional spectrum planning for the forty-four European and neighbouring countries
4. coordination of European preparation and input for World Radiocommunications Conferences through its Preparatory Group.
5. Mutual acceptance of type approval and self declaration of conformity.

---

[22] The Treaty of Rome, europa.eu.int/abc/obj/treaties/en/entoc05.htm

3. North America, Latin America and the Caribbean

The United States co-ordinates the use of radio services with neighbouring countries Canada and Mexico. The United States adopted a pair of orders that open the US basic telecom and satellite markets to foreign competition. These include liberalization of FCC rules concerning the process for non-U.S satellites to provide service in the U.S. and for U.S. earth stations to access such satellites. In addition, the FCC adopted rules permitting service providers to utilize INTELSAT capacity directly, rather than the previous requirement that all such service in the U.S. be accessed through Comsat, the U.S. signatory to INTELSAT.

Regulations pertaining to broadband wireless in North America aim to encourage the highest and best use of spectrum domestically and internationally in order to support the rapid deployment of innovative and efficient communications technologies and services. More specifically, the goals are to:

- advance spectrum reform by developing and implementing market-oriented allocation and assignment reform policies;
- protect against harmful interference and enforce public safety-related rules.
- conduct effective and timely licensing activities that encourage efficient use of the spectrum;
- provide adequate spectrum and improve interoperability for better public safety and commercial purposes;
- serve as a dependable information source for Congress and the American people on the complex issues inherent in using the finite spectrum resource.

The Inter-American Telecommunications Commission (CITEL) coordinates issue relevant to wireless technologies and encourages the development of adequate, flexible regulatory systems that permit the rapid access and use of innovative technologies. Granting licences for satellite networks has been an item of key importance for regulators in Latin America recently. The Third Summit of the Americas held in Quebec, Canada in April 2001 requested that Ministries or departments responsible for telecommunications and appropriate regulatory bodies to cooperate, within CITEL, in order to clarify and simplify rules governing the provision of satellite services in the countries.

Consequently, CITEL's Permanent Consultative Committee on Radiocommunications including the Broadcasting and Working Group on Satellite Systems developed a website with information on regulation and policies regarding VSAT terminals. Based on information, common areas and differences were identified on the requirements in the existing regulations of various CITEL member Administrations.

It was observed that countries were at varying levels of development of such regulations for granting satellite network licences in member countries. It was also found that regulators in the region share certain fundamental objectives and principles like simplification of procedures, harmonization of policies and ensuring health and safety and reducing interference. As a result CITEL began to discuss the concept of OSS (One-Stop-Shop), an initiative that has already been implemented in Europe by the CEPT. It has established an electronic forum to take the concept of harmonization of wireless regulations further.

5. Africa

In Africa, there is no systematic coordination in the area of wireless technologies in general and satellite in particular. Until recently, the PTOs have been the main users of wireless technologies. The World Bank/AVU report's findings are corroborated by satellite regulatory surveys conducted recently by the International Telecommunication Union (ITU)[23] and the GVF, both of which found that policies for low-cost "consumer grade" satellite services for Internet access remain unclear in many nations. Government policies are in many cases not keeping up with technological developments, and some countries are still protecting their monopoly national telecom operators at the expense of affordable and universally accessible services.

Even in countries where private satellite services are allowed, the licence fees are often excessive for consumer and enterprise-grade VSAT terminals, particularly when compared to the rates customers in developed countries pay for the same services. In particular, lofty licence fees are a major obstacle to Internet development in Africa, where up to 35% of expenditures consist of one-time and recurring VSAT licensing charges. Licensing fees in Africa range between $5,000 and $10,000 per year per terminal on average for a 128-Kbps link[24]. Although there is significant progress in reducing both licensing and monthly fees (e.g. Mozambique), the high potential for mass deployment of terminal equipment costing $1,000 and Internet bandwidth at $200/month or less will only be realized if licence fees are substantially reduced.

In countries that have adopted a more liberalised regulatory framework, private VSAT networks are allowed to function under the authority of the incumbent operators, while the latter still retain a formal monopoly. The bilateral arrangement may require a "landing right fee" or tariff to be paid to the incumbent operator, even if the incumbent does not participate in the service chain. Other restrictions include denial of voice transmission, limitation of voice to domestic use or forcing operators to route their private network transmission through the national hub of the incumbent operator, regardless of the financial or the technical disadvantages. A commercial / legal presence is often required as a precondition for licence issuance. This has been an obstacle to the effective roll-out of VSAT services in some countries. More often rules are often not transparent, are inaccessible to the general public, and are often difficult to interpret.

Similarly, a recent study by Neto shows diversity and heterogeneity in the regulation of the ISM bands across Africa. "Not only do licensing requirements and specific conditions change widely from country to country, but so do power, range and services restrictions, as well as certification requirements. In addition, regulation is still not in place in some countries, and is changing in others. Enforcement is low, adding to overall uncertainty. However, the use of wireless technologies is increasing." Neto found that about 37% of

---

23 ITU Question 17-1: Satellite regulation in developing countries.

24 International Development Research Centre and CATIA, Policy Reform and Regulatory Issues in Bridging the Digital Divide through Satellite Technologies, Report by the Global VSAT Forum, September 2004

African countries are using wireless technologies for providing backhaul network connectivity in rural areas[25].

Meanwhile, significant private sector experience and interest has been gained in the integration, installation, and provision of satellite-based services over recent years. Among the African companies that are currently providing services are Afsat, Alldean Communications, CommCarrier and Satcom Networks Africa, based in East Africa; DCC, Direct On PC, GlobalNet, GS Telecom, Internet Gabon, and MindSprout based in West and Central Africa; Alkan and Spacecom based in North Africa; Accelon, Q-Kon, Sentech and Transtel based in South Africa; Pronet in Zambia; Telecom Plus, based in the Democratic Republic of Congo; and a host of others. Many of these companies, as well as numerous carriers, operators, manufacturers and value-added resellers provide services in Africa and with headquarters in other regions, have been operational for years and have accumulated substantial experience in rolling out services in Africa, policy and regulatory environments permitting.

There is also increasing support for policy harmonization within the framework of NEPAD and regional economic communities. The Catalysing Access to ICT in Africa project aims to promote policy reform and creating one-stop-shop (OSS) for information on - and licensing of – wireless services in southern, eastern and western Africa. The development of these guidelines was supported by the CATIA program.

V. Wireless Regulation in SADC Region

The IDRC/GVF survey shows that there is diversity in wireless regulation in SADC region although harmonization in frequency management has been achieved through the SADC Band Plan that specifies a cohesive frequency allocation in the 20 MHz to 100 GHz range. Botswana, Malawi, Mauritius, Mozambique, Tanzania and Zambia have relatively advanced policies with regard to satellite services. There is also variation between Angola, DRC, Lesotho, Namibia, Seychelles, South Africa, Swaziland and Zimbabwe that have more restrictions on satellite services. For example Zimbabwe puts on a hefty licensing fee for operators that bypass the incumbent's network.

Mauritius has the most advanced regulation where it has adopted technology and content neutral regime. The terminal equipment market in Malawi is fully liberalised and ISPs are allowed to use VSATs to obtain international bandwidth independently of the incumbent and to use wireless data links to service customers. Multi-branch companies such as Lever Brothers, Shoprite, and Oilcom have also begun to use VSAT to service their internal data communications needs, including online connections directly to South Africa. In Malawi, a VSAT licence costs US$5,000/site initially and $2,500 per year subsequently. About 20 licences have been issued. Zambia and Tanzania have categories of services where different fee structures apply for satellite service providers. These categories include:

---

[25] Maria Isabel A. S. Neto, 2004, Wireless Networks for the Developing World:
The Regulation and Use of Licence-Exempt Radio Bands in Africa, An MSc. Thesis, Massachusetts Institute of Technology

- Public data communication operators;
- Private data communication operators; and
- Internet service providers.

There is full competition in each of these categories. The barriers to entry are primarily financial (namely, start-up capital and licence fees). The licence fees for the categories relevant to VSAT and the existing number of operators are shown in the table below:

Table 1: Tanzania Key Licence Fees[26]

Type of Licence	Number of Operators	Application Fee (US$)	Initial Licence Fee	Annual Fee (Royalty)
Public data communication service	10	$1,000	$100,000	3% of annual gross turnover or $30,000 whichever is higher
Private data communication service	6	$500	$5,000	$500
Internet Protocol Service (Commercial)	23	$75	$1,000	$5,000
VSAT Terminal		$0	$1000	

In South Africa Telkom SA (through PSTS licence) and Sentech (through Multimedia Service licence) are currently the only providers allowed to provide VSAT services. An international telecommunication service licence and multimedia service licence can only be issued upon an invitation from the Minister. Further, agreements need to be made with licenced operators to obtain VSAT network facilities and services. Two other private network operators serving Closed User Groups are active in the South African market, the power utility company Eskom and the railway company Transtel who will shortly be jointly issued with the Second Network Operators (SNO) licence and are expected to leverage these resources to compete with Telkom SA in 2005.

With regard to2.4 and 5.8 GHz ISM band, the survey by Neto mentioned above shows that this licence exempt band is barred in Zimbabwe for commercial purposes. A licence is required to operate telecommunication services in the ISM band in Angola, Botswana, DRC, Malawi, Mauritius, Mozambique, Seychelles, South Africa and Zambia. In Namibia and South Africa the bands are unlicenced, but ‘any use beyond the boundaries of one’s property is illegal.’ In Mozambique the use of the 2.4 GHz band is not allowed for commercial purposes while in Botswana, despite the fact that licence attribution is said to be automatic, some minimum conditions apply: in order to receive a licence ISP operators are required to be a registered company in Botswana and also have to prove their financial sustainability by providing their business plan.

[26] International Development Research Centre and CATIA, Policy Reform and Regulatory Issues in Bridging the Digital Divide through Satellite Technologies, Report by the Global VSAT Forum, September 2004

PART II

Policy and Regulatory Issues

VI. Objectives of Guidelines

The Objective of these guidelines is to propose a policy and regulatory regime that would enable SADC countries to extract the maximum economic and social benefits from the use of wireless technologies. The guidelines aim to promote regional cooperation and harmonization of policies in the area of wireless technologies when appropriate. They provide a clear step-by-step guide to promote the diffusion of wireless technologies. The major goals are facilitating removal of structural barriers for widespread use of wireless technologies for social and economic development particularly in reducing poverty and achieving the UN Millennium Development Goals. Other goals are:

- Attracting investment
- Building a regional infrastructure
- Improving connectivity to enhance education, innovation, science and technology
- Creating jobs, and
- Building the Internet user base.

The guidelines propose a policy framework for harmonizing wireless regulations in the region. The guidelines also make recommendations for the review of policies spanning issues such as the authorization of the use of the radio spectrum, registrations, licensing and other measures that would encourage innovation, investment and use of these technologies. Based on examinations of key regulatory and licensing trends worldwide, the guidelines aim to:

- Propose policy framework for the removal of structural barriers for the diffusion of wireless communications technologies and services. The issues discussed cover protection of public safety, managing spectrum, licensing, transparency and enforcement;

- Institute procedures for a regional policy harmonization including general authorization or blanket exemption and mutual acceptance of test results and type approvals for radio equipment in conformity with national type approval regulations and international standards;

- Outline strategies to simplify and streamline licensing procedures through the creation of a one-stop-shops (OSS) that organize information on regulation and licensing requirements;

- Initiate the steps towards a streamlined Common Application Form (CAF);

- Provide an overall blue print to facilitate administrations' efforts to develop and enforce policies and regulations in wireless systems and services.

VII. Wireless Regulations, Policies and Principles

As highlighted in international policy declarations such as United Nations Resolution 1721 (XVI), ITU Resolution 64 and the World Trade Organization's General Agreement on Trade in Services (GATS) in its Fourth Protocol on Basic Telecommunications Services, the major goals of wireless regulation are the reduction of barriers that inhibit innovations and the use while at the same time preserving public health, safety and national interest.

Stronger socio-economic development cannot be realized without enhanced public services – including health through telemedicine, education through distance learning and universal access to rural communications – as well as stimulating private-sector activity by attracting foreign investment, creating jobs, encouraging exports, and much more.[27] Experiences of regional harmonization efforts of organizations such as the Inter-American Telecommunications Commission (CITEL) in the Americas, the Asia Pacific Telecommunications (APT) and Asia Pacific Economic Co-operation group (APEC) in Asia, the Conference Europeene Posts et Telecommunications (CEPT) and the European Union (EU) suggest that transparency, content and technology neutrality, protection of public safety and competitions should remain the core principles of wireless regulations.

1. Transparency

Transparency is an important aspect of telecommunication service regulation as it improves accountability and private sector confidence for investment. The lack of transparency in some countries constitutes a significant barrier to entry by new competitors, particularly since many service providers are forced to abandon plans to provide services in these countries rather than shoulder the significant expense of ascertaining the regulatory requirements.

Administrations should undertake public consultations in preparing regulations and will need to take on the task of publishing their laws and regulations on wireless licensing and permits regularly. Making this information readily available to the public is an important step in advancing the transparency of a country's policies. Administrations should use their websites to post their regulatory framework, upcoming regulations, the list of licenced providers, technical standards and even to facilitate on-line filing of radio spectrum, satellite and/or earth station authorizations applications. The advantages of making data readily accessible on the Internet is immense; posting of regulatory requirements is inexpensive, reduces the burden on administrations (by reducing the need to respond to numerous individual inquiries), enables the industry to provide services effectively and this serves as an effective platform from which to promote regulatory harmonization.

2. Competitive Access

Licensing requirements and their associated costs vary worldwide, but a significant trend has emerged toward adopting more streamlined, publicly accessible licensing arrangements for satellite and other wireless network operators and service providers. This trend reflects the fact that licensing of wireless services should be used solely for protecting public safety and managing spectrum resources in order to prevent harmful interference. The use of licensing conditions and requirements to serve collateral purposes unnecessarily increases barriers to entry by potential competitors in the market.

---

[27] GVF, Policy Satellite Policy Guidelines, www.itu.int/wsis/docs/pcip/misc/gvf.pdf

Restrictive licensing rules could discriminate against providers by denying them a competitive advantage through the use of onerous licensing conditions. Several types of licensing requirements have been employed effectively by administrations in various regions of the world. These licensing rules tend to focus either on the space segment of a satellite network, or on the terrestrial earth station portion of satellite networks. In both situations, care must be taken in order to ensure that licensing requirements do not become barriers to free trade, innovation and access to the people, but instead are used sparingly in order to accomplish legitimate regulatory requirements. Legislation should not restrict competition and innovation unless it can be demonstrated that the benefits of the restriction, to the community as a whole, outweigh the costs, and that the objectives of the legislation can only be achieved by restricting competition.

3. Service Neutrality

Wireless networks can be effectively used to provide all forms of telecommunications services. As a result, administrations that regulate "content" often apply those regulations to satellite operators. For example, some countries still maintain limits on the number of carriers that are permitted to provide international voice traffic while others restrict the provision of private line resale services, call-back services, or international carriage of Voice over Internet Protocol (VoIP). Administrations should encourage service neutral regulation as far as possible.

4. Technology Neutrality

Modern telecommunication services are being provided to consumers using a number of different technologies, such as fixed line telephony, satellite and terrestrial wireless networks. In order to facilitate fair competition between these technologies, regulators must strive, to the extent possible, to make their regulations, licensing requirements and regulatory fees technically neutral. For example, an authorized Internet service provider (ISP) would ideally be able to select either a terrestrial (wireless or fixed line) or satellite system architecture to build its network, based solely on the relative costs and benefits of each available technology.

There is no one particular wireless technology that can solve all development problems in the region. The future will see a mix of various technologies and the market should be permitted to determine, over time, which ones best suit particular applications. Administrations are encouraged to maintain general technology-neutral regulatory policy principles that would facilitate the expansion of wireless services in the SADC region.

5. Protecting Public Safety

Regulation and licensing of wireless services is required to protect public safety, which includes public and private networks, natural persons, environment and other spectrum users. Regulatory conditions that can be used to protect public safety include restrictions on physical accessibility of transmission equipment (*i.e.*, use of fencing, secure areas and warning signage), restrictions on the design and configuration of transmission parameters in order to ensure that transmissions do not exceed appropriate levels and restrictions on the proper installation and use of transmission equipment (*i.e.*, requiring adequate training for equipment installers and operators).

VIII. Landing Rights Issues

1. Need for "Open Skies" Policy

A number of administrations require service providers to use only locally-owned satellite capacity when providing wireless services. The model was important in monopoly situation and when satellite operators such as Intelsat, Eutelsat and Inmarsat were inter-governmental organizations and owned by the PTTs. Consequently, in the beginning space segment could only be bought via the incumbent PTT or telco. Given the increasing demand for Internet, data, voice, video and other essential services and increasing need for competition, it is recommended that administrations adopt policies that permit open and direct access to all wireless resources assuming that they have been properly coordinated at international levels through the ITU.

The "footprint" of a satellite – the region of the Earth served by a satellite - does not match national borders, making it necessary to regulate this matter through international agreements such as those developed by the ITU. While the policies being implemented today are not completely open, they all involve permitting increased access to orbital resources, regardless of the satellite operators' country of origin. "Open Skies" policies require satellite operators to compete for customers interested in obtaining C-band, Ku-band and Ka-band satellite bandwidth. It has been proven that this competition can result in more options for local customers with a significant boost in quality and lower prices. This approach is referred to as "Open Skies" and is being adopted by most administrations in every major region of the world.

The ITU Radio Regulations have international treaty status and include the international table of radio frequency allocations. These ITU Regulations form the global framework for regional and national frequency spectrum planning. As a result, regulation of satellite and other radiocommunication services is appropriate to the extent that it is necessary to manage scarce spectrum resources locally. This is true in cases where satellite services share a co-primary allocation with other radiocommunication services in the same frequency bands.

In some frequency bands, however, satellite services do not share the same spectrum with other radiocommunication services. In such cases, the restrictions may be limited as these are coordinated through the ITU. As much as regulations are required to facilitate competition through such international coordination or " open skies", it is also important to pay attention to the issues of national sovereignty, regional harmonization and to ensure mutual socio-economic benefits.

2. Commercial Presence

A commercial presence is often required by administrations as a precondition for licence issuance for all wireless services. Although protection of indigenous companies is important, polices that require local presence could stifle competition and innovation.

IX. Spectrum Management Issues

1. Introduction

The radio frequency is the band of frequencies in the electromagnetic spectrum [from 9KHz to 275 GHz] used by all wireless communications systems for broadcasting, mobile radio, microwave, satellite, cellular, public safety services and certain domestic electronic devices. The radio frequency spectrum is vital for national security, public safety, research and personal usage. This natural renewable and finite resource is shared with the world. Renewable because the same part of the spectrum can be used again and finite because the spectrum is similar to a highway in that only a certain amount of traffic can be carried depending on the road and weather conditions and the type of traffic on the road.

The radio frequency spectrum is a natural resource of significant economic, social and cultural importance. Managing this electromagnetic “highway” along with the telecommunications infrastructure is the responsibility of each country’s regulator. The regulator’s broad mission in managing the spectrum and telecommunications infrastructure is to facilitate the development and use of world-class telecommunications infrastructure, technologies and services for the express purpose of enhancing the country’s competitiveness, economic growth and quality of life. To achieve this, the regulator elaborates a regulatory and policy framework to ensure the continued evolution of the telecommunications and spectrum infrastructure and, oversees a program to manage and maintain the radio frequency spectrum and telecommunications infrastructure.

The usage of the radio frequency spectrum is subject to multiple changing conditions such as the development of new technologies, current manufacturing standards, and importation and sales of spectrum-using equipment. In addition, the technical and operational characteristics of spectrum-using systems are becoming increasingly complex and diverse, pointing to the need for more flexible policies, regulations, standards and enforcement mechanisms.

The radio frequency spectrum allocation table is an integral part of spectrum management for every regulator. A radio frequency spectrum allocation plan must factor in technical issues, such as electromagnetic compatibility and interference criteria, as well as policy objectives, which include ensuring that spectrum is efficiently and fairly allocated and, compliant with national legislation and international standards. National spectrum allocation should also conform to the SADC regional band plan.

In order to manage the use of the radio frequency spectrum it is vital for administrations to develop a database where all the frequency assignment criteria, parameters and licensing information are stored. An added benefit will be if this database is linked to a spectrum management tool to perform technical and administrative spectrum management functions such as frequency coordination, issuing of licences, printing invoices, etc.

2. Spectrum Management Objectives

There are two broad types of efficiency, which regulators have to take into account when considering spectrum management namely.

- Technical efficiency
- Economic efficiency

i. Technical Efficiency

Technical efficiency refers principally to the requirement that different users and different uses of radio frequencies should not interfere with each other. It also refers to the need to tackle a host of related problems, such as the use of faulty or non-standard equipment, the unauthorised or illegal use of frequencies, spill over signals from neighbouring administrations, the use of inappropriate levels of power, finding the optimum location for antennae, and so on, all of which can effect the attenuation, successful transmission and reception of signals, the problems of cross-talk and the general problem of radio frequency interference. The technical efficiency should also include environmental issues including collocation and spectrum utilization efficiency – the extent to which a given frequency is utilized in space and time.

These problems are what economists call 'negative externalities' which means that the use of one radio channel can have an adverse impact on those that are external to it. Achieving technical efficiency is really the work of the engineers inside the regulatory body. National regulations are issued by the regulator and are the vehicle to ensure harmonisation between the various radio systems and operations without harmful interference. Regulations on spectrum use and technical standards usually compliment the national table of frequency allocations.

One of the main concerns for CRASA is the management of the effect of spill-over signals from neighbouring countries (across-border frequency coordination). Harmonisation of radio frequency spectrum use does facilitate across-border frequency coordination and has the added benefit of allowing regional roaming of certain customer devices (e.g. GSM). Harmonization is also critical from economic stand point to build an economy of scale and promote regional cooperation and integration.

ii Economic Efficiency

The second type of efficiency is economic efficiency. This is a much wider regulatory issue because it involves a judgment regarding the allocation of relatively scarce spectrum among alternative uses to provide different, in some cases competing, types of services.
Some of the methods the regulators can use to allocate spectrum include:

- On a first-come-first-served basis
- Using purely administrative criteria or beauty contest
- Using some form of spectrum pricing so that the market will influence the choice.

Markets will change over time, and so will the prices consumers are willing to pay for different categories of services delivered by radio, and therefore so will the value a service provider places upon the spectrum they use. If the economic value of spectrum is to be included in the allocation decision, then it follows that there should also be some mechanism to allow spectrum to be assigned as market valuations change over time. This will normally involve migration strategies which can be very time consuming and financially expensive. Great caution should be taken by regulators when considering or planning spectrum reassignment considering the tremendous financial impact it could have on operators and the economy in general.

The economic efficiency issue is therefore very important, but once a certain spectrum allocation has been decided the technical efficiency issues determine whether the services on offer guarantee the quality of service the public demands. The 'public interest' is not just a matter of consumer interest; it also reaches out to foreign investors who will be attracted by a well managed allocation and operation of spectrum. Although changes to the national table of frequency allocations are necessary in order to introduce new services and technologies, stability in national frequency allocations are crucial to ensure the required investment in national networks and the sustainability of services delivered to customers.

It should be noted that public and private service requirements are two distinct areas. The spectrum required for government and public services, for example the emergency services, national defence, public service, broadcasting, and so forth, has traditionally been determined by administrative means, which raises some problems. It is necessary to reserve spectrum for these services because a market mechanism would almost certainly result in the relevant spectrum being used for other, more commercial purposes. On the other hand, political and security concerns may well result in an over-allocation of spectrum to these services, and the use of the spectrum by public service operators may become very wasteful if there is no mechanism to enforce the most efficient use of frequencies. A regulator may choose to allocate some of the public spectrum to an operator at a discounted cost, with licence obligations attached (such as cheap or free services for use by emergency/defence personnel).

Spectrum allocated to private services, and frequencies assigned to private service providers, may confer either property rights or rights of usage, which can raise difficult questions of whether spectrum should be tradable, of the dangers of monopoly, and what, if any, regulations or obligations should be imposed upon the assignment of frequencies. A further question concerns the re-assignment of frequencies that may become necessary, and whether the holders of the frequencies are under an obligation to return them before the expiry of their licences. In the absence of strict regulations governing the use and non-use of frequencies, private operators may be tempted to 'bank' licences, being motivated by the prospect of a future sale, or simply by the desire to keep the frequency out of the hands of a competitor.

For all these reasons the allocation of spectrum and the assignment of frequencies needs close co-ordination between the technical, engineering side of the regulator's office to monitor the efficient use of spectrum, and the economic, policy side to monitor the market and possible abuses of market power and to ensure that assignment of frequencies are done in accordance with national legislation pertaining to the issuing of service licences.

3. ITU and WRC Influence

When a government signs the Instruments of the ITU it actually agrees to only a limited commitment. It agrees to abide by the Radio Regulations (RR) of the ITU which have been agreed by successive WARCs and WRCs, and which require Member States to abide by spectrum allocations that do not cause interference with the radio stations of other Member States.

Member States will draw up their own national frequency tables, which follow closely WRC's tables, but they have flexibility to vary spectrum allocations according to local circumstances. For example, WRC allocates spectrum in frequency bands that in many cases can be shared between many different services and local allocations may therefore vary considerably in that only one or two of such allocations are used in any particular country. Although Africa is in the same (ITU) region as Europe, it does not necessarily need an allocation for radar systems to monitor glacier movements. On the other hand, if there is an international satellite system used, for example for space science purposes, countries have an obligations to ensure that harmful interference is not caused to these systems due to assignments to other national systems.

National frequency tables will also identify future allocations planned to meet forecast demand, and this process often involves the re-allocation of spectrum among existing users to free up certain bandwidths.

WRC divides the world into three regions, and Africa is, together with Europe, part of Region 1. Because the world is divided into separate jurisdictions and regions, the issue of technical standards and standardisation of spectrum allocations are crucially important. If the world acted as a single marketplace, it is conceivable that the economic pricing of spectrum would allow large companies with a global interest to buy spectrum internationally and harmonise its use, so that, for example, everywhere in the world you could use the same wavelengths for broadcasting or for cellular telephony, and that consumers could use the same television set or cell phone wherever they roamed in the world. This is not how the world is organised so governments and regulators have to decide how far they will go in harmonising their allocation of spectrum with other jurisdictions and in adopting the same standards for equipment, as well as how far they will go in opening their markets to foreign service providers and equipment manufacturers. In the past many economies in all regions chose to pursue their own spectrum allocations and standards, sometimes just because the demand was immediate and urgent, sometimes as part of a national industrial policy and strategy. On both the trade front, for example the WTO, and on the industrial standards front, for example the ITU and even commercial pressures, the tendency is strongly towards global harmonisation. The SADC Band Plan is therefore critical for coordination of wireless service provision at regional levels.

The "Master" table of frequency allocations on which most countries base their own TFA is the ITU Table of Frequency Allocation, as contained in Article 5 of the ITU Radio Regulations. All the Member States of the ITU have a vote on the decisions taken when this band plan is revised. This mechanism allow each country's own interest to be protected by allowing them to exclude themselves from any new allocation which will conflict with the current spectrum usage (future plans) in their own country. Unfortunately the process of revising the ITU Radio Regulations (which the band plan is only a small part thereof) is a very complex and time-consuming exercise. For this reason it is common practice for all the spectrum users/operators and the regulator of a country to combine forces and attend the WRC as a single delegation, overlooked by the country's administrator. Many countries even went one step further and formed alliances with neighbouring countries before the WRC, to get a common stand on the issues to be discussed at the WRC, giving them in effect a stronger vote. Further regional co-operation within SADC in preparing for WRC is therefore essential. It is crucial for the TRASA Members to coordinate their position for WRC preparations. At national levels, it is improtant to improve the capacities of spectrum management departments. At a regional level, it is critical to reachout to various regional organizations and coordinate with regulators from west, east, north and central Africa.

Although the spectrum management issues discussed in this document are only the tip of the iceberg and highlights only two of the most obvious areas where interaction between neighbouring countries is needed, many more examples exists, i.e.:

- Where one country may lack the experience or equipment to perform complex radio frequency interference measurements (which form part of the spectrum manager's daily work function), the expertise of a neighbouring country may be consulted with, rather than an international company not understanding local conditions and politics.
- For network expansions/new technology rollouts international suppliers may sometimes be lured into "dumping" legacy equipment on a developing country. If the national regulator has close ties with the neighbouring regulators and local operators, it will better understand market trends and future technologies, enabling it to make more advised decisions applicable to its geographic area and clientele.

4. Frequency Assignment Versus "Licence Exempt"

Users of the radio frequency spectrum are assigned certain frequencies according to the national table of frequency allocations. Assignments could be made for either individual systems (e.g. a point-to-point link) or a block allocation (e.g. GSM allocation in the 900 MHz band). Block allocations are essential to operators where national networks are planned using FWA or cellular type systems are used (e.g. DECT and GSM). Block allocations should also be considered where operators require speedy delivery of services in the access network and where the individual licensing of systems will introduce unnecessary delays in the provision of services. With block allocations it is essential that the regulator ensure effective use of the radio frequency spectrum.

Authorisation is made either through a licence to use a portion of the radio frequency spectrum or falls into a category of equipment classified as “licence exempt”. Radio devices are generally declared as “licence exempt” where the risk of radio interference to other users is very low (e.g. cordless telephones, remote controlled toys, wireless LAN, Bluetooth devices, etc.). These “licence exempt” operations are usually associated with technical (e.g. maximum allowable transmitted power) and/or operational use restrictions (e.g. indoor/outdoor use).

Because of the nature of unlicenced devices it is generally not practical or possible for a regulator to investigate complaints of interference to these devices and they are therefore generally used on a non-interference and non-protection basis. Type approval is generally required to ensure that these devices are manufactured according the adopted technical standards.

5. Across-border Frequency Co-ordination

Regulators are involved with frequency co-ordinations between equipment within the same service on a daily basis. This is more commonly known as frequency assignments. Normally a database is used to assess all the frequencies already used within a specified area within the new proposed deployment, and then a free frequency is assigned to the new service. The specified area, as mentioned above, differs in size as a function of the frequency used, terrain, radio equipment characteristics (i.e. antenna gain and transmit power) and propagation model.

Since the harmful interference one radio device can cause to another radio device do not adhere to political boundaries, the co-ordination area may sometimes include neighbouring countries. Regulators of one country then need to co-ordinate this new frequency assignment with its neighbouring countries. This may vary between:

- a normal procedure between two countries having harmonised band plans (thus coordinating more or less equivalent equipment types with each other),
- to the complex scenario of two different allocations (thus two different types of applications) competing for the same spectrum close to the border of the involved countries.

i. Harmonized frequency band plans

When two neighbouring countries have more or less harmonized band plans (not only the same frequency allocation table, but also similar channel arrangements and best practice recommendations (i.e. ITU-R Recommendations), the equipment they use in a specific frequency band may well be similar to those used by its neighbour. This will invoke a rather easy exercise of involving the neighbouring country in a normal frequency coordination process.

ii. Different services

Whenever the tables of frequency allocations for two neighbouring countries are not aligned, whether it is totally different services assigned to the frequency (e.g. mobile versus fixed), or just different band plans used for the same service, a more complex exercise needs to be followed. Once again the ITU-R Recommendations can be turned to for assistance.

iii. Procedures for across border frequency co-ordination

Various recommendations have been written on the co-ordination of different services, as well as guidelines on the calculation of the co-ordination area to be used (Appendix 7 of ITU Radio Regulations). Neighbouring countries can also beforehand negotiate a more accurate co-ordination area to be used for each service they wish to protect, to both ensure adequate protection as well as reducing the number of unnecessary co-ordinations.

X. Licensing

1. Purpose of Licensing

The purpose of licensing is to grant permission to operators/users to use frequencies under certain conditions. Among these conditions are standard of service, efficient use of the spectrum, avoidance of interference and avoidance of overloading when the same channel is assigned to more than one user, etc. Licensing involves dialogue between the Administration and the end user of the radio frequency spectrum.

The introduction of new and advanced technologies coupled with liberalisation/competition has created new requirements for entering and operating in the information and communication market. Addressing these needs, the adoption of a harmonized licensing process in wireless technologies and its implementation by TRASA members, constitutes the best way to increase access and facilitate innovation.

The specific objectives of licensing are to:

- **Determine how to facilitate access the satellite and terrestrial wireless market** - A potential new entrant must know to whom to address his application to, from where to obtain necessary information or, if applicable how to participate in public consultation
- **Define conditions of operation, rights and obligation of licencees -** To stimulate investment in the satellite and terrestrial wireless market, all the stakeholders must be provided with enough information about their rights and obligations so that they might make informed investment decisions. Certainty is a key factor for ensuring the development of investment initiatives.
- **Contribute to the creation of a level playing field and promote competition -t**o provide mechanisms for managing the co-existence of many operators whether in complementary, supplementary or competing segments. By their nature, wireless services have to interact somewhere since they all converge to the end users, even if they are produced by different networks/operators.
- **Set out conditions for consumer protection** - Clear provisions defining the relationships between consumers and licencees with regard to pricing, billing practices, consumer complaint procedures, reciprocal responsibilities, dispute

resolution, limitations of liability for service, and mandatory services to consumers have to be part of the licence conditions.

- **Create a transparent and predictable regulatory regime and safeguard industry development in the region-** When the rights and obligations are clearly defined and balanced, the wireless operators gain confidence in the industry and the market. They are encouraged to plan long-range activities and/or conduct research to develop new branches of wireless operations, in the interest of the market and consumers.
- **Manage scarce resources: -** The licensing process allows regulators to allocate fairly, efficiently and in the public interest, scarce resources such as radio spectrum, blocks of numbers and rights of way. In instances where allocated scarce resources are not utilised, under-utilised or misused, the licence conditions allow regulators to reclaim the resources concerned.
- **Promote universal access/service -**Define targets and obligations to be attained by all licencees, in order to achieve universal access/service objectives.

Licensing should cover:

i. technical aspects (e.g. quality of service, sharing/collocation of facilities, interconnection, type approvals, spectrum management, etc)
ii. commercial aspects (e.g. competition, pricing, Universal access/service obligations, etc)
iii. administrative aspects (e.g. licensing conditions and procedures, coordination, etc)

2. Methods of Granting Licence

Depending on the type of services to be licenced, administrations may use different approaches to grant a licence. The most commonly used method is the “first come, first served” process that enables an applicant to be granted a licence so long as frequencies are available and that the licensing requirements of administrations are satisfied. Licence applications are handled independently by the administrations in the order they are received and considered according to relevant national procedures. When spectrum shortage is anticipated or when specific government goals are being pursued to e.g. foster competition in particular business areas, the “first come, first served” approach may not be appropriate to ensure an efficient and optimal use of spectrum or to promote competition. In such cases, administrations may revert to selection procedures such as auctions or beauty contests or a combination of both.

Bidders are allowed to participate in an auction if they fulfil certain pre-selection criteria. These may range from for example having sufficient financial resources to being capable of meeting specific obligations should the licence be awarded. Further to a pre-selection phase, auctions may consist of one or several phases, with e.g. multi-round sequential auction or simultaneous auction. Beauty contests on the other hand are based on the evaluation of applications against a number of requirements such as financial resources, technical capabilities, business plan, geographical coverage and roll-out targets. As in the case of auctions, the selection process may consist of two phases, a pre-selection phase and a selection phase. In the latter, applications are compared by and licences are granted to the candidates that best fulfil certain requirements (e.g. roll-out and coverage).

When granting licences, administrations are required to ensure that regardless of the method chosen, the process happens in an objective, transparent, non-discriminatory and proportionate manner.

In order to assist in the harmonization process, it would help if the same format for licence application forms were used throughout CRASA members. Therefore, in an effort to standardize the format of the application forms used by the various TRASA Administrations, a generic application form can be drawn up based on the inclusion of common components. Administrations may add to this generic structure to meet specific national requirements and, by following this common sectioned format, their application forms should be more users friendly. (Annex 1 shows the generic application form).

3. Types of Licences

There are basically three types of licences that are considered suitable for the CRASA region at this stage of development of satellite and wireless based services:

a) Class licence or General Authorisation/Registration
b) Individual licence – operators licencing
c) Blanket licence

However, it is accepted that other forms of licences and methods of applying are used by some administrations.

i. Class Licence or General Authorisations/Registration

In the case of class licence, the applicant can apply for a licence with a simple registration procedure. The conditions for registration should be established in advance so that any entity complying with the defined conditions should be entitled to provide services without any further decision or licensing action by the relevant administration. This method is useful in segments which are fully liberalised and where there are clear objectives that can be achieved by establishing general broad conditions, for example for services under such a licence may include data communication services, customer premises equipment, satellite terminals, services for closed user groups and value-added services.

ii. Individual Licence

In the case of individual licence, the applicant must make a formal application to the regulatory authority that considers the application and issues the relevant licence with corresponding rights and obligations of the licencee, if the terms and conditions of such a licence are met. The administration may invite applications for individual licences in a given sub-sector of the satellite and wireless market. This approach is applicable in segments where the regulator finds it advisable to introduce competition gradually, for example in fixed backbone networks.

iii. Blanket Licence

In the case of blanket licence, Administrations makes explicit decisions or general authorizations where licence applications are no longer required prior to providing service or running a network. Administrations might require a notification, including basic information on the operator, the network location, the type of service provided, etc. However, the service can be offered under general authorization and cannot be put on hold awaiting a reply or consent of the Administration.

General authorization could for example be used for some satellite licensing because it recognizes fully the international nature of satellite services, whereby there is no need to have a service provider located in each country. It overcomes, therefore, the difficulty of obtaining blanket licences in countries where a small number of terminals belong to several service providers, or where foreign ownership restrictions require the establishment of a national presence. It is recommended that CRASA Administrations consider class licensing and general authorization for satellite terminals including to facilitate the diffusion of Internet access. However, the adoption of class licence is the discretion of individual administration.

4. Licence Applications Procedures

There are differences in complexity of the requirements for different services. Application information should be easily available preferably by way of application forms or online application forms.

Applications must include the following minimum information:

a) Name and address of applicant
b) Name, telephone and fax number of contact person representing the applicant
c) Legal status of the applicant/company
d) Details of ownership of the applicant/company
e) Licence class requested/type of licence required
f) Details of the planned category of telecommunications service
g) Details of the geographic location of the fixed terminal or station, including an outline map
h) Details of the equipment or system technical specifications
i) Planned date of start up of the activity subject to licence
j) Proof that the applicant/company does not have a dominant position in the market.

The applicant for some wireless services should also follow coordination with neighbouring or affected administrations.

i. Licence Conditions

The conditions for licensing should be determined in such a way to be objectively justified, proportionate, non-discriminatory and transparent. The following are the most common conditions for licensing:

- Compliance with relevant essential requirements (legal basis of licensing system, industry standards and public interest);
- Provision of information reasonably required for the verification of compliance with applicable conditions and for statistical purposes;
- Compliance with requirements of interconnection of networks, interoperability of services or other ICT infrastructure access issues;
- Protection of consumers and subscribers;
- Ownership

The granting of a licence is subject to the applicant's fulfilment of certain conditions including specialized knowledge, efficiency, and reliability on the part of the applicant. The Regulatory Authority can request the applicant to provide any proof and supporting documents.

ii. Proof and Supporting Documents

The applicants are often required to produce the following:

a) Proof of specialized knowledge: -The applicant should detail the relevant knowledge; experience and skills of the persons intended to operate the requested system. The applicant can submit, inter alia, licences granted to the persons to set up, connect, modify and maintain terminal equipment as proof of specialized knowledge.

b) Proof of Efficiency: - Anyone who guarantees competency for setting up an operation necessary to exercise licence obligations in an optimal manner is deemed to possess the required efficiency.

c) Proof of Reliability: -The applicant should in particular state whether itself, one of its affiliate companies or a person appointed to manage its business has in the past five years been subject to:

- the withdrawal of a telecommunications licence;
- the imposition of conditions for non-fulfilment of obligations ensuing from a telecommunication licence or;
- legal proceedings for violation of telecommunications or data protection law, or whether;
- such legal proceedings are pending.

d) Outline map showing the geographic location of the area in which the activity subject to licence is to be performed (if not a transportable system).

e) Interference analysis report where relevant

The operator should also specify all the technical conditions. The technical conditions part of the licence defines the parameters within which the frequency-spectrum will be used. Typically, the conditions vary but the key details include:

- Purpose and coverage area.
- Stations location.

- Channel/frequency band of operation and bandwidth.
- Antenna configuration and height of antenna above ground level.
- Maximum power permitted.
- Emission code (based on ITU).

For some services additional details will be necessary and examples of these are:

- Selective signalling codes (CTCSS, DSC).
- Call sign or identification.
- Digitally coded squelch.
- Access arrangements to specific frequencies, and how authorized.
- Hours of operation.
- International requirements
- Connection to PSTN

5. Duration of the Licence

Duration of licence vary from country to country. In some countries licences are issued for limited periods, varying from 5 to 25 years. However, it is important to harmonize the duration of specific licences across the region such as multinational and regional licences. When determining the duration of a licence several factors have to be considered such as:

- Future changes in the use of radio spectrum.
- The period of time during which the spectrum is intended to be used.
- The technical development to be expected.
- The time required in order to achieve a reasonable financial return for the licencee.

The most common licence durations are as follows:

- Temporary licence (from 1 day to a few months) allows licencee to use frequency for short-term events, temporary work or trial purposes. In this case, especially for very short-term events, all the requirements of the hosting administration (e.g. frequency plan) may not have to be fulfilled. For short-term events, the fees should be adapted accordingly.
- One-year licence; this is the most common duration which in particular enables the administration to make sure that the relevant fees are paid. Generally these licence are renewed automatically on payment.
- A licence for a period longer than one year could be issued:
    - if no changes are expected in the next years, either from the view point of spectrum management or from the licencee side.
    - to allow licencees to have a return of investment, for example the case of auctions.
    - for major licence such as PSTS, mobile, trunking, etc.
- Permanent licences could also be issued but in this case, administrations must take measure to be able to take back the spectrum, e.g. in the case of re-farming purposes.

6. Principles Governing Licensing of Satellite Systems

The increasing popularity of satellite terminals like VSAT demands specific attention to licensing these terminals. Many countries require public network operators to hold licences of which quality assurance is one of the conditions. A few countries have adopted this rule also for private VSAT services. As the nature of private satellite services is being understood better, the requirement for individual terminal licence is declining. The most popular licences are Service Provider Licences, Value Added Service Licences and sometimes certain types of Class Licences.

Traditionally, most governments have required each VSAT or mobile terminal to be licenced individually or pass through a pre-defined gateway; this was in addition to requiring a network operator's licence. A new approach to regulating VSATs - "blanket licensing" has now began to be implemented in Europe. With this regulation, VSATs are configured based upon technical criteria - involving power level, frequency, etc. - that eliminate the risk of unreasonable interference. A single blanket licence can be issued covering a very large number of VSAT terminals.

This approach has worked well for the regulator, for the industry, and for end users, wherever it has been applied, including administrations in North and South America, Asia, Africa, and Europe. Indeed, 44 European nations have now adopted a set of policy principles that eliminates the need for individual licensing of receive-only and interactive VSAT terminals, as well as a wide range of mobile terminals. The policy principles were adopted through the regional Conference Europeene Posts et Telecommunications (CEPT) and, more recently, have begun to be *implemented* by individual national administrations. The CEPT Decisions "exempt" VSATs or mobile hand-helds from individual terminal licensing requirements, provided that they meet specific technical criteria – such as frequency use, maximum radio power, etc. - that assure adherence to recognized safety standards. Stations that meet these requirements can quickly and easily be put under a general "blanket" type of licence. In this case no or minimal administration is necessary and there is no need to require a licence prior to operating the terminal although notifications are required.

This assumes that international frequency co-ordination procedures, as well as the use of harmonized standards, eliminated the risk of harmful interference. A growing number of countries were able to exempt the circulation of terminals from individual licensing requirements. There are key advantages in having such generic decisions, both for the CEPT and also for satellite operators, since one Decision can cover multiple technically-comparable antenna and terminal types. It also recognizes the international nature of satellite services, whereby there is no need to have a service provider located in each country.

In addition, the following principles are recommended to facilitate the licensing of satellite services:

- Network licensing is more efficient than a licence per terminal
- Calculating the licence fee on the bandwidth used is more efficient than a fee based on the transmitter power and network density

- ➢ Applicable rules to satellite licensing should be readily available to the public and industry preferably on the Internet, or through the regulatory agency or ministry. Contact information with multiple persons listed should be clearly posted to facilitate processing.
- ➢ Regulators are encouraged to form a regional one-stop-shop (OSS) on satellite licensing.
- ➢ Regulations should be clear that users and service providers have the right to own and operate earth stations independent of the other operators.
- ➢ Licence requirements can be limited to those instances where regulatory review is necessary to prevent harmful interference.
- ➢ Regulators should encourage space segment providers to provide capacity under "Open Skies" policies allowing for competing space segment suppliers in VSAT. Licenced VSAT service providers should be able to choose from among competing space segment suppliers and should be able to contract with them directly for space segment capacity.
- ➢ Regulations should encourage the contribution of wireless operators to the universal service obligations.

7. Principles Governing the Use of Industrial Scientific and Medical Band (ISM)

Traditional means of managing spectrum have resulted in large portions of the spectrum being reserved exclusively for licenced users of a specific radio technology. This has created scarcity of the spectrum. By allowing more unlicenced use and more flexibility within licenced use of the spectrum adminstrations can improve innovations and access to wireless technologies. In recent years, the definitions of unlicenced spectrum have normalized around two major sets of frequencies at 2.4 GHz and 5 GHz. Most countries have regulations supporting licence-exempt bands and some countries have regulations that now support the commercial use of licence exempt spectrum. A few countries impose licence fees on individual equipment for hotspots and access devices. In general it is widely considered that unlicenced does not mean unregulated, and all manner of operators providing wireless services still need to maintain a no-interference working plan and a "good neighborhood" attitude.

To promote efficient use of the spectrum and maintain flexibility it is recommended that:

- The requirement for carrier licence on the ISM bands should be eliminated for both commercial and non-commercial operation to allow broadband customers easier access to WLAN and to other broadband alternative. Administrations should permit flexible use of the ISM spectrum as long as devices adhere to these rules particularly to the power limits. ISM and other licence exempt bands power limits should remain unchanged unless an exemption applies in non-metropolitan areas. It should also be recognized that the ISM bands are used for other telecommunication networks and these must be protected from harmful interference. The technical limits as contained in EN 300 328 (2.4 GHz band) and EN 301 893 (5.8 GHz) should be adopted and enforced.

- Administrations should follow a harmonized approach towards new frequency bands in the 5 GHz range - 5.1.5-5.35, 5.47-5.725 and 5.725-5.875 GHz, in view of new frequency allocations made by the WRC-2003. Administrations should make clear that whether a licence-exempt approach should be used or fee structure to be applied to these bands, the possibilities for commercial use of these bands and the class of users that should be excluded. The technical requirements for these bands should also be clear to the operators.

- Individual administrations should determine whether there are legislative, regulatory and business impediments to the interoperation of wireless ISPs and their access to the Internet backbone and, if so, eliminate them;
- Operators should not be allowed to cause harmful interference and should not operate outside of the approved technical specifications. Upon notification that their devices cause interference by the administration the operator should stop operation;
- Operators should " accept" interference from ISM devices, licenced operators and other wireless LAN devices but should also inform administrators of people violating the technical rules;
- Administrations allow existing licencees to use their spectrum in ways that utilize new technology without having to go back to the government to get permission for each new innovation. An obvious requirement is that the new technology does not interfere with existing users, either by causing co-channel interference (interfering with others on the same frequency) or adjacent channel interference (interfering with others on different frequencies) and the equipment is type approved;
- Administrations evaluate the use of ISM and other licence exempt bands on regular basis utilizing clear criteria and make provision for registrations renewal and changes in technology.

8. Co-ordination on Customs Issues among CRASA Members

Coordination between customs and administrations is required to improve the infusion of wireless technologies in the SADC region. This could be achieved through:

- Effort to increase customs official awareness of the implications of wireless communications for development;
- Improving communication between customs and regulators by establishing focal points at each institutions.

9. Mutual Recognition of Type Approvals (MRAs)

To promote the harmonization of technical standards as far as possible, it is necessary to simplify type approval procedures, and mutually accept the results of type testing where possible. CRASA Members are encouraged not to duplicate the regulatory efforts of other countries, or impede the importation of transmission equipment though potentially onerous type approval requirements. Testing requirements (homologation) from country to country are often redundant, resulting in major delays, high costs and less efficient provision of communication services. Instead, CRASA Members should, as far as possible, honour equipment approvals and certificates issued by other countries, or by recognized international certification bodies so as to eliminate the need for type approval requirements on a country-by-country basis. These procedures can be used in connection with national type approval regulations including those based on ETSI and IEEE standards or other international standards.

European standards are generally considered to be more appropriate to the SADC region as compared to standards developed in North America and Asia. Europe and Africa share the same region in the ITU frequency allocation table and most standards developed in Europe are relevant to African countries. Many North American standards have European versions and these need to be considered. Considering the fact that the manufacturing base of African countries is small and that most equipment comes from outside, the approval should be granted on the basis of mutual recognition.

CRASA Members are encouraged to adopt the following common procedures for mutual acceptance by national regulatory bodies of type approval and accreditation requirements for type testing of radio equipment:

1. Type testing shall be carried out at test laboratories accredited in accordance with the ISO guides 25 and 38, or EN 45001 and EN 45002, or a National Standard conforming to ISO guides 25 and 38, or EN 45001 and 45002;

2. Accredited test laboratories shall use application forms and test report forms, approved by CRASA;

3. If an application form and test report form for a particular standard is not available, the documents shall be based upon the 'model' application form and 'model' test report form approved by TRASA;

4. In cases where CRASA has made provisions for free circulation and use of radio equipment, CRASA members shall grant type approval based on a type approval certificate issued by another Administration, showing that the equipment conforms to the relevant national regulations;

5. Type approval certificates shall contain as a minimum the following information:

    - the CRASA Administration that issued the original type approval for this equipment;
    - the manufacturer;
    - the technical standards;
    - the type designation of the equipment;
    - the type of equipment (e.g. terminal, base station, mobile station, portable or other);
    - type approval number;
    - issue number;
    - date of original certificate;
    - original approval reference;
    - category of service;

- frequency (transmitter and receiver) range;
- power (fixed or variable) range;
- channel spacing(s);
- temperature range(s);
- further information relevant to each particular standard (e.g. communal site usage, simplex, duplex etc.);

6. Where free circulation and use is envisaged for type approved equipment, the equipment shall bear a mark in the form given in the Recommendation dealing with free circulation of the equipment in question;

7. In other cases TRASA Administrations shall accept as a basis for type approval the application form together with the test report of tests carried out to a technical standard, and validated by an accredited test laboratory;

8. At the request of the applicant the equipment may be tested to a number of options included within a technical standard for a given parameter in order to meet different regulatory requirements. In relevant cases, Administrations shall accept the results of tests carried out in this way as a basis for type approval, if these test results show that the particular Administration's regulatory requirements are met;

9. The manufacturer, not the end-user, should be qualified to obtain homologation certificates. VSAT type approvals obtained by the antenna manufacturer for trans-border applications should be mutually recognized by each administration.

10. The radio equipment mark, if any, shall be at the discretion of National Administrations.

It is recommended that CRASA administrations:

- Enter into agreements (Memorandum of Understanding) in order to mutually recognize type approvals
- Develop databases of type approved equipment and exchange information via CRASA
- Recognize, involve and utilize regional standard bodies and institutions (e.g South African Bureau of Standards, CSIR, etc.)

10. Marking Radiocommunication Equipment for Mutual Recognition

TRASA members should adopt a mark to bear radio equipments in the following suggested form:

SADC X Y

Where X is radio equipment identifier, specified in the relevant type approval Recommendation and Y is the symbol of the National Administration, which issued the type approval certificate. The national authorization number could follow the symbol.

The symbol of the national SADC Administrations should be as shown in the list of SADC Member Countries.

XI. Licensing Fees

Fees can be a major issue or obstacle for the provision of wireless services. Therefore, fees should not be seen from the perspective of generating income but should acknowledge the uniqueness of the requirements of the wireless industry and the benefits it brings to Internet diffusion and economic development. In some CRASA national regulations, fees are a pre-condition, meaning that fees must be paid in order to consider the application as valid. In other countries, it may be an operating condition -meaning that if annual fees are not paid, authorization can be withdrawn.

The licence fees could include application fees and annual fees. Application fees and annual renewal fees are payable to cover the administrative costs incurred by the regulator for management, control and enforcement of the applicable individual licence provisions. Licence fees may vary according to the type of the licence, the spectrum, duration and potential of the market. Annual renewal fees may be adjusted in line with potential market development and the evolution of regulatory requirements.

It is recommended that cost based principles be applied in determining the fees. The amount of the radio communications licence fee should be calculated on the basis of the consumption of spectrum in particular on the range of assigned frequency, the frequency class, the assigned bandwidth and the territorial and temporal scope of the licence. One or some of the following may be taken into account in determining spectrum fees:

- the frequency band and the bandwidth
- output power of the antenna
- the number of stations
- type of service and service coverage

CRASA Members should adopt a common approach to satellite and terrestrial wireless fees by harmonizing the types of fees charged. It is often recommended that only fees covering administration and spectrum elements be charged. A separate registration/service licence fee for the provision of services might be inappropriate. It is therefore recommended to reduce the number of fees applying to a system by administrations and to charge fees based on common and transparent principles. Administrations should also try to simplify and harmonize the methods used for spectrum related fee calculation and agree on some common criteria and methods to be used.

Administrative fees

- *Administrative fees* can be defined as fees charged independently of the type of licence (spectrum or service) for issuing of a licence. Administration fee could be paid annually for the duration of the licence or initially for a specified period of a licence.

The fees should reflect the amount of administration required to manage the licence. Administrations should benchmark their fees with comparable services in other sectors and among themselves so as to apply a reasonable and harmonized fee. There should be a clear and economical administrative procedure to determine the basis for applying a licence fee.

Service licence fees

- *Service licence* fees are generally charged for the type of service offered.

Spectrum related fees

- Fees relate to the spectrum, be it the use of the spectrum, the management of the spectrum or the value of the spectrum itself, may be called spectrum usage fee. This type of fee should strictly relate to spectrum as opposed to the above mentioned administrative or service licence fees.

For all applicable licence fees, the following principles should apply:

a) Any fees associated with a licence should be proportionate to the level of effort involved in administering the licensing process, and not constitute a discriminatory levy on expected profits or revenues.

b) Notwithstanding the previous principle, fees may, in the case of licensing of radio-frequency, be set at a level which encourages the efficient use of allocated resources. Fee setting policies and procedures should be streamlined in order to increase transparency.

c) Promotion of auction or tendering in the licensing process is encouraged where applicable. Care should however be taken that excessive prices doesn't create a barrier to entry (as was the case in Europe with 3G).

d) The regulatory authority should determine a reasonable applicable registration fee. It is important for administrations to review their fee regulation on a regular basis.

e) The regulatory authority should publish annually an overview of administrative costs and collections so that necessary adjustments could be made in a case of a surplus where the total sum of charges collected exceeded administrative costs or deficit.

f) The regulatory authority should determine the fees for rights of use of frequency spectrum and or rights of way objectively, transparently, on a non-discriminatory basis and with respect to the intended use.

g) Information relating to all applicable fees or clear criteria for determining fees should be published and updated regularly.

h) Fees should be examined on annual basis. Administrations should follow flexible regimes that allow fees to change on a regular basis.

XII. Transparency and Expedite Procedures

Transparency and expedited licensing procedure is important from the economic and the cross-border nature of wireless technologies. The availability of well-structured online information considerably reduces the burdens of licence administration, enables more efficient service delivery and can help to promote regulatory harmonization at regional levels. Following experience in the Americas and Europe there is a growing justification for publicly accessible information in SADC region on telecommunication law, technical standards and regulations and licensing procedures, as well as for online filing of licence applications for authorization of equipment and satellite services, commonly known as a regional One-Stop-Shop (OSS). The growing use of the Internet by applicants can facilitate transparency and efficiency.

- Firstly, it is recommended that administrations make all regulatory information including application forms available via the web.
- Secondly, regulators should also consider the development of interactive databases on regulation linked to various application forms to facilitate expediency. The variety and cross-border nature of wireless regulations often means that applicants should go through each national regulation and provide information, individually. To eliminate the time consuming bottlenecks in the submission of multiple licence applications, and to ensure economies of scale, it is recommended that administrations in TRASA region adopt a SADC-wide One-Stop-Shop (OSS) procedure on licensing of wireless technologies. Through the OSS, operators can file their licence or authorization applications electronically, on-line, via one central point (the Shop), which ensures that the application is forwarded to all relevant administrations for processing. The OSS procedure does not involve any transfer of responsibilities or sovereign rights in granting the licences or authorizations from the national administrations to the Shop. The Shop only acts as a point of contact, as an (electronic) post-box and as an information center for applicants. The OSS does not prevent applicants and National Regulatory Authorities from having direct contact. Building on existing experience in Europe and North America, and by adopting the new standards in distributed XML-based free and open-source software, each administration's online information on wireless regulation can be managed locally, while information delivery and licence applications can be consolidated at sub-regional level.
- Thirdly, it is also recommended that administrations strive towards creation of harmonized application forms to facilitate cross-broader applications.
- Administrations should also be able to disseminate information on their activities to all their stakeholders on ongoing basis using email alerts, newsletters, etc.

The CRASA licence OSS procedures should therefore:

- Comprise both regulatory database of licensing regimes for wireless networks and services and electronic combined application forms
- Make information on regulation up to date
- Should be restricted to wireless regulation initially and designed in such a way to improve harmonization in other areas of regulation

- Open to applicants without discrimination
- Encourage the use of electronic application
- Provide further information and act as a point of contact providing advice, as an electronic post-box and as an information centre for applicants but should not transfer responsibilities and sovereign rights in granting the licences from the national Administrations and should not prevent applicants and Administrations from having direct contact.
- Strive towards creation of a harmonized regional Common Application Form

It is also important to standardize on the duration for granting a licence. The duration between applications for a license and its granting must be reasonable.

XIII. Enforcement of Wireless Regulations

The proliferation of wireless technologies makes enforcement of regulations essential, for example appropriate use of frequencies and power limitations. The unlawful use of radio equipment has increased considerably over the last few years. Unlawful use of radio equipment presents regulatory and technical problems and a potential source of interference for radio services operating legally. It is within the interest of regulators and duly authorized users that the unlawful use of radio equipment be suppressed.
It is recommended that administrations use incentives for industry, education programs, monitoring/inspection and legal measures to suppress unlawful use of radio frequency spectrum.

1. Industry Incentives

By establishing predictable and transparent regulations administrations can indirectly enforce lawful use of spectrum. Mainstream businesses tend to avoid investing in countries that lack objective, transparent and predictable regulatory structures. When mainstream businesses avoid (or are prevented from) investing in certain countries and regions, a gap develops in the chain of supply and demand. Either a certain percentage of the demand for telecommunications services is not met by existing suppliers, or the demand is met, but at much higher prices than would exist in a competitive market. Such a gap between supply and demand could encourage the growth of illegal businesses, which may be willing to provide services in non-compliance with domestic laws and regulations. Non-mainstream businesses are less likely to promote local economic development, because they are less likely to create well-paying jobs and they often take measures to avoid payment of local taxes.

Therefore one of the most expedient ways for governments to discourage the development of unlawful businesses is to create legal and regulatory conditions that are conducive to the mainstream business community. When given the option, consumers – particularly business customers – will purchase services from mainstream business as opposed to non-mainstream businesses. Furthermore, mainstream businesses are often willing to help the government regulate and "police" the participants in an industry segment in order to help eliminate unfair competition or radio frequency interference from non-mainstream business ventures. Incentives for industry through the adoption and use of objective, transparent and predictable laws, regulations and licensing conditions is one of the best ways to ensure compliance with laws, regulations and licensing conditions. Mechanisms to consult the public and other interested parties are set up to ensure transparency and fairness in the licensing process.

2. Education Programmes

Education programs for prospective wireless operators about the wireless market, customer requirements, legal and regulatory issues could also reduce unlawful use of spectrum and compliance with regulation. The licensing criteria, the terms and conditions of licences, the period required to make decisions concerning an application should be made publicly available. Regulators should institute education programmes on new wireless technologies.

3. Legal Actions

Administrations should introduce the necessary legal actions into their regulations that:

- Subject all licencees and non-licencees (in case of unlicenced band) to abide by rules, regulations and technical requirements,
- Require all users of radio equipment to ensure that such equipment conforms to the regulations and technical requirements in force,
- Prohibit the possession, use, import, sale or distribution of radio equipment which does not conform to the relevant regulations and technical requirements,
- Prohibiting the sale or supply of equipment to persons not possessing a licence issued by an Administration where such a licence is required under national legislation.
- Impose appropriate penalties that commensurate with the magnitude of the offence and category of the licence.

It is also recommended that law enforcement agencies in collaboration with regulators establish a working group to monitor the potential of ISM networks for illegal activities.

4. Inspection

Inspection can also be used as one of the major enforcement measures. National Authorities should carry out inspections and measurements of radio equipment on a regular basis. The main reasons for inspections are:

- Suspicion or evidence of transgressing the law;
- Verification of compliance with licence conditions;
- Protection from harmful interference; and
- Review policies

While any applicant is entitled to be granted a licence, if all required conditions are met; the regulatory authority may suspend, amend or revoke a licence when a licencee fails to comply with a condition attached to the licence. Depending on the market segment of interest, new entrants may be licenced through competitive processes or upon applications submitted to the regulatory authority. The regulatory authority should not impose artificial barriers on the number of operators or service providers in the market, unless there are limitations due to the lack of resources (e.g. non-availability frequency band). For the purpose of equity, the licencee should be given a reasonable time to remedy or present its case, which the regulatory authority may consider. Withdrawal of a licence should only take place in exceptional circumstances and must be proportionate to the breach of conditions. The revocation of a licence should take place if there is a serious and repeated breach of the conditions given in the licence and the undertaking has been given a chance to remedy the breach.

Most of CRASA administrations do not permit to transfer licences unconditionally. This is because the format of a licence is such that it is a "permission" from the Regulator authorizing the licencee to carry out a defined operation under the specific terms set out in the licence. The regulator needs to know who is using specific frequencies. The administration needs to be informed in advance of the transfer, to ensure that the original terms and obligations are still met, no distortion of competition is caused and for technical reason such as interference and enforcement problems. However, the licencees or the applicants should be entitled to appeal on any decision made by the regulatory authority to a relevant institution. The procedures for appealing and the bodies to which such appeals may be brought should be considered a national issue, since they are dependent on the legal traditions and structure of the public administrations of member countries. One principle should, however, always be observed to ensure the service provider a fair proceeding; that is, the individuals treating the appeal cannot be the same as those individuals who have made the decision on which the appeal is founded.

Part C

Recommendations

The following recommendations are made to policy makers and regulators in the region

i. **General Recommendations**

- Administrations should undertake public consultations in preparing regulations and will need to take on the task of publishing their laws and regulations on wireless licensing and permits regularly. Making this information readily available to the public is an important step in advancing the transparency of a country's policies. Administrations should use their websites to post their regulatory framework, upcoming regulations, the list of licenced providers, technical standards and even to facilitate on-line filing of radio spectrum, satellite and/or earth station authorizations applications. The advantages of making data readily accessible on the Internet is immense; posting of regulatory requirements is inexpensive, reduces the burden on administrations (by reducing the need to respond to numerous individual inquiries), enables the industry to provide services effectively and this serves as an effective platform from which to promote regulatory harmonization. **P.41**

- Legislation should not restrict competition unless it can be demonstrated that the benefits of the restriction, to the community as a whole, outweigh the costs, and that the objectives of the legislation can only be achieved by restricting competition. **P.42**

- Administrations should encourage service neutral regulation as far as possible. **P.42**

- Administrations are also encouraged to maintain general technology-neutral regulatory policy principles that would facilitate the expansion of wireless services in the SADC region. **P.42**

- Regulation and licensing of wireless services is required to protect public safety, which includes public and private networks, natural persons, environment and other spectrum users. **P.42**

- As much as regulations are required to facilitate competition through international coordination or " open skies", it is also important to pay attention to the issues of national sovereignty, regional harmonization and to ensure mutual socio-economic benefits. **P.43**

- Administrations need to elaborate a regulatory and policy framework to ensure the continued evolution of the telecommunications and spectrum infrastructure. **P. 44**

ii. Regional Harmonization

- One of the main concerns for CRASA is the management of the effect of spill-over signals from neighbouring countries (across-border frequency coordination). Harmonisation of radio frequency spectrum use does facilitate across-border frequency coordination and has the added benefit of allowing regional roaming of certain customer devices (e.g. GSM). Harmonization is also critical from economic stand point to build an economy of scale and promote regional cooperation and integration. **P.44**

- Allocation of spectrum and the assignment of frequencies need close co-ordination between the policy and technical or engineering side of the regulator's office. This would enable the monitoring of the efficient use of spectrum, possible abuses of market power and ensuring that assignment of frequencies are done in accordance with national legislations. **P.45**

- Regional co-operation within SADC in preparing for WRC is essential. It is crucial for the CRASA Members to coordinate their position for WRC preparations and do so well in advance of the actual conference. At national levels, it is important to improve the capacities of spectrum management departments. At a regional level, it is critical to reach out to various regional organizations and coordinate with regulators from west, east, north and central Africa. **P.48**

- Since the harmful interference one radio device can cause to another radio device do not adhere to political boundaries, the co-ordination area may sometimes include neighbouring countries. Regulators of one country then need to co-ordinate this new frequency assignment with its neighbouring countries. This may vary between:
    - a normal procedure between two countries having harmonised band plans (thus coordinating more or less equivalent equipment types with each other),
    - to the complex scenario of two different allocations (thus two different types of applications) competing for the same spectrum close to the border of the involved countries. **P.49**

iii. Licensing Issues

- The conditions for licensing should be determined in such a way to be objectively justified, proportionate, non-discriminatory and transparent. **P.53**

- The granting of a licence is subject to the applicant's fulfilment of certain conditions including specialized knowledge, efficiency, and reliability on the part of the applicant. The Regulatory Authority can request the applicant to provide any proof and supporting documents. **P.53**

- It is important to harmonize the duration of specific licences across the region such as multinational and regional licences. **P.54**

- The following principles are recommended to facilitate the licensing of satellite services: **P.55**

    - Network licensing is more efficient than a licence per terminal
    - Calculating the licence fee on the bandwidth used is more efficient than a fee based on the transmitter power and network density
    - Applicable rules to satellite licensing should be readily available to the public and industry preferably on the Internet, or through the regulatory agency or ministry. Contact information with multiple persons listed should be clearly posted to facilitate processing.
    - Regulators are encouraged to form a regional one-stop-shop (OSS) on satellite licensing. Initially the OSS will cater for a centralised repository where operators could obtain information on legislative, regulatory and satellite application information to assist in applying for licences.
    - Regulations should be clear that service providers have, within the legislature framework of the particular country, the right to own and operate earth stations independent of the other operators.
    - Licence requirements can be limited to those instances where regulatory review is necessary to prevent harmful interference.
    - Regulations should encourage the contribution of wireless operators to the universal service obligations.
    - Regulators should encourage space segment providers to provide capacity under "Open Skies" policies allowing for competing space segment suppliers in satellite services. Licenced satellite service providers should be able to choose from among competing space segment suppliers and should be able to contract with them directly for space segment capacity.

- It is recommended that CRASA Administrations consider class licensing and general authorization for satellite terminals including to facilitate the diffusion of Internet access. However, the adoption of class licence is the discretion of individual administration. **P.53**

- It is recommended that the requirement for a carrier licence on the ISM bands should be eliminated for both commercial and non-commercial operation to allow broadband customers easier access to WLAN and to other broadband alternatives. Administrations should permit flexible use of that spectrum as long as devices adhere to the applicable rules and standards particularly with regard to the power limits. ISM and other licence exempt bands power limits should remain unchanged unless an exemption applies in non-metropolitan areas. It should also be recognized that the ISM bands are used for other telecommunication networks and these must be protected from harmful interference. The technical limits as contained in EN 300 328 (2.4 GHz band) and EN 301 893 (5.8 GHz) should be adopted and enforced. **P.56**

- Administrations should follow a harmonized approach towards new frequency bands in the 5 GHz range - 5.1.5-5.35, 5.47-5.725 and 5.725-5.875 GHz, in view of new frequency allocations made by the WRC-2003. Administrations should make clear that whether a licence-expempt approach should be used or fee structure to be applied to these bands, the possibilities for commercial use of these bands and the class of users that should be excluded. The technical requirements for these bands should also be clear to the operators. **P.57**

- Administrations should determine whether there are legislative, regulatory and business impediments to the interoperation of wireless ISPs and their access to the Internet backbone and, if so, ascertain whether the limitation imposed by such impediment is justifiable. **P.57**

- Operators should not be allowed to cause harmful interference and should not operate outside of the approved technical specification. Upon notification that their devices cause interference by the administration the operator should take immediate steps to eliminate the harmful interference. **P.57**

- Administrations should allow existing licencees to use their spectrum in ways that utilize new technology without having to go back to the government to get permission for each new innovation. An obvious requirement is that the new technology does not interfere with existing users, either by causing co-channel interference (interfering with others on the same frequency) or adjacent channel interference (interfering with others on different frequencies) and that the new technology has been type approved. **P.57**

- Users of the ISM frequency bands should ”accept” interference from ISM devices, licenced operators and wireless LAN devices but should also inform administrators of people violating the technical rules. **P.57**

- Administrations evaluate the use of ISM and other license exempt bands on a regular basis to facilitate its effective use. **P.57**

- Licences should facilitate the expedient operation of services through coordination between customs and administrations. This can be achieved by establishing focal points at both institutions. **P.57**

- Effort should be made to increase customs official awareness of the implications of wireless communications for development **P.57**

IV. Mutual Acceptance of Test Results

CRASA Members are encouraged to adopt the following common procedures for mutual acceptance by national regulatory bodies of type approval and accreditation requirements for type testing of radio equipment:

- Type testing shall be carried out at test laboratories accredited in accordance with the ISO guides 25 and 38, or EN 45001 and EN 45002, or a National Standard conforming to ISO guides 25 and 38, or EN 45001 and 45002; **P.58**

- Accredited test laboratories shall use application forms and test report forms, approved by CRASA; **P.58**

- If an application form and test report form for a particular standard is not available, the documents shall be based upon the 'model' application form and 'model' test report form approved by CRASA; **P.58**

- In cases where CRASA has made provisions for free circulation and use of radio equipment, CRASA members shall grant type approval based on a type approval certificate issued by another Administration, showing that the equipment conforms to the relevant national regulations; **P.58**

- Type approval certificates shall contain as a minimum the following information:

    - the CRASA Administration that issued the original type approval for this equipment;
    - the manufacturer;
    - the technical standards;
    - the type designation of the equipment;
    - the type of equipment (e.g. terminal, base station, mobile station, portable or other);
    - type approval number;
    - issue number;
    - date of original certificate;
    - original approval reference;
    - category of service;
    - frequency (transmitter and receiver) range;
    - power (fixed or variable) range;
    - channel spacing(s);
    - temperature range(s);
    - further information relevant to each particular standard (e.g. communal site usage, simplex, duplex etc.); **P.59**
- Where free circulation and use is envisaged for type approved equipment, the equipment shall bear a mark in the form given in the Recommendation dealing with free circulation of the equipment in question; **P.59**

- In other cases CRASA Administrations shall accept as a basis for type approval the application form together with the test report of tests carried out to a technical standard, and validated by an accredited test laboratory; **P.59**

- At the request of the applicant the equipment may be tested to a number of options included within a technical standard for a given parameter in order to meet different regulatory requirements. In relevant cases, Administrations shall accept the results of tests carried out in this way as a basis for type approval, if these test results show that the particular Administration's regulatory requirements are met; **P.59**

- The manufacturer, not the end-user, should be qualified to obtain homologation certificates. VSAT type approvals obtained by the antenna manufacturer for trans-border applications should be mutually recognized by each administration. P.59

- The radio equipment mark, if any, shall be at the discretion of National Administrations. **P.59**

V. Licensing Fees

- Fees can be a major issue or obstacle for the provision of wireless services. Therefore, fees should not be seen from the perspective of generating income but should acknowledge the uniqueness of the requirements of the wireless industry and the benefits it brings to Internet diffusion and economic development. **P.60**
- Licence fees may vary according to the type of the licence, the spectrum, duration and potential of the market. Annual renewal fees need to be adjusted in line with potential market development and the evolution of regulatory requirements. **P.60**

  - It is recommended that cost based principles be applied in determining the fees. **P.60**

- CRASA Members should adopt a common approach to satellite and terrestrial wireless fees by harmonizing the types of fees charged where required. It is often recommended that only fees covering administration and spectrum elements be charged. A separate registration/service licence fee for the provision of services might be inappropriate.

- For all applicable licence fees, the following principles should apply: **P.61**
  - Any fees associated with a licence should be proportionate to the level of effort involved in administering the licensing process, and not constitute a discriminatory levy on expected profits or revenues.
  - Notwithstanding the previous principle, fees may, in the case of licensing of radio-frequency, be set at a level which encourages the efficient use of allocated resources. Fees setting policies and procedures should be streamlined in order to increase transparency.
  - Promotion as far as applicable of auction or tendering in the licensing process is encouraged

- The regulatory authority should determine a reasonable applicable registration fee. It is important for administrations to review their fee regulation on a regular basis.
- The regulatory authority should publish annually an overview of administrative costs and collections so that necessary adjustments could be made in a case of a surplus where the total sum of charges collected exceeded administrative costs or deficit.
- The regulatory authority should determine the fees for rights of use of frequency spectrum and or rights of way objectively, transparently, on a non-discriminatory basis and with respect to the intended use.

▪ Information relating to all applicable fees or clear criteria for determining fees should be published and updated regularly.

VI. Transparency and Expedite Processes

▪ In order to manage the use of the radio frequency spectrum it is vital that administrations develop a database where all the frequency assignment criteria, parameters and licensing information are stored. An added benefit will be if this database is linked to a spectrum management tool to perform technical and administrative spectrum management functions such as frequency coordination, issuing of licences, printing invoices, etc. **P.62**

▪ Administrations should use their websites to post their regulatory framework, upcoming regulations, the list of licenced providers, technical standards and even to facilitate on-line filing of radio spectrum, satellite and/or earth station authorizations. **P.62**

▪ To eliminate the time consuming bottlenecks in the submission of multiple licence applications, and to ensure that economies of scale across, it is recommended that administrations in CRASA region adopt a SADC-wide One-Stop-Shop (OSS) procedure on licensing of wireless technologies **P.62**

▪ In order to assist in the harmonization process, it would help if the same format for licence application forms were used throughout CRASA members. Therefore, in an effort to standardize the format of the application forms used by the various CRASA Administrations, a generic application form can be drawn up based on the inclusion of common components. It is also recommended that administrations strive towards creation of harmonized application forms to facilitate cross-broader applications. **P.62**

VII. Enforcement

It is recommended that administrations use both incentives for industry –wide monitoring and legal measures to suppress unlawful use of radio frequency spectrum. **P.63**

Regulators should institute education programmes on the rules and regulations applicable to new wireless technologies to ensure that operators all abide to the applicable rules and regulations. **P.63**

National Authorities should carry out inspections and measurements of radio equipment on regular basis. The main reasons for inspections are:

P64

- Suspicion or evidence of transgressing the law;
- Verification of compliance with licence conditions;
- Protection from harmful interference; and
- Review policies

It is also recommended that law enforcement agencies in collaboration with regulators establish a working group to monitor the potential of ISM networks for illegal activities.

P65

PART D

Annexes, Appendices, Glossary of Terms

Annex I

Generic Application Form for Satellite Communication Station Licence

Applicant Information	
Name (Company)*	
Contact Person Name	
Contact Person Designation*	
Passport №.	
Nationality	
Business Registration №.	
Principal Activity (ies) (as registered)	
Correspondence address*	

Billing Address	
Physical Address:	
Fixed Telephone №.*	
Fax №.*	
E-mail*	
Mobile Number:	

Application Information	
System Description	
Proposed Use of System	
Class of Licence (Please Tick One)	__Very Small Aperture Terminal (VSAT) Station Licence __Tracking, Telemetry and Command (TT&C) Earth Station Licence __Earth Station Licence __Portable Satellite Communication Terminal Licence
Station Information	
Station Name	
Intended date of bringing into use (DD/MM/YYYY)	
Location	
Address	
Is the station transportable?	__Yes __No If Yes, state radius of operation (Km)
Latitude in Degrees-Hours-	

Minutes-(N/S)(eg.120-45-30-N)		
Longitude in Degrees-Hours-Minutes-(E/W)(eg.120-45-30-W)		
Antenna Displacement From Station Location	Latitude Displacement	m
	Longitude Displacement	m
Site Elevation (meters) (above mean sea level)	M	
Structure Height (meters)	M	
Antenna Height (meters) (above ground level)	M	
Building Height (meters)	M	
Lowest Equivalent Satellite Link Noise Temp (ºK)		
Receiver Noise Temp (ºK)	Front End	
	Antenna	
	Lowest Total System	
Class of Station		
Nature of Service		
G/T (dB/K)		
Data Interface		
Encryption/Scrambling Standard		
Modulation Scheme		
Modulation Type	___Digital	___Analog

Associated Space Station	
Associated Space Station	
Nominal Orbital (For Geostationary only) **Longitude** in Degrees-Hours-Minutes-(E/W)(eg. 120-45-30-W)	
Name of Satellite Operator	
Associated Satellite Receiving Beam Designation	
Associated Satellite Transmitting Beam Designation	

Frequency Information		
Usage Period	Start Time	
	Stop Time	

	Transmit	Receive
Desired Frequency (MHz)	From	From
	To	To
Assigned Frequencies (MHz)	a.	a.
	b.	b.
	c.	c.
Corresponding Bandwidth of Assigned Frequency (KHz)	a.	a.
	b.	b.
	c.	c.
Feeder Line Type		
Feeder Line Length (meters)		
Feeder Line Loss (dB)		
Emission		
Total Peak Power (+/- dBW)		
Maximum Spectral Power Density (+/- dBW/Hz)		
Polarization (Linear, Circular, etc)		
(Digital Only) Baseband Bit-Error Rate (10E-35) MB/s		
(Digital Only) Baseband Symbol Rate (Kb/s)		
(Analog Only) Baseband Noise/Power Ration (dB)		
(Analog Only) Baseband Frequency Range (KHz)		
IF Frequency		

Radio Equipment Information		
Station Name		
	Transmit	Receive
Manufacturer		
Trade Name		
Model		
Serial №.		
Frequency Range (MHz)		
Maximum Frequency Separation	If 3dB Bandwidth (KHz)	If 3dB Bandwidth (KHz)
	Necessary Bandwidth	Necessary Bandwidth
	Transmitter Rate Power (Watts)	Minimum Acceptable Rx Signed Level (dBW)

Frequency Stability		
Spurious Emissions		

Antenna Information		
Antenna Diameter (m)		
Manufacturer		
Model		
Antenna Type		
	Transmit	Receive
Frequency Range (MHz)		
Midband Gain (dB)		
3dB Beamwidth (º)		
	Elevation	Azimuth
Adjust Range (º)		
Operating Angle		
	Operational	Survival
Wind Loading (Km/hour)		
Radiation Pattern		

Transmit/Receive RF Filter Information	
Manufacturer	
Model	
RF Filter Type (eg. Band pass/reject)	
Insertion Loss (dB)	
Isolation A	
Isolation B	
Frequency Range (MHz)	
Transmit	
Receive	
Minimum Separation (MHz)	
Tuned Frequency (MHz)	

Identity Reference of the Functional Units Installed	Following	
	Transmit	Receive
	Transmitter	Receiver
	Up-converter	Down-converter
	Modulator	Demodulator
Monitor & Control		

(Analog Only) **Baseband (Audio/Video)**		
(Digital Only) **Data Interface**		
Power Supply		
Others (to be specified)		

Technical Document (One set is to be submitted)	
Please check [x] if you are including the under mentioned documents	
___Earth Station System Block Diagram and Description ___General Description of the Functional Units ___An Equipment Rack Diagram with Panel Layout showing functional units Transmitter, receiver, up-converter/down-converter, modulator/demodulator, monitor & control, base band (audio/video)/data interface, power supply and others (please specify)	
Technical Data & Specification of the following Functional Units (title to be specified)	
a. Transmitter	
b. Receiver	
c. RF Filter	
d. Antenna	
e. Base band (Audio/Video) Data Interface	
Please check [x] if you are including the under mentioned documents ___Horizontal Elevation of Earth Station ___Antenna Radiation Diagram (Copolar & Crosspolar) ___Transmit/Receive RF Filter Attenuation Diagram	

We declare that we have not commenced provision/operation of any of the telecommunication station/networks applied for in this application and all the information in this application form is true and correct. We understand that approval from the concerned CRASA Administration is based on information as declared in this application. We further acknowledge that, should any of the information declared herein be found to be untrue, inaccurate or incorrect, any licence granted by concerned CRASA Administration will be rendered null and void. Any concerned CRASA Administration reserves right to impose penal sanctions against us under any applicable laws and regulations in force in the respective country, and without prejudice to any civil remedies that the concerned CRASA Administration has against us if any of the information declared in the application be found to be untrue, inaccurate or incorrect.

______________________ ______________________

Name/Signature Date/Company Stamp

Glossary of Terms

2G mobile: Mobile phone technologies that provide voice and low speed Internet access, using digital voice encoding and a mixture of circuit-switching and packet-switching techniques that support data transmission rates around 9.6 kbps (for example, GSM and CDMA).

2.5G mobile: 2.5 generation mobile. An evolutionary cellular mobile technology on the way to third generation (3G) mobile, using packet-switching techniques that can support data transmission rates up to 384 kbps (for example, GPRS and EDGE).

3G mobile: Third generation mobile. An emerging cellular mobile technology employing more advanced digital switching technologies than 2G and 2.5G mobile systems. 3G technologies include WCDMA and CDMA2000 and offer the prospect of data transmission rates up to 2 Mbps.

802.11: 802.11 is a standard that was approved in 1996 for Wireless LANs using spread-spectrum technology. Signals are transmitted across a range of frequencies using very low energy levels. Initially transmission speeds over the 802.11 standard were between 1 and 2 Mbps. However, in 1999 a new standard called IEEE 802.11b was ratified. This standard enables a rate of transmission of 11 Mbps. 802.11a and 802.11g versions of the standard also exist. The technology can be converted to use over a longer distance using directional antennas but this is not the original purpose the standard was developed for.

ADSL: Asymmetric digital subscriber line. ADSL is one of a family of DSL technologies that are capable of transforming phone lines (copper networks) into high-speed digital lines. ADSL enables simultaneous voice and data transmission (for example, for voice telephony). ADSL is asymmetric in that it utilizes most of a channel to transmit downstream to the user and only a small part to receive from the user.

Allocation: The division of the radio spectrum bands of frequencies dedicated to particular services, as documented in the SADC Band Plan

Assignment: The process of issuing the right to access spectrum to spectrum users. The method of assignment is through licences and may be administrative or market-based (principally auctions).

Backhaul: The process of transferring information to a central point from which it can be distributed over a network. Fixed links, for example, are often used to backhaul traffic for mobile communications and broadcasting.

Bandwidth: The range of frequencies, expressed in hertz (Hz), over which a spectrum user can transmit or receive radio signals. In general, the greater the bandwidth the more information that can be sent through the spectrum in a given amount of time.

bit: A bit is the smallest possible piece of digital information and is a binary digit with a value of either one or zero. Bits are used to store data on computers and to sequence digital transmissions. A kilobit equals one thousand bits.

bps: bits per second. The number of bits transmitted each second. kbps
is the number of kilobits transmitted each second.

Bluetooth: A short-range (10 to 100 metres), low-power radio technology that allows wireless communication between devices such as mobile handsets and computers.

Broadband: Broadband refers to information transmission speed and capacity often a transmission speed above 512 Kbps.

Broadcasting Satellite Service(BSS) – A radiocommunications service in which signals transmitted or re-transmitted by space stations are intended for direct reception by the general public.

Byte: A byte is a collection of eight bits and can have one of 256 possible values ranging from '00000000' to '11111111'. Text is normally represented using one byte per alphanumeric character.

CDMA: Code Division Multiple Access. A second-generation (2G) digital cellular mobile phone technology that uses spread spectrum techniques to transmit coded signals across several channels, rather than allocating each signal to an individual channel. CDMA is also used in many other wireless technologies, including satellite communication systems.

CDMA 2000: Code Division Multiple Access 2000. A standard for third generation (3G) mobile phone technology that employs advanced spread spectrum techniques.

Class licence: Open, standing licences that allow anyone to operate specified devices, within the conditions of the licence (for example, CB radios, mobile phone handsets, cordless phones and remote controls). Device users do not have to apply for a class licence and do not pay a fee.

Competition- Refers to introducing competition among national service suppliers and/or foreign suppliers without any limitations. Therefore all countries allowing more than one operators are competitive.

Convergence: The ability of similar types of information to be transmitted using different platforms and different radio frequencies.

Data: - Information represented in a manner suitable for automatic processing

Data Transmission: The conveying of data from one place to another by telecommunication.

Downlink: A radio link between a transmitting space station and a receiving earth station. The term is also used in terrestrial communications for a link between a transmitting base station and a receiving mobile station

Earth Station: A station located either on the Earth's surface or within the major portion of the Earth's atmosphere and intended for communication: with one or more space stations; or with one or more stations of the same kind by means of one or more reflecting satellites or other objects in space.

EDGE: Enhanced data for global system for mobile (GSM) evolution. A packet-based data technology for cellular mobile phones that overlays GSM networks and supports data transmission rates of up to 384 kilobits per second.

End Users: The individual or organization that originates or is the final recipient of information carried via a network (i.e. the consumer)

Externality: An indirect cost or benefit resulting from a transaction that is not covered or captured by either party to the transaction. In radiocommunications, interference is an externality.

FDMA: Frequency division multiple access. An analogue technique that increases the intensity of spectrum use by splitting a single channel (allowing one signal) into a number of sub-channels (each supporting one signal).

Frequency: The number of complete cycles or waves per second, as measured in cycles per second or hertz (Hz).

Frequency band plan: A legal instrument made at national level that subdivides the broad spectrum allocations of the Australian Radio frequency Spectrum Plan into specific service types.

Fixed Satellite Services: A radiocommunication service between earth stations at given positions, when one or more satellites are used

Frequency Allocation: Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunications services or the radio astronomy service under specified conditions

Frequency Assignment: (of a radio frequency or radio frequency channel): Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunications service in one or more identified countries or geographical areas and under specified conditions

Gateway: Any mechanism for providing access to another network. Gateway earth stations link one or more terrestrial networks and satellites.

Global Mobile Personal Communications by Satellite: Any satellite system (i.e. fixed, mobile, broadband or narrowband, global or regional, geostationary or non-geostationary, existing or planned) providing telecommunications services directly to end-users from a constellation of satellites.

GMPCS MOU and Arrangements: The GMPCS-MoU is a cooperative framework signed by Member States, GMPCS System Operators, GMPCS Terminal Manufacturers and Service Providers to memorialise the non-contractual and non-legally binding terms of their cooperation. The objective of the cooperation is to allow GMPCS subscribers to take their terminals anywhere and, more importantly, to use them in countries where they are licenced.

GPRS: General packet radio service. A packet-based data technology for cellular mobile phones that overlays global system for mobile (GSM) networks and supports data transmission rates up to 114 kilobits per second.

Ground Segment: The ground segment refers to the network of gateways.

GSM: Global system for mobile. A second-generation (2G) digital cellular mobile technology based on time division multiple access (TDMA).

Hotspot: A place where users can access Wi-Fi service for free or a fee.

Hotzone: An area where users can access Wi-Fi service free or for a fee.

Hub: A multi-port device used to connect several PCs to a network.

Hz: Hertz. A unit of frequency, equal to one cycle per second. A kilohertz (kHz) equals one thousand hertz. A megahertz (MHz) equals one million hertz. A gigahertz (GHz) equals one billion hertz.

IEEE—Institute of Electrical and Electronics Engineers (www.ieee.org), in New York, is an organization composed of engineers, scientists, and students and is best known for developing standards for the computer and electronics industry. In particular, the IEEE 802.xx standards for local-area networks are widely followed.

Interference: The effect of unwanted energy colliding with transmitted signals. Interference can arise from artificial sources (for example, two or more radio signals colliding) or natural sources (for example, lightning). Interference is a negative externality.

Internet Protocol (IP): A set of rules used to send and receive messages at the Internet address level.

ISDN: Integrated services digital network. A set of standards for digital transmission over copper wire and other platforms using a circuit-switched technology to allow both voice and data over the same network.

ITU: International Telecommunication Union. An organ of the United Nations, the ITU is the international forum within which governments and the private sector coordinate the operation of telecommunication networks and services, and advance the development of communications technology. The ITU is responsible for developing standards for new technologies, such as mobile telephony and the Internet, and for managing the radio frequency spectrum. The ITU maintains the international Radio Regulations, which allocate frequency bands to various types of services.

Last mile: The last mile refers to the final stage in the connection from individual homes and businesses to broadband.

Licence: An authorisation means any permission setting out rights and obligations specific to the telecommunications sector and allowing undertakings to provide telecommunications services and, where applicable, to establish and/or operate telecommunications networks for the provision of such services, in the form of a general authorisation or individual licence as defined below. A general authorisation means an authorisation regardless of whether it is regulated by a class licence or under general national law and whether such regulation requires registration, which does not require the undertaking concerned to obtain an explicit decision by the national regulatory authority before exercising the rights stemming from the authorisation. Individual licence means an authorisation which is granted by a national regulatory authority and which gives an undertaking specific rights or which subjects that undertaking's operation to specific obligations supplementing the general authorisation where applicable, where the undertaking is not entitled to exercise the rights concerned until it has received the decision by the national regulatory authority.

Licence for VSAT Terminals: An authorisation to carry and use of a Terminal. According to the national regime, the licence can be one of the following; An individual licence; whereby for each terminal a separate authorisation is issued; A general licence or class licence, whereby one generic authorisation is issued, which applies to al users and to all terminals of a given category; A licence exemption, whereby there is an exemption from requiring an individual licence for each terminal; A blanket licence, whereby an individual operator or service provider is authorised to use a certain number of technically identical terminals.

Local Area Network (LAN)—A high-speed network that connects a limited number of computers in a small area, generally a building or a couple of buildings.

LMDS: Local multipoint distribution system. A terrestrial radio system using radio frequencies of around 25 to 40 GHz to provide interactive video, Internet and voice services (usually limited to customers residing within a 3 km radius of a transmission tower).

MAC—A unique identifier that can be used to provide security for wireless networks. All Wi-Fi devices have an individual MAC address hard-coded into it.

MDS: Multipoint Distribution Station. One-way radio services operating from a fixed location and generally transmitting to multiple receiving facilities at fixed locations, generally used for terrestrial broadcasting.

MMDS: Multi-channel multipoint distribution system. A terrestrial radio system utilising radio frequencies between 2 and 3 GHz that is used for television broadcasting and increasingly for two-way, high-speed Internet access (usually limited to customers within a 50 km radius of the transmission tower).

Mobile Satellite Services: A radiocommunication service between mobile earth stations and one or more space stations or between space stations used by this service; or between mobile earth stations by means of one or more space stations

Multiplexing: A range of techniques that enable transmission of multiple signals (voice or data) simultaneously along a single channel (for example, FDMA and TDMA).

Mutual Recognition Agreements: An agreement that does not modify the authority of each regulatory body to set standards and requirements

Narrowcasting: Specialized radio and television transmissions intended for a specifically defined group.

Network: A public and/or private communications transmission that provides interconnectivity among a number of local or remote devices (e.g. telephones, exchanges, computers, television sets). The PSTN is operated by local Public Telecommunications Operators. Like the PSTN, other private and public networks can comprise many point-to-point transmission media, including wire, cable and radio-based ones.

Open Skies: Open Skies Agreements create a free market for aviation services and provide substantial benefits for travellers, shippers, and communities as well as for the economy of each country. Bilateral Open Skies Agreements give the airlines of both countries the right to operate air services from any point in one country to any point in the other, as well as to and from third countries. These rights enable airlines to network using strategic points across the globe. These agreements are either bilateral or multilateral

PCS: Personal Communications Services. A generic term for mobile phone services, including technologies such as GSM and CDMA.

Peer-to-Peer Network (P2P): Also known as Ad-hoc mode, a network of computers that has no server or central hub. Each computer acts both as a client and network server. It can be either wireless or wired.

Personal Area Network (PAN): A casual, close-proximity network where connections are made on the fly and temporarily. Meeting attendees, for example, can connect their Bluetooth-enabled notebook computers to share data across a conference-room table, but they break the connection once the meeting is over.

Platforms: The type of system or network used to transmit communications, for example, platforms transmitted over copper wire, HFC cable, fibre optic cable, terrestrial microwave and satellites.

Point-to- multipoint services: Wide area services that transmit signals from a central distribution point to multiple fixed points (for example broadcasting transmitters, LDMS, MMDS, and mobile services).

Point-to-point services: Fixed links that transmit information between two fixed points in the form of directed beams of radio waves, and are often used to backhaul traffic for mobile communications and broadcasting.

P**rimary use**: The single use that takes precedence over others in a given frequency. Secondary uses are unable to claim protection from or cause interference with the primary use.

Propagation: The area or distance of 'service coverage' that can be achieved from a transmitting device. The propagation of radio signals depends on factors including the communications equipment, power, time of day, time of year, solar activity and topography and weather conditions.

Public good: A good or service that is both non-excludable and non-rivalrous. That is, once the good is produced, it is not possible to withhold its benefits from anyone, and the benefits for one person do not reduce the benefits available to others. This means that private producers may not supply public goods, or may produce less than is desirable.

Public Switch Telephone Network: The infrastructure of physical switching and transmission facilities that s used to provide the majority of telephone and other telecommunications services to the public. In a monopoly environment, one PTO owns and operates the PSTN. In a competitive environment, the PSTN typically comprises the interconnected networks of two or more PTOs.

Radiocommunication: Telecommunication by means of radio waves. *Note* – The definition of the term "telecommunication" is included in Appendix 2 of Recommendation ITU-R V.662 dealing with general terms.

Radio-frequency spectrum: Part of the electromagnetic spectrum, currently defined as the subset of frequencies between 3000 hertz (Hz) and 300 GHz.

Radio Frequency (RF)—Any frequency within the electromagnetic spectrum associated with radio-wave propagation.

Range—The distance a wireless signal can reach.

Re-allocation: The process of changing the allocation of spectrum, as defined in the SADC Radio frequency Spectrum Plan, from one use to another. Incumbent users who do not conform to the new allocations must be re-located to other frequencies.

Receive Only terminal: Pertaining to a link where the transfer of users' information is possible in one pre-assigned direction only

Recognized Operating Agencies: Any operating agency, as defined in the ITU Convention, which operates a public correspondence or broadcasting service and upon which the obligations provided for in the ITU Constitution are imposed by the Member in whose territory the head office of the agency is situated, or by the Member which has authorized this operating agency to establish and operate a telecommunication service on its territory

Repeater: A device that receives a radio signal, amplifies it, and retransmits it in a new direction. Repeaters are used in wireless networks to extend the range of base-station signals, thereby expanding coverage—within limits—more economically than by building additional base stations.

Roaming: The ability to move from one access point coverage area to another without losing connectivity.

Satellites: A wireless receiver and transmitter that orbits the earth. Satellites are used for communications (voice, data & fax), weather forecasting, television broadcasting, amateur radio communications, Internet communications and other services.

Satellite Broadband: A wireless high-speed Internet connection provided by satellites. Some satellite broadband connections are two-way—up and down. Others are one-way, with the satellite providing a high-speed downlink and then using a dial-up telephone connection or other land-based system for the uplink to the Internet.

Satellite News Gathering (SNG): the temporary and occasional transmission with short notice of television or sound for broadcasting purposes, using highly portable or transportable uplink earth stations operating in the framework of the fixed-satellite service

Secondary use: A use that shares frequencies allocated to primary and co-primary uses, but is unable to claim protection from or cause interference with the primary or co-primary uses.

Shadow pricing: A technique used by regulators that aims to mimic market-based valuations, in the absence of actual market-based methods of valuing goods, services and resources (for example, calculating apparatus licence fees based on annualized auction prices).

Signal: A physical phenomenon one or more of whose characteristics may vary to represent information. The physical phenomenon may be for instance an electromagnetic wave or acoustic wave and the characteristic may be an electric field, a voltage or a sound pressure

Spectrum: The set of all frequencies (or electromagnetic waves) produced in the electric and magnetic fields. Spectrum can be defined according to frequency, space and time.

Spectrum Allocation—The range of frequencies designated by a National Telecommunications Regulatory Authority for a category of use or uses.

Spectrum licence: A licence authorizing the use of spectrum space for any device from any site within that space, subject to the conditions of the licence and relevant technical regulations. They are issued for a fixed, non-renewable term and may be subdivided, combined and traded.

Spread spectrum: A digital technique that combines FDMA and TDMA technologies to allow many users to occupy several channels at the same time. Signals are distributed (or spread) over the whole range of channels and each user is assigned a unique code that differentiates it from other users simultaneously carried over the
same spectrum (for example CDMA technology).

TCP/IP: The underlying technology behind the Internet and communications between computers in a network. The first part, TCP, is the transport part, which matches the size of the messages on both end and guarantees that the correct message has been received. The IP part is the user's computer address on a network.

TDMA: Time division multiple access. A digital technique used to increase the intensity of spectrum use. TDMA splits a single channel (allowing one subscriber) into into a number of timeslots depending on the design of the specific system. Each timeslot supports a particular subscriber.

Telephony: A form of telecommunication primarily intended for the exchange of information in the form of speech. NOTE – This is the definition given in the Constitution of the International Telecommunication Union (Geneva, 1992) (CS 1017) (RRNo. S1.123).

Telecommunications Terminal: An equipment connected to a telecommunication network to provide access to one or more specific services. NOTE – The term may be qualified to indicate the type of service or user, e.g. "data terminal" "subscriber's terminal".

Type Approval: – An administrative procedure of technical tests and vetting applied to items of telecommunication equipment before they can be sold or interconnected with the public network. Also known as homologation.

Unlicenced Spectrum: The government sets up general rules, such as the power limits
on devices, and then allows any device that meets those standards to operate (unlicenced)

in that spectrum.

UMTS: Universal mobile telecommunications system. A 'third generation' (3G) mobile communications system being developed by the European Union within the framework defined by the ITU and known as IMT-2000. UMTS will enable broadband services to be delivered to mobile users via fixed, wireless and satellite
networks. Data rates of up to 2 Mbps are promised.

Uplink: A radio link between a transmitting earth station and a receiving space station. The term is also used in terrestrial communications for a link between a transmitting mobile station and a receiving base station.

Voice Over the Internet: The use of the Internet as a transmission medium for all or part of a voice telephone call. This is not to be confused with IP Telephony, which merely denotes the use of the Internet protocol for transmission, which may occur over private networks other facilities.

Very Small Aperture Terminal (VSAT): An earthbound station used in communications
of data, voice, and video signals, excluding broadcast television into a number of timeslots depending on the design of the specific system. Each timeslot supports a particular subscriber. A VSAT consists of two parts: a transceiver placed outdoors in direct line-of-sight to the satellite, and a device placed indoors to interface the transceiver with the end user's communications device, such as a PC.

Virtual Private Network (VPN): A private network of computers at least partially connected by public phone lines. An example is a private office LAN that allows users to log in remotely over the Internet (an open public system). VPNs use encryption and secure protocols such as PPTP to ensure that unauthorized parties do not intercept data transmissions.

Voice-Over IP (VoIP): Technology that supports voice transmission via IP-based
LANs,WANs, and the Internet.

Wide Area Network (WAN): A network that connects computers and other devices
across a large local, regional, national, or international area.

WCDMA: Wideband Code Division Multiple Access. A standard for third generation (3G) mobile technology that employs advanced spread spectrum techniques.

Wi-Fi: The standard commonly given to 802.11b devices that interoperate under testing by the Institute of Electrical and Electronic Engineers (IEEE).

Wi-Fi Alliance: A coalition of wireless-industry leaders committed to the open interoperability of 802.11 IEEE standards.

WiMAX Forum—A coalition of wireless-industry leaders committed to the open interoperability of all products used for broadband wireless access based on 802.16 IEEE standards.

Wireless—Use of radio-frequency spectrum to transmit and receive voice, data, and video signals for communications.

Wireless Internet Service Provider (WISP)—An organization providing wireless access to the Internet.

Wireless LAN: Wireless local area networks (LANs) using the 802.11 standard are primarily provided in offices as an alternative or extension to a wire-line LAN. Wireless LANs can connect computers, printers, palm pilots and other equipment without the need for network cables.

WLL: Wireless local loop refers to the use of radio access technology to link a customer to a local exchange or service provider. WLL is now used interchangeably with 'wireless access', which the ITU defines simply as "End-user radio connection to a core network." A range of technologies can be used to provide WLL.

Wireless Loop (WL)—A wireless system providing the "last mile" connectivity; that is, the last wired connection between the telephone exchange and the subscriber's telephone set (which can be up to several miles in length). Traditionally, this has been provided by a copper-wire connection.

World Radiocommunication Conference (WRC)—An international conference organized by ITU at which standards and interference issues are discussed at the intergovernmental level.

WCDMA Wideband Code Division Multiple Access- A standard for third generation **(3G)** mobile technology that employs advanced spread spectrum techniques.