Review of the Regulatory, Policy and Competitive Framework of the ICT Sector In Rwanda

Strengthening Legal and Regulatory ICT Framework and Governmental Institutions

Section 3:
Access to Backbone Infrastructure

By

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Glossary of Terms and Abbreviations

TERM	FURTHER EXPLANATION
ADM	Add-Drop Multiplexers
ADSL	Asymmetric Digital Subscriber Line
CDMA	Code Division Multiple Access
CPE	Customer's Premises Equipment
DSL	Digital Subscriber Lines
DSLAM	Digital Subscriber Line Access Multiplexer
EMS	Internet Message
G2B	Government to business
G2C	Government to citizen
G2G	Government to Government
GSM	Global System for Mobile communication
ICT	Information Communication Technologies
IP	Internet Protocol
IPBX	Intranet Private Branch Exchange
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ITU	International Telecommunication Union
IXP	Internet Exchange Point
LAN	Local Area Network
LL	Local Loop
MDF	Main Distribution Frame
MININFRA	Ministry of Infrastructure of Rwanda
OPGW	Optical Ground Wire Cables
ORINFOR	Government owned radio and TV company
PBX	Private Branch Exchange
PIKE	Predominantly Information and Knowledge Economy
PON	Public Optical Network
POTS	Plain Old Telephone Service
PSO	Public Service Organisation
PSTN	public switched telephone network
REGGI	Rwandan Electronic Government and Governance Initiative
RITA	Rwanda Information Technology Authority
ROI	Return on Investment
RURA	Rwanda Utilities Regulatory Authority
RwaSOB	Rwanda Shared Optical Backbone
SCADA	Supervisory, Control and Data Acquisition
SDH	Synchronous Digital Hierarchy
SLA	Service Level Agreement
SME	Small and Medium-size Enterprise
SONET	Synchronous Optical Network
UAF	Universal Access Fund
VoIP	Voice over IP
VSAT	Very Small Aperture Terminal
WB	World Bank
WIMAX	Worldwide Interoperability for Microwave Access

Summary of Recommendations

RECOMMENDATIONS 1

RECOMMENDATION	REASONING
Suggested Approach GOR should note the following options for proceeding with the EASSy Project. 1. proceed, with RwandaTel as the Rwanda partner using its own funds - unlikely to be agreed to by the company's current owners, 2. proceed, with RwandaTel as the partner, but with a special shareholding taken by the GOR to cover the cost of participation in the project – unlikely to be agreed to by the GOR, because it would be investing in a company it would not control, or alternatively would effectively reverse the privatisation so recently completed, it would also be unlikely that the other private companies would see this as a transparent arrangement, 3. encourage the exiting private operators to form a consortium to act for Rwanda - this will be difficult to organise, 4. attaching it to the Electrogaz fibre with similar governance arrangements, when these are finally agreed, 5. setting up a special purpose wholesale only company to manage the investment in the project, this could be either private or government owned or a mixture of the two.	The conditions that existed at the time the EASSy project began no longer exist. Rwandatel is no longer in the state sector and its private owners are unlikely to want to put up Rwanda's contribution to a long-life project. Currently, the only company that has committed finance to the EASSy project is MTN. They would not be happy with RwandaTel being the principal partner in the project, particularly as RwandaTel has not yet committed itself to the project. The principle of separation of networks from services offers a way of addressing this problem. It simplified the issue of interconnection and gives the manager of the facility the incentive to maximise traffic.

RECOMMENDATIONS 2

RECOMMENDATION	REASONING
RwSOB Investment in RwSOB should be guided by the existence of customers. Any investments made in un-served areas where the potential number of customers is small should be handled within the framework of the UAF policy already announced and enshrined in Ministerial Decree No 5 of 15/03/2004 Determining the Functioning of the Universal Access Fund.	The E & M Study is not yet complete. Given the developments in the sector since it began, the GOR should proceed with caution. Rwanda will soon have two or even three nationwide networks offering a full range of services. Cost minimisation (or efficiency of investment), seamless interconnection and high quality services should be the goal.

RECOMMENDATIONS 3

RECOMMENDATION	REASONING
Suggested Approach • After an appropriate process of consultation, the Board of RURA should resolve that all existing licence holders should be issued amended licences as specified in Articles 9 and 22 of the Telecommunications Law. The reissued licences will apply, in an objective and non-discriminatory manner, regulatory changes intended to ensure equal opportunities and effective competition in telecommunications markets in both rural and urban areas, The regulatory changes will be: • That each organisation will receive one licence to govern the operation of wholesale network services, and another to govern the delivery of final customer (retail) services, • The wholesale licence will be completely technology neutral and empower the licensee to use any technology to connect any subscriber with any other subscriber using any electronic or other communication network and connect with any backbone system operating in Rwanda or neighbouring countries, • The retail licence will empower the retail service provider to offer any legitimate retail electronic communications services (i.e. excluding, illegal or immoral services as defined elsewhere), • The Board of RURA will in future issue new telecommunications licences for either, wholesale network ownership, operation and management, or the provision of retail services, but not both. This will apply to both Electrogaz and RwSOB, who will both receive network (wholesale only) • The Board of RURA shall further indicate that its preference will be for existing companies to voluntarily separate their wholesale and retail operations into separate subsidiary companies (or in some other equivalent and appropriate institutional form) and offer wholesale services in an objective and non-discriminatory manner, to ensure equal opportunities for wholesale connection and effective competition for retail services in telecommunications markets in both rural and urban areas, • To that end, the RURA Board will expect that existing operators will adopt accounting systems similar to those described in Article 51 of the Telecommunications Law to apply to dominant organisations. While these provisions are designed to apply to Dominant Organisations and currently no organisation is designated as a dominant organisation RURA will assess the need to designate depending Dominant Organisation based on the performance of the existing operators in terms of independent verification of accounting separation and reported wholesale costs. Wholesale cost information should be disclosed publicly.	The relevant paragraph has outlined the need for assistance in these areas. The primary requirements are: more people and expertise transfer.

RECOMMENDATION	REASONING
• The Board of RURA will engage independent monitors to report regularly on the performance of existing operators in terms of declaring their wholesale network costs and wholesale market offerings. • Wholesale prices will be monitored on an ongoing basis, but there will be neither monitoring or controls of any kind imposed on retail prices, although RURA will reserve the right to investigate retail prices should there be substantial complaints. • The Board of RURA should resolve to review the position in 24 months. If by that time existing companies are operating wholesale and retail operations in separate subs • idiary organisations, such as subsidiary companies and offer wholesale services in an objective and non-discriminatory manner (i.e. on the same terms that they offer them to their own affiliated service operation), there will be no further need for regulatory intervention, • The Hon Minister should indicate that should the powers of the existing act prove inadequate to implement the proposed regulatory scheme, amendments to the Law will be promoted that will ensure that adequate powers exist, but that his preference is for these matters to be resolved by agreement within the current law.	
Consumer Protection • The private sector retail service providers will be encouraged to appoint a retail ombudsman, funded by the private sector but tasked to investigate consumer complaints regarding retail services from individual companies, • Similarly, the private sector will be encouraged to appoint a technology competent consumer advocate to investigate and report on disputes that arise in respect of technological factors are unlikely to be understood by ordinary consumers.	

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2. Introduction

1.1 Background

Government of Rwanda (GOR) policy plans to transform Rwanda into a Predominantly Information and Knowledge Economy (PIKE) within twenty years. There is already a substantial and rapidly expanding Information Communication Technology (ICT) infrastructure in Rwanda. The future shape of the development of the public and private sector infrastructure will depend to a large extent on the extent to which this infrastructure is shared. Shared infrastructure means better utilisation. Better utilisation means lower unit costs. Lower unit costs mean more efficient and more rapid development of business, employment, ending poverty and achieving GOR policy goals.

1.2 Infrastructure

The purpose of this paper is to address the TOR requirement to "Identify key regulatory and policy issues to ensure open access to the national backbone infrastructure, putting particularly the emphasis on in the interconnection/unbundling, licensing, numbering, frequency management, regimes." These are all seen as aspects of access to the backbone.

To assess GOR policy for open access, it is necessary to describe the infrastructure to which access is being sought. The basic configuration of the network is analysed with core components elaborated. Current and anticipated obstacles to access are defined based on discussions with existing and new telecommunications providers. The current regulatory regimes and the effectiveness of provisions designed to promote competitive behaviour and access to essential infrastructure will be reviewed in connection with

1.3 Definitions

It is necessary to define the meaning of the word "backbone" in this context. Backbone telecommunications equipment plays the role that multi-lane inter-city highways or main line railways play in transport. Most modern backbone now comprises lines of fibre optic cables. Backbone capability can also be provided using satellite and wireless systems. To operate, the main highway has to receive traffic and that is what happens in telecommunications backbone infrastructure.

1.3.1 Local Loop

Signals originating in a home or an office travel through the Customer's Premises Equipment (CPE). This term used to refer to equipment placed at the customer's end of the telephone line and was usually owned by the telephone company. Today, almost any end-user equipment can be called customer premise equipment and it will most probably be owned by the customer.

In telephony, the next link in the chain is the "Local Loop" (LL). This is the wired connection from the subscribers' equipment in home or businesses to the telecommunications company's facility. This connection is still usually on a pair of copper wires (called a "twisted pair") although new installations are likely to be fibre.

Twisted Pairs were originally designed for voice transmission using analog technology on a single voice channel. Computer modems make the conversion between analog signals and digital signals. With Integrated Services Digital Network (ISDN) or Digital Subscriber Lines (DSL), the local loop can carry digital signals and at a much higher bandwidth than for voice.

1.3.2 Exchange

The twisted pair leads to a Street Cabinet (sometimes called a Distribution Box). From there, signals are transmitted through secondary cables to a Cross Connection Cabinets and finally

through a Primary Cable to the Main Distribution Frame (MDF). The MDF is a connection point that allows multiple cables from street cabinets, containing multiple signals to be transmitted to a telephone company's exchange through common lines. It is at the MDF that the local loop ends and the Telephone Exchange begins.

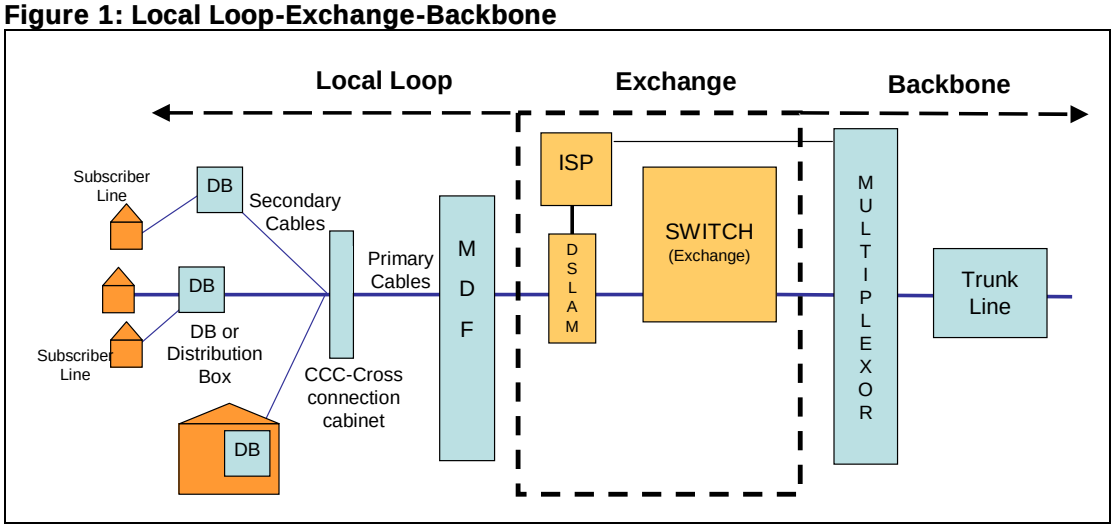
Exchanges were originally sets of operators manipulating cables, dials and plugs. The exchange is now a sophisticated computer. The exchange embodies the intellectual property of the telephone company. It is there that data transmission incurs chargeable services other than data transmission. While everyone in the telecommunications business knows how much it costs to dig a trench, build a tower, install a cabinet or connect CPE, not even the most assiduous regulator will ever find out what a telephone company's exchange costs in terms of software and software development. It is here that value added services are offered: call-blocking, voicemail, small messages, call waiting, call forwarding and the many other services that can now be offered.

1.3.3 Backbone

Subscriber signals transit from the local loop to the exchange through a Digital Subscriber Line Access Multiplexer (DSLAM). Returning signals follow the same path. DSLAMs receive signals from multiple customer DSLs and relay these to the exchange. Once the exchange has resolved the appropriate transmission path (either returning through the local loop or entering the main trunk) another DSLAM (called a Multiplexer) puts the trunk signals on a high-speed backbone line.

The backbone signal is a high-bandwidth, complex signal containing data from all the end users. It may be relayed through wireless, such as microwave circuits, fibre cables, satellites, undersea cables and copper wires. At the other end of the transmission, the individual signals are separated out by means of a circuit called a de-multiplexer and are routed to the proper subscribers. A two-way communications circuit requires a multiplexer/de-multiplexer at each end of the long-distance, high-bandwidth cable. This layout is illustrated in Figure 1.

Figure 1: Local Loop-Exchange-Backbone



A telecommunications network, like a tree, grows off its trunk; the backbone used to be called "the trunk" and long-distance calls were called trunk calls. The backbone carries long-distance, high-capacity, high-speed transmission of massive quantities of data. Access to the backbone is essential for new telecommunications companies. Similarly, no branch of a tree can survive if it does not draw sustenance through the trunk.

Sometimes it is overlooked, that if there is to be competition in the fixed line business, access to the local loop is also very important. Because the local loop links individual subscribers whose usage patterns are uneven during the day the local loop is uneconomic to reproduce.

Competition in telecommunications depends to a large extent on the ability of the subscriber to switch service providers. If one service provider also owns the local loop it has an incentive to deny access to competitors. While wireless technologies are developing fast it is probable that in most systems the local loop network will remain an important feature of the system for many years to come. This matter will be discussed later.

1.4 Policy Objective

With the Rwanda economy undergoing rapid change and with competition among enterprises, there is a tendency for the construction of proprietary networks. Typically these are designed to carry only the owner's calls, including terminations of calls from other networks, although currently there is some sharing of facilities.

Duplication of networks can create excess capacity, due to a limited number of customers, design limitations and the cost of management, maintenance and repairs, which may make service unit costs high. Unused capacity increases the cost of providing network services in two ways: (1) investment takes place above the level necessary to meet consumer demand, increasing the capitalisation of the sector (and lowering the overall rate of return on capital) and (2) by reducing the potential business available to each network below the level used to justify the investment. Both of these effects increase the real cost per unit of transmission and limit the scope for price reductions.

1.5 E & M Capital Assignment

Accordingly, the GOR commissioned E&M Capital to investigate the possibility of an overall design for Rwanda's national backbone network and a clear framework for network infrastructure sharing among multiple stakeholders[1]. E & M are aiming to provide a technical proposal that will result in a network that minimizes the total cost of ownership[2] of the network and meets the service provisioning targets of individual stakeholders. To achieve that goal they want to:

- define a clear framework on sharing network expenditures and revenues among stakeholders,
- an agreement on the sharing of both existing and future network capacity,
- ensure the availability of networking capabilities that meet the service needs of individual stakeholders,
- reusing existing infrastructure as much as possible, with traffic segregation and security and service assurances.

1.6 Comment

Technically there is no impediment to access to backbone facilities, where these are currently accessible. There are significant areas of Rwanda where the lines and connections do not exist at present but the GOR is taking steps to ensure that people can gain access to the telecommunications services. There are strong economic drivers behind this policy. Not only will the national economy benefit but the value of the network increases as more and more parties are connected. Much of the access will be provided by private companies investing their own money and policy should focus on how to maximise the efficiency of this investment.

[1] *Rwanda Shared Optical Backbone* , E&M Capital Corporation, 18-02-06 RwaSOB Project Phase I Report

[2] That is, the sum of the up-front capital expenditure (CAPEX) and the recurring operating expenditure (OPEX).

3. Existing Infrastructure

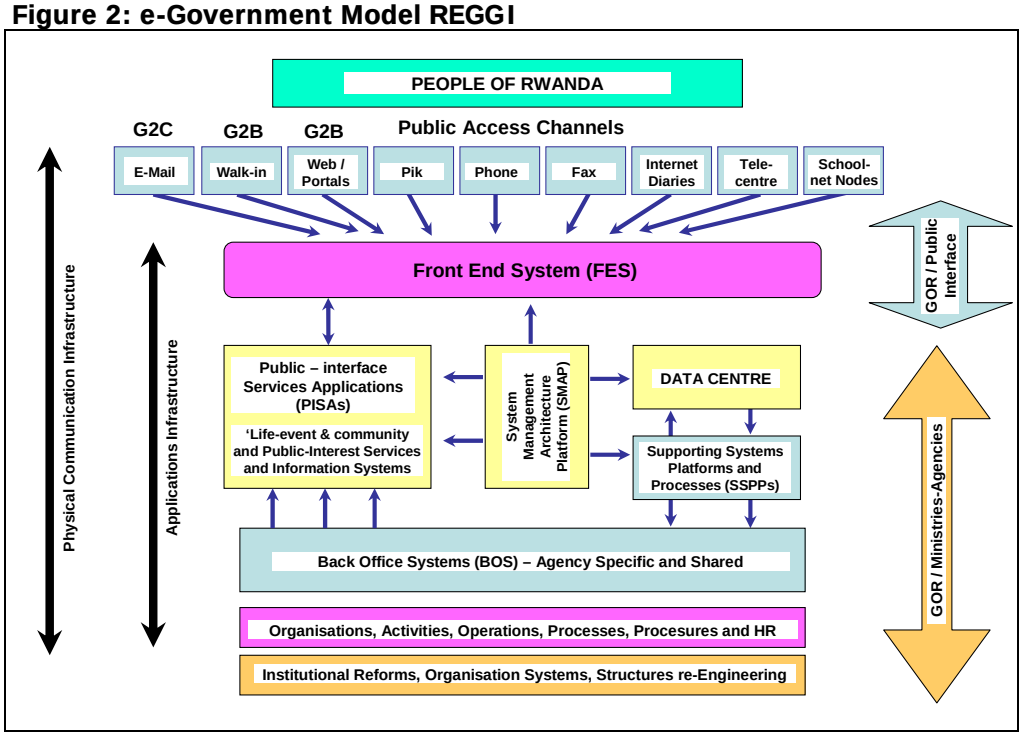
Several government agencies operate their own networks and are planning investments in infrastructure. There are currently three commercial enterprises offering services to the public with commercial networks. There is also an international backbone dimensions

2.1 Government of Rwanda

The GOR recognizes the need for solutions that bring Government closer to the people, assist decentralization and enable universal access to telecommunications services (in some locations access takes precedence over particular revenue earning potential and this intervention is usually conducted through a Universal Access Fund (UAF)).

At the heart of the GOR's plan[3] is the implementation of a fully-functional, citizen-centred and integrated government to citizen (G2C), government to business (G2B) and government to government (G2G) e-government system. The GOR's plans for the future can seen in the e-government model developed by the Rwandan Electronic Government and Governance Initiative (REGGI) and depicted in Figure 2.

Figure 2: e-Government Model REGGI



2.1.1 Networks Operational and Planned

Several developments are currently underway (or identified) to fulfil some of the service requirements of Figure 2. These include:

- **GovNET** – is a private network interconnecting the Local Area Networks (LAN)s of individual government ministries, agencies and various Public Service Organisation (PSO) networks within the Kigali City. Currently, fibre is employed by GOR units in different clusters such as Kaciryu and Umujyi with wireless bridges interconnecting the clusters. Currently the hardware is in place, but the software and system management are not yet in place. Complete end-to-end connectivity between Government units in Kigali and local authorities in the provinces is the next phase planned for GovNET's development.

[3] Much of the material that follows was obtained from the E & M capital report: *RwaSOB Project Phase I Report*, E&M Capital Corporation, 18/02/06

- **Telemedicine Network** – is a backbone network linking national referral hospitals and laboratories throughout the country. Developing the telemedicine network is included in the NICI II plan with the objective of expanding accessibility to health services and enabling unlimited exchange of data between different hospitals. Institutions affected include:

  - University Central Hospital of Kigali,
  - University Central Hospital of Butare,
  - King Faysal Hospital, Kigali,
  - Cyangungu Hospital,
  - National Pharmaceutical Laboratory,
  - Ruhengeri Hospital

- **Education Network** – is a high capacity network linking networks of various higher learning institutions for general research exchanges, administration and e-learning. Affected institutions include:

  - National University of Rwanda, Butare.
  - Kigali Institute of Education, Kigali.
  - Kigali Science and Technology (KIST) University, Kigali.
  - Kigali Health Institute, Kigali.
  - Higher Agriculture and Veterinary Institute, Busogo.
  - School of Finance and Banking, Kigali/Gikondo.

  Private higher learning institutions (about 14) spread across the country are also being considered for inclusion in the Education Network. A similar concept has been adopted in South Africa. The South African Universities Network, provides an Internet backbone that interconnects over 500,000 students and staff at 21 universities and 15 technikons. The World Bank funded School-Net Rwanda initiative, to computerize secondary schools in Rwanda, would most likely rely on wireless internet connectivity.

  Similar networks that cover all service areas are expected to be proposed for the nationwide justice/court system and security forces. Apart from G2B, G2G and G2C systems, the GOR has committed itself to provide connectivity for all and provide affordable infrastructural services.

- **Mount Karisimbi** - the GOR has launched various projects for fibre deployment notably the fibre deployment exercise running parallel with electrification of Mount Karisimbi summit. As of February 2006, a total of over 8 km of ADSS aerial and underground fibre segments had been deployed by the Terracom (the subcontractor). The underground segments run underground through a national park, for safety and environmental reasons. Further segments are expected to be deployed in the Mount Jari area. the GOR's fibre is being shared by multiple stakeholders (ORINFOR, Terracom, MINADEF, MTNRwandacell).

2.1.1 Government Use of Private Networks

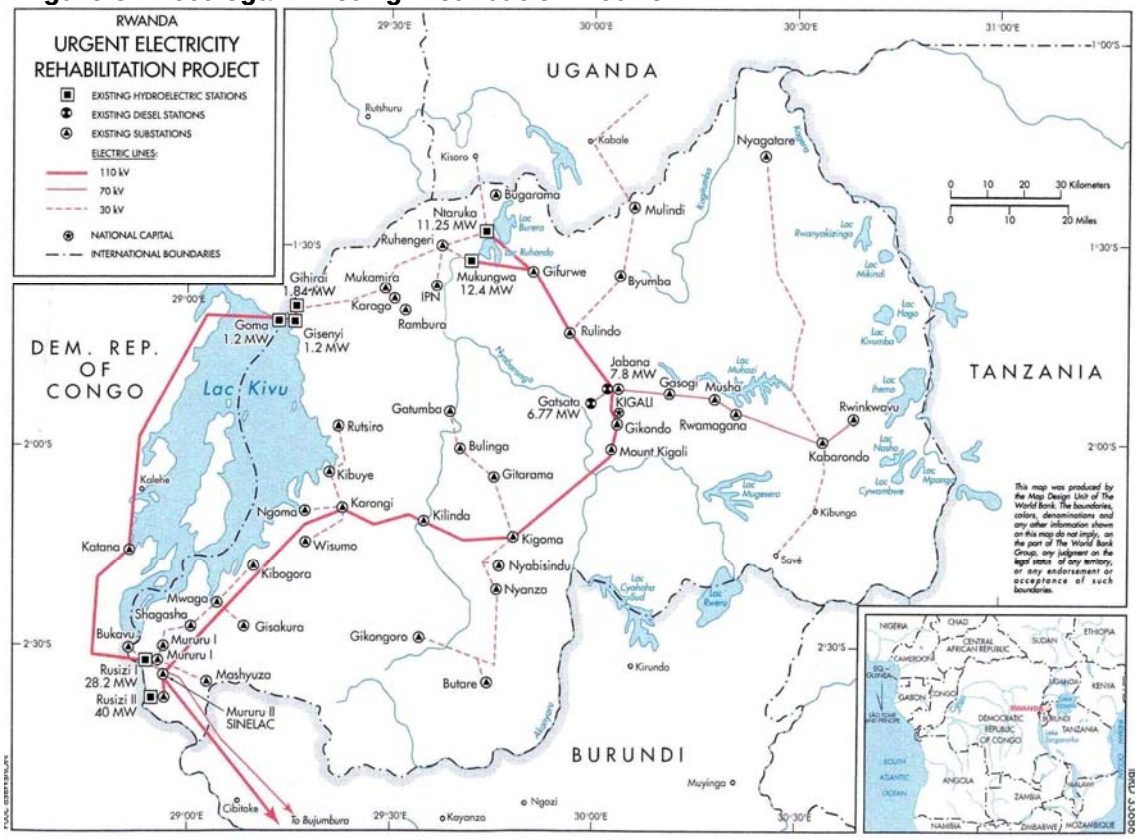
Most of the government units in the Kigali area employ gateway routers to a local provider's fibre network and the international gateway. The PSOs and local governments in the provinces tend to use very small aperture terminals (VSATs) for their low cost and ease of deployment. The principal justifications for private networks are security and the need for capacity above that available to the public networks.

- **ELECTROGAZ** - is the nationwide electric power and water distribution monopoly, fully owned by the GOR. A map of its current distribution network is in Figure 3 and shown diagrammatically in Figure 4.

ELECTROGAZ needs communication among its staff to enable the efficient provision of power and water supply to its customers. Currently there is an Intranet Private Branch Exchange (IPBX) that provides services between the headquarters and eight branch offices.

There is a need for networking to support the performance monitoring and control systems of the power/water transmission and distribution networks. For instance, a Supervisory, Control and Data Acquisition (SCADA) system is planned to span the main power distribution network with technical user interface points at different power stations, substations and control centres.

Figure 3: Electrogaz Existing Distribution Network



Source: Electrogaz, cited in Rwanda Shared Optical Backbone , E&M Capital Corporation

In March 2006 Electrogaz signed a contract based on a technical proposal from Draka Comteq Telecom B. V. The contract depends upon both grant and commercial funding.

The contract will become effective and construction will begin when grant finance has been arranged, non-grant finance has been authorised, the advance payment received by Draka and bank guarantees are arranged.

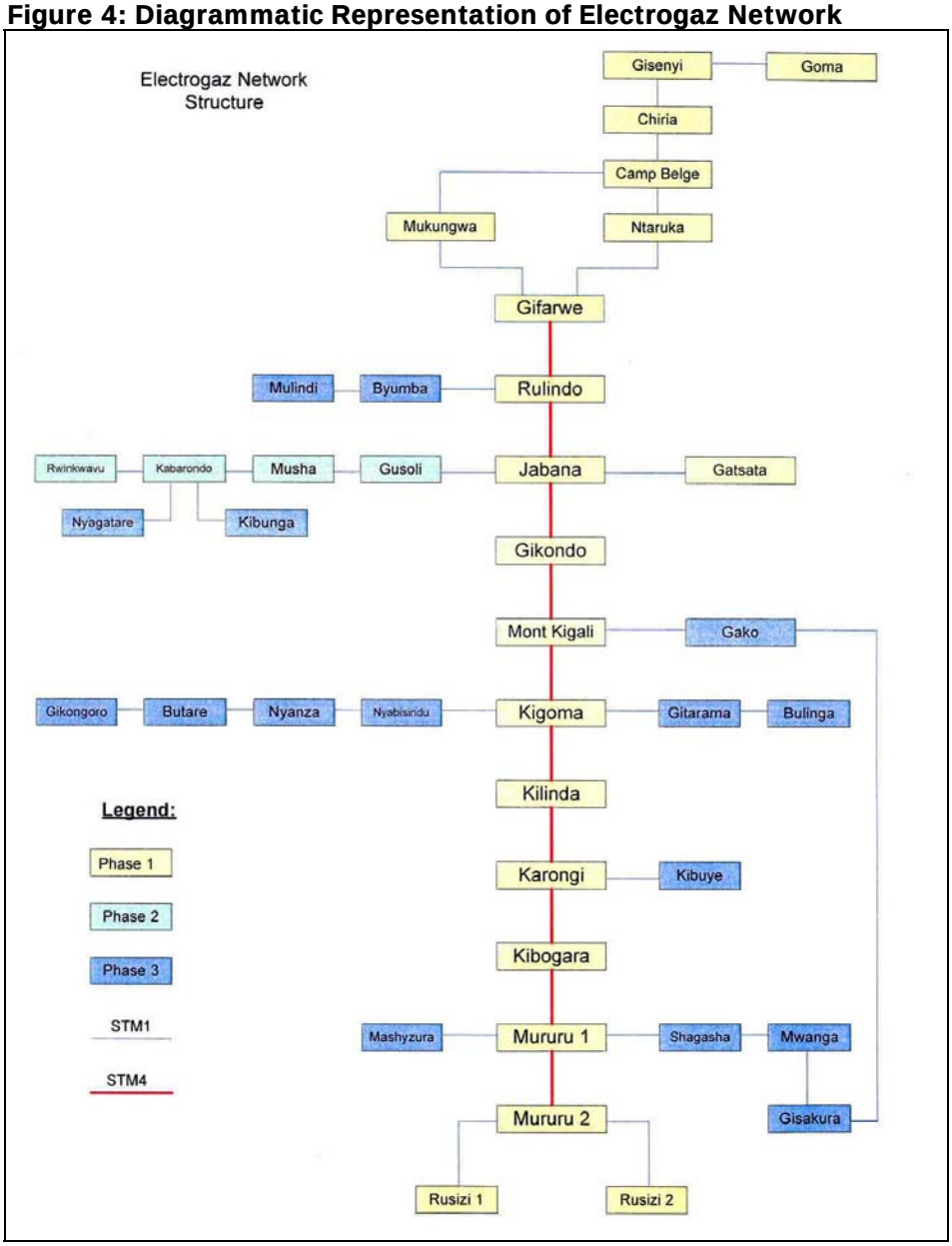
If all conditions are met 825 km of Synchronous Digital Hierarchy (SDH) fibre will be deployed across Rwanda using Electrogaz's power transmission network, shown in Figure 3.

The network will connect twenty one existing power generation plants and all substations, including the control centre at Gikondo. It will provide IPBX telephones and related power supply, also SCADA and Internet Message (EMS) services.

In the proposal, Optical Ground Wire Cables (OPGW) are suggested for the high-voltage (110 kV) routes (from Gifarwe to Mururu II via Mount Kigali stations, total 372 km), while ADSS cables would be placed on the medium-voltage (30 and 70

kV) routes (connected from Gifarwe, Jabana, Mount Kigali, Kigoma, Karongi and Mururu I/II stations, total 404 km).

Figure 4: Diagrammatic Representation of Electrogaz Network

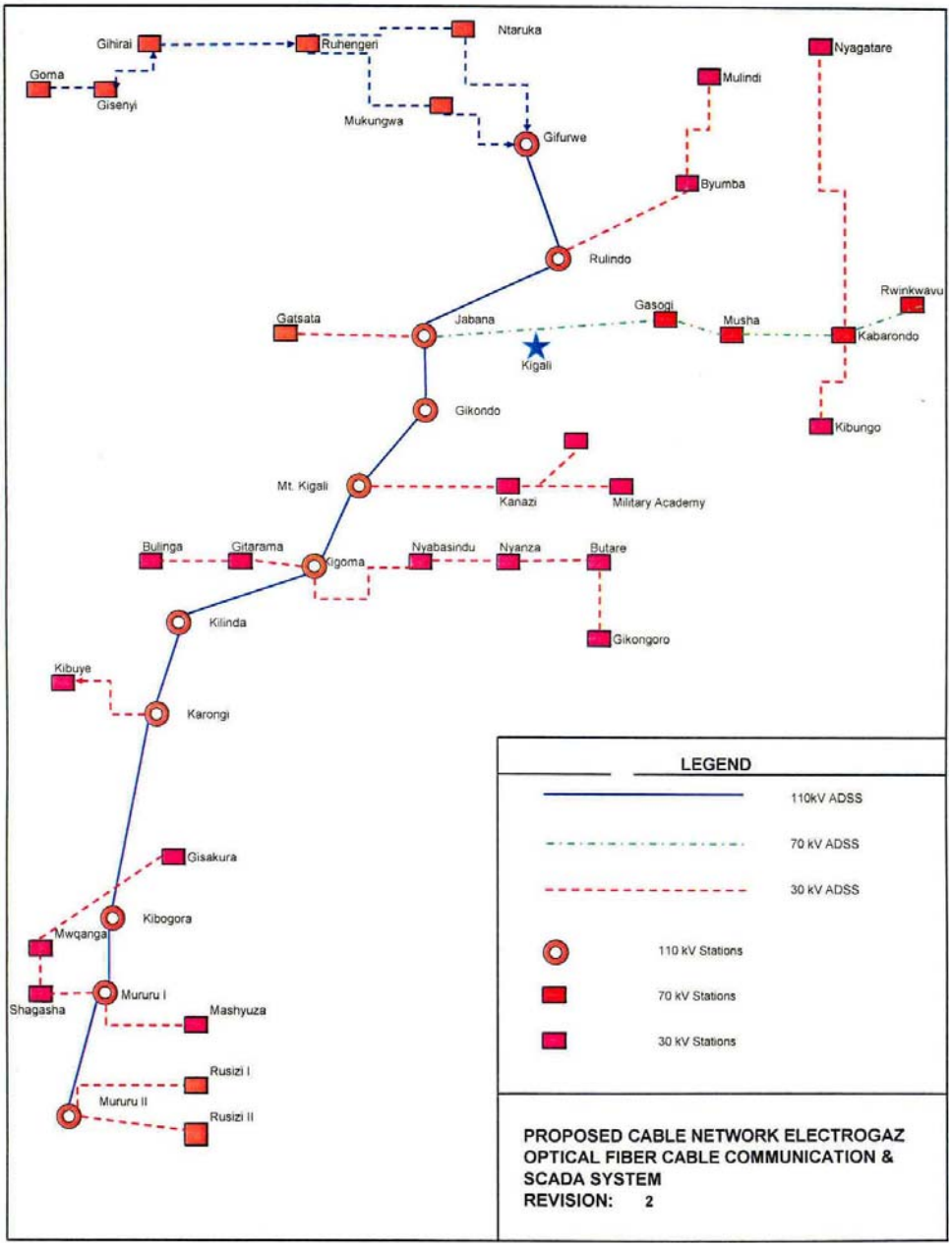


Draka proposes an additional IPBX switch be deployed in Gikondo and the network be extended to cover up to 20 branch offices, including Power over Ethernet switches and/or Internet Protocol (IP) routers at the headquarters and different branch offices and SCADA equipment (possibly with Ethernet interfaces) at different Supervisory, Control and Data Acquisition power stations and substations.

Some 21 spur routes with a total length of 340 km will lead from these main lines to power stations and connect 68 Electrogaz, public service buildings, clinics and universities with 24 fibre optical fibre cable and SDH transmission equipment.

Junctions will be made by Add-Drop Multiplexers (ADM) and the required number of 2 Megbit channels will be dropped and inserted according to the network matrix. Maps of the existing and proposed networks are depicted in Figures Figure 4 and Figure 5.

Figure 5: Electrogaz Fibre Network as Proposed by Draka



2.2 The Private Sector

- **Terracom / RwandaTel -** This company is merger between an Internet Service Provider (ISP) and wholesale data transmission company (Terracom) and the former state-owned public telecommunications network operator, RwandaTel.

  Terracom/RwandaTel has the widest service offering and its components have licenses to offer all service and user types. Terracom's service offerings include[4]:

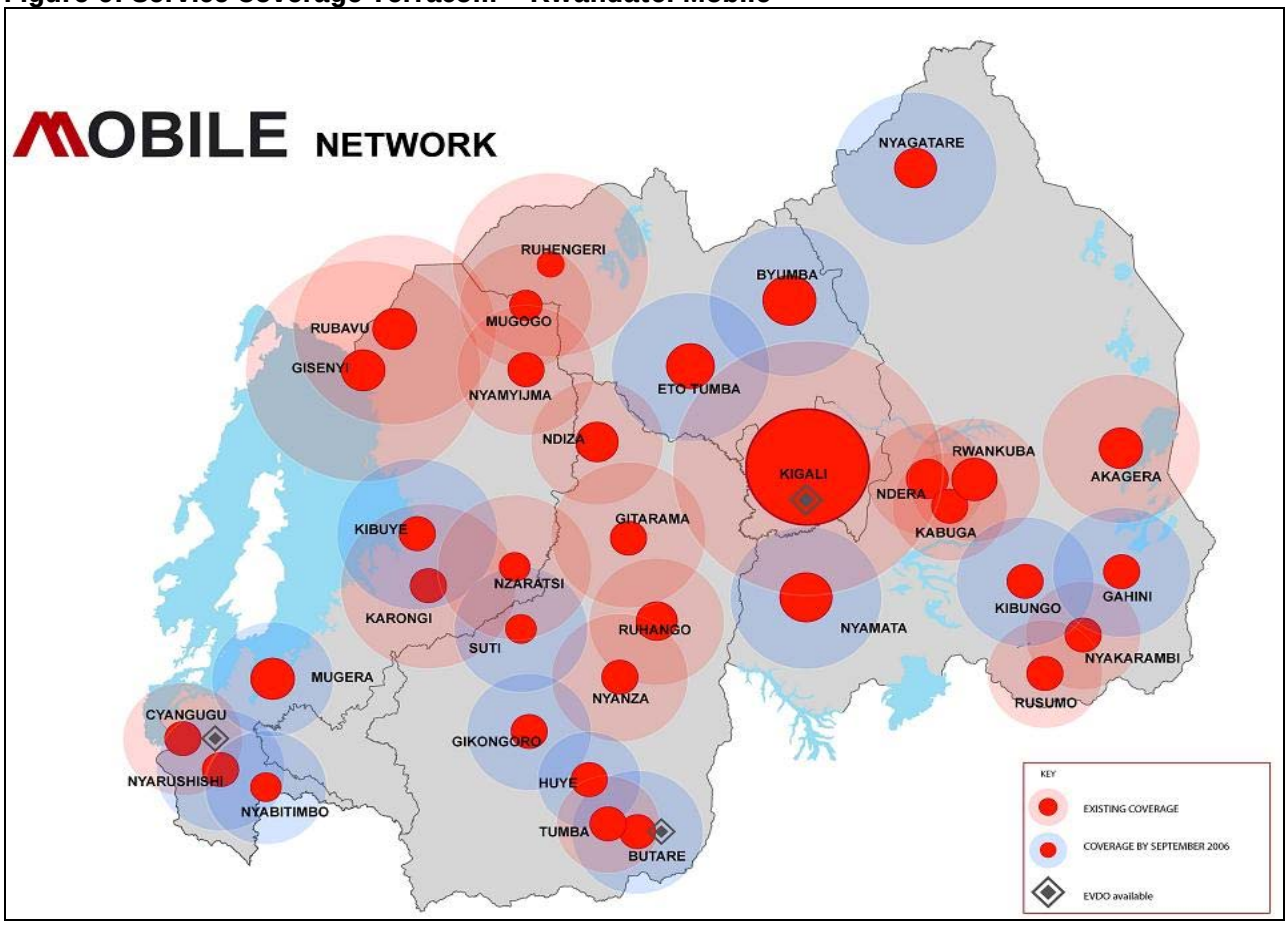
  - Internet access via ADSL (128 to 512 kbit/s downstream), fixed wireless using equipment from Trango Broadband Wireless (128 to 512 kbit/s downstream) and Code Division Multiple Access (CDMA) EV-DO mobile data access (64 to 256 kbit/s),

[4] Technical Information obtained from *Rwanda Shared Optical Backbone* , E&M Capital Corporation, 18-02-06 RwaSOB Project Phase I Report

- private leased circuits using Public Optical Network (PON) based fibre enterprise connectivity, regional microwave links and international circuits via an earth station in Kicukiro,
- basic voice services (over 30,000 users) using fixed lines, Voice Over Internet Protocol (VOIP) and CDMA (EasyCall product) solutions,
- fibre installation services for businesses, Government (e.g. Karisimbi project) and PSOs.

Terracom/RwandaTel's CDMA mobile and CDMA data coverage is illustrated in Figure 6 below.

Figure 6: Service Coverage Terracom – Rwandatel Mobile

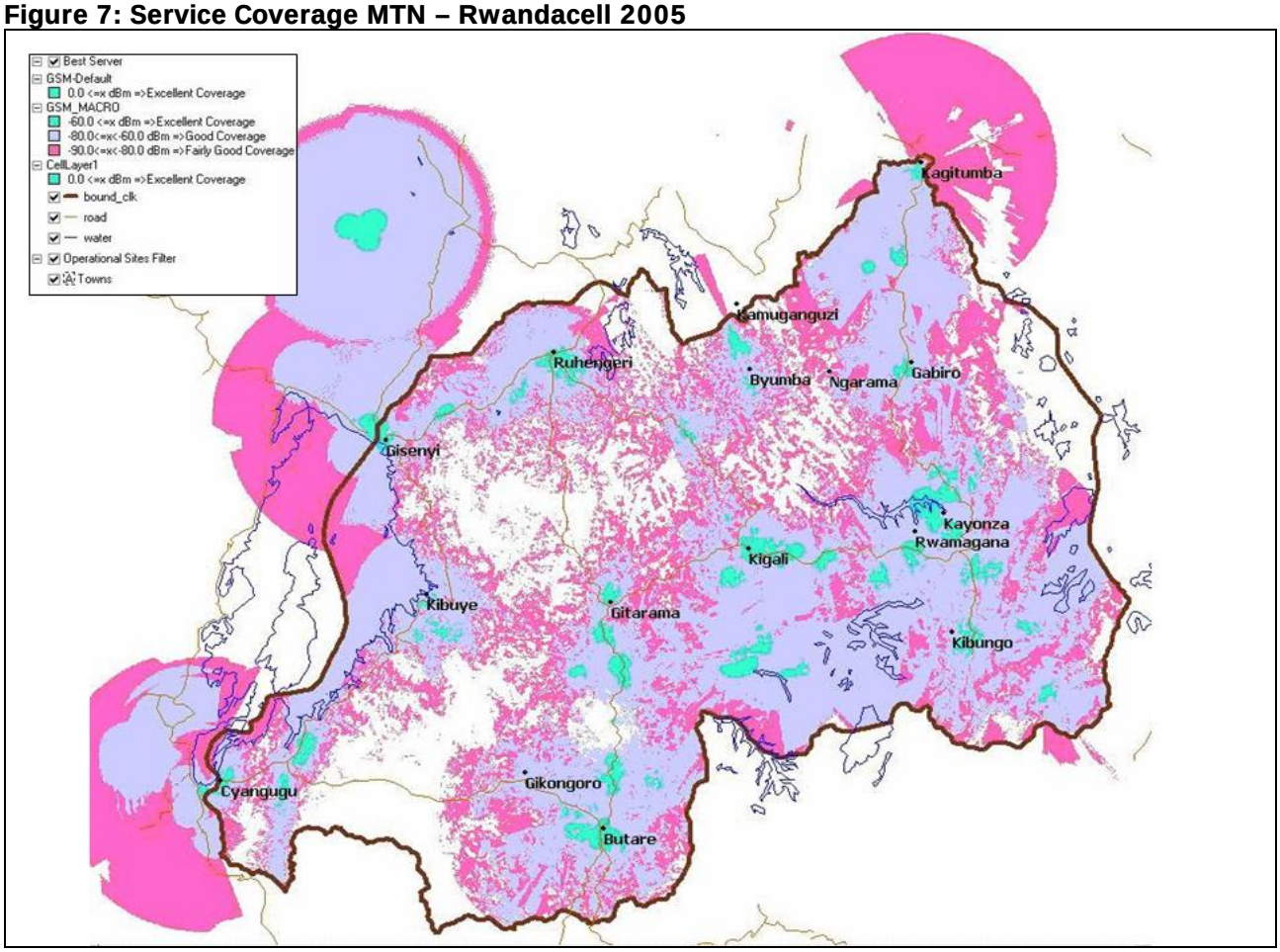


What this map shows is that Terracom – RwandaTel will soon be offering a CDMA voice and data service nationwide and a nationwide data service using EVDO – a broadband data service nationwide that uses the CDMA network.

MTN-Rwandacell – MTN targets residential/private users, business and PSOs with a service offering range that includes:

- mobile Global System for Mobile communication (GSM) (approximately 200,000 users) and Tuvugane/Tel'mbere (about 2500 units) voice services with coverage reaching 90 percent of Rwanda's population.
- microwave leased circuits for Private Branch Exchanges (PBX)s belonging to PSOs (mostly in Kigali area and at UNR Butare),
- GPR (WIMAX) mobile internet connectivity in the near future, and
- an application for a licence to become a full service solution provider is under way.

Figure 7: Service Coverage MTN – Rwandacell 2005



Source: MTN cited in Rwanda Shared Optical Backbone, E&M Capital Corporation Phase I Report

It operates through a nationwide microwave backbone network which aims at 90 percent coverage by the end of 2006, as can be seen in Figure 7. MTN is looking a ring pattern of microwave circuits for increased resistance to network failure. Within the near future MTN will be able to offer nationwide mobile and data services and it aspires to full service provision.

- **Artel International** - Artel International is a private company providing voice, data and IP services and targets unserved rural areas. Artel has deployed over 250 VSAT dishes. It now has a significant presence across Rwanda out of which 10 percent are connected to the internet.

  Most of the VSATs deployed are solar powered IP 1.8m VSATs with larger 3.7m VSATs used in major towns. The user base counted by VSAT number includes:

  - up to 40 businesses in industries such as agriculture and tourism,
  - various PSO that includes 23 health centers and 35 secondary/tertiary schools,
  - up to 61 district level and 88 sector level local Government offices.

  Currently Artel operate telephone services in rural areas using VSAT transmission It already has a full operator's licence. It will soon be offering a broadband service focused on rural areas. It leases microwave circuits from Terracom and MTNRwandacell. Artel expects that the VSATs will be gradually phased out as broadband wireless networks and fibre links proliferate.

2.3 Other

RINEX, is an Internet Exchange Point (IXP) that was specifically designed to establish an Internet Exchange Point in Kigali, Rwanda to allowing peering between ISPs without passing through international links. This enhanced the quality of Internet services and saving bandwidth and money. It has access to international links thereby ensuring access to backbone infrastructure for all providers.

2.3.1 RwSOB

E & M capital were asked to identify the need and outline the design for the development of fibre backbone infrastructure of Rwanda. The E & M Report notes that the layout, coverage, size and technologies used in the proposed new network will be determined by the requirements of the various stakeholders sharing the network.

E & M created a requirements list from interviews with stakeholders detailing their requirements. Specifications and standards were also obtained, but are mentioned in passing only here as the focus is on regulatory and institutional requirements.

At the junction of regulatory and technical requirements are the proposed service standards between the operator of any backbone network and the stakeholders. They must not only be defined in Service Level Agreements (SLAs), but must be honoured[5].

2.3.2 EASSy

EASSy[6] is proposed project to link seven coastal countries in East Africa, including: Djibouti, Kenya, Madagascar, Mozambique, Somalia, South Africa and Tanzania (the "EASSy anchor countries") with a fibre optic cable. In addition, 15 other East African countries[7], including Rwanda, wish to connect to EASSy through terrestrial cables. Rwanda will be connected by the East Africa Backbone System (EABS) shown in Figure 8.

The estimated cost of ESSAy is US$ 300 million and an additional US$ 300 million for the connection of the 15 inland countries. The GOR has agreed to commit US$ 10 million to the project

The initiative will improve the connectivity of the region to the rest of the world for both voice and data communications. Instead of paying high charges for international connection through a transit point, operators in the region can establish direct connections, which promise decreases in operating costs for international telecommunication.

This in turn promises important benefits to the ultimate African consumers and businesses through substantial price reductions for both voice and Internet services. In the longer-run, the benefits of improved connectivity and improved competition will foster the economic and social development of the region through increasing its competitiveness and its attractiveness to foreign investors.

EASSy's main problem for Rwanda is that when the initial designs of the project were being considered RwandaTel was still a state owned entity. It would have been the logical counter part for the project. Now the position is not so clear. In fact, so far MTN is the only party to commit formally to the project.

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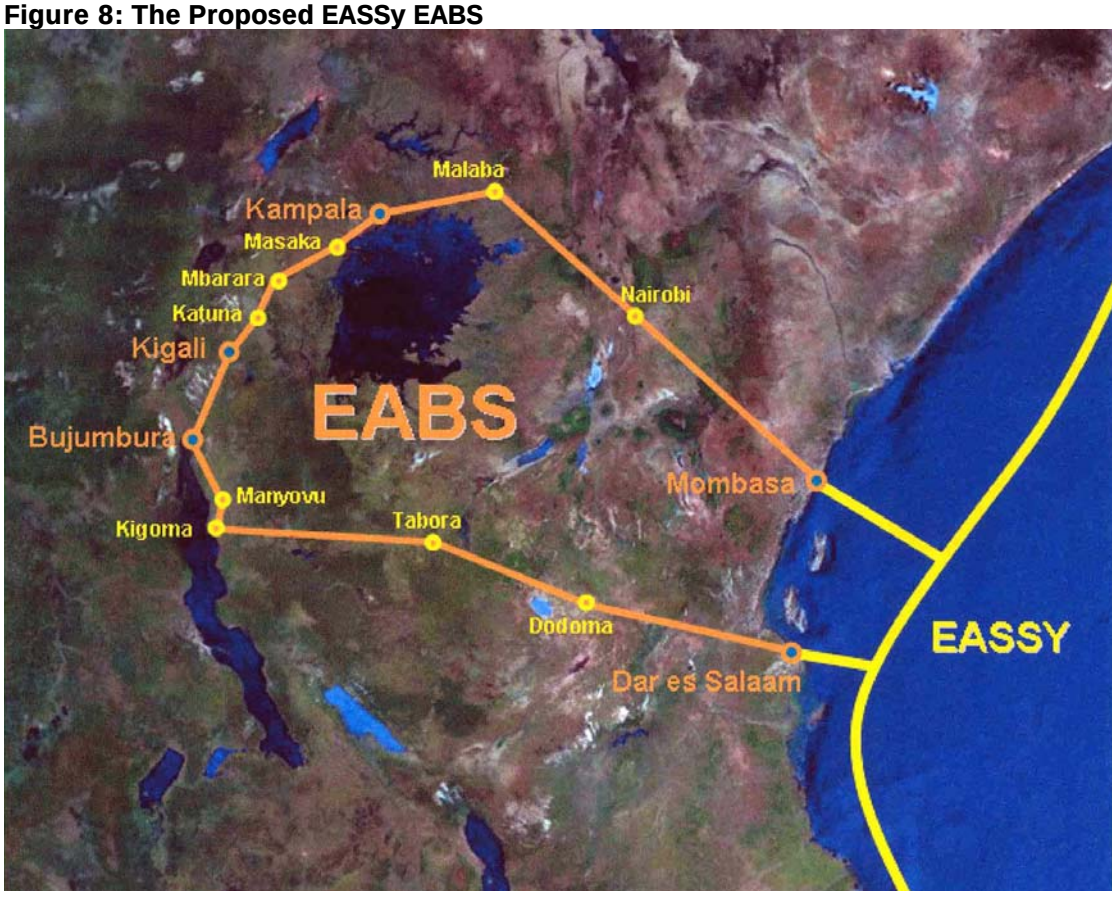
[5] SLAs are expressed as service availability levels (e.g. 99.999 percent, or 5 nines service availability) and end-to-end latency (e.g. delays measured in milliseconds or microseconds). Service availability is directly related to network availability, which is dependent on the availability of network elements (NEs) and redundant fibre paths. The availability is then evaluated based on the mean-time-before-failure (MTBF) and mean-time-to-repair (MTTR) of NEs.

[6] *Identifying key Regulatory and Policy, Issues to Ensure Open Access to Regional Backbone Infrastructure Initiatives in Africa*, Global ICT Policy Division (CITPO), World Bank, P. Hamilton and TeleGeography, 9 December 2004

[7] The 15 interested countries are: Botswana, Burundi, Comoros, Democratic Republic of Congo, Eritrea, Ethiopia, Lesotho, Malawi, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia and Zimbabwe

Figure 8: The Proposed EASSy EABS



Source: EAB survey Form

A number of possibilities exist to resolve this problem, including:

- proceed, with RwandaTel as the GOR partner as originally proposed, but using its own funds - unlikely to be agreed to by the company's current owners,
- proceed, with RwandaTel as the partner, but with a special shareholding taken by the GOR to cover the cost of participation in the project – unlikely to be agreed to by the GOR, because it would be investing in a company it would not control, or alternatively would effectively reverse the privatisation so recently completed. It would also be unlikely that the other private companies, especially MTN would contribute under this arrangement,
- encourage the exiting private operators to form a consortium to act for Rwanda - this will be difficult to organise,
- attaching it to the Electrogaz fibre with similar governance arrangements, when these are finally agreed,
- setting up a special purpose wholesale only company to manage the investment in the project, this could be either private or government owned or a mixture of the two.

Some suggestions made in paragraph 4.3 below may facilitate the use of the last solution.

2.4 RECOMMENDATIONS 1.

RECOMMENDATION	REASONING
Suggested Approach GOR should note the following options for proceeding with the EASSy Project and further, note that that the approach suggested in paragraph 4.3 below will facilitate the option 5. 1. proceed, with RwandaTel as the Rwanda partner using its own funds - unlikely to be agreed to by the company's current owners, 2. proceed, with RwandaTel as the partner, but with a special shareholding taken by the GOR to cover the cost of participation in the project – unlikely to be agreed to by the GOR, because it would be investing in a company it would not control, or alternatively would effectively reverse the privatisation so recently completed, it would also be unlikely that the other private companies would see this as a transparent arrangement, 3. encourage the exiting private operators to form a consortium to act for Rwanda - this will be difficult to organise, 4. attaching it to the Electrogaz fibre with similar governance arrangements, when these are finally agreed, 5. setting up a special purpose wholesale only company to manage the investment in the project, this could be either private or government owned or a mixture of the two.	The conditions that existed at the time the EASSy project began no longer exist. Rwandatel is no longer in the state sector and its private owners are unlikely to want to put up Rwanda's contribution to a long-life project. Currently, the only company that has committed finance to the EASSy project is MTN. They would not be happy with RwandaTel being the principal partner in the project, particularly as RwandaTel has not yet committed itself to the project. The principle of separation of networks from services offers a way of addressing this problem. It simplified the issue of interconnection and gives the manager of the facility the incentive to maximise traffic.

2.5 Comment

The design for a Rwanda Shared Optical Backbone (RwaSOB) network has not yet been completed. The situation in the private sector is changing rapidly and if the Electrogaz contract with Draka is brought to fruition it could drastically alter the requirements of a RwSOB and could even make a whole new network redundant. Similar problems arise with respect to EASSy.

The principal question to be answered is: having extracted itself from investment in telecommunications at the retail level, how far does the government want to go at re-entering the market at the wholesale level? Should the government decide that investment in a RwaSOB is a good idea, another element to be considered is the network sharing model desired by each stakeholder.

Issues that will arise include governance arrangements (including RwaSOB, Electrogaz and the private sector), tariff setting and interconnection arrangements, capital expenditure and/or operating expenditure sharing, shared revenues from leased excess capacity, payment for network transmission services or one-off payments and management arrangements, with options including self-managed, independent carrier-managed provisioning and joint venture arrangements.

In Phase II of the E & M study (network design and financial analysis stage) E & M propose to analyse and compare these options. They will produce a financial model of the available options. However, given the signing of the contract with Draka in March 2006 the parameters of the study have change from when the study began.

Investment in RwSOB should be guided by the existence of customers. Any investments made in un-served areas where the potential number of customers is small should be handled within the framework of the UAF policy already announced and enshrined in Ministerial Decree No 5 of 15/03/2004 Determining the Functioning of the Universal Access Fund.

This study has to deal with the reality is that Rwanda will soon have two or even three nationwide mobile telephone and broadband networks offering a full range of services. The critical issue is to ensure cost minimisation (or efficiency of investment), seamless interconnection and high quality services.

2.6 RECOMMENDATIONS 2.

RECOMMENDATION	REASONING
RwSOB Investment in RwSOB should be guided by the existence of customers. Any investments made in un-served areas where the potential number of customers is small should be handled within the framework of the UAF policy already announced and enshrined in Ministerial Decree No 5 of 15/03/2004 Determining the Functioning of the Universal Access Fund.	The E & M Study is not yet complete. Given the developments in the sector since it began, the GOR should proceed with caution. Rwanda will soon have two or even three nationwide networks offering a full range of services. Cost minimisation (or efficiency of investment), seamless interconnection and high quality services should be the goal.

4. Current Access

3.1 Government

While the proposed development of the sector provides a range of possibilities in the future, the current situation with respect to physical and commercial access is as follows:

- GovNET – so far interconnection arrangements are not in place but when up and running GovNET will require access to backbone infrastructure for national and international services. Actually a private venture, but focused on government services.

- Telemedicine Network – Developing this network is in the NICI II plan. It is not clear which service will finally comprise the network offering. It is anticipated that data transmission over leased lines, or wholesale capacity, will be the main service with limited capability for international traffic. Interconnection will be required but is unlikely to present particular problems.

- Education Network – as a high capacity network linking networks of various higher learning institutions for general research exchanges, administration and e-learning the critical element is bandwidth. Access to the backbone is likely to be commercial and uncontroversial.

- Similar networks to cover all service areas are expected for the nationwide justice/court system and security forces. Apart from Government to Business (G2B). Currently, the government is expected to look at the Elecrogaz network to provide this service and interconnection is unlikely to be an issue.

- Mount Karisimbi - the GOR's fibre is being shared by multiple stakeholders and there appears to be no particular problem of access to either the Terracom or MTN networks. Commercial arrangements have determined relationships so far.

- Electrogaz – Electrogaz's 825 km of fibre infrastructure will be the largest single contributor to the backbone. However, interconnection, governance, commercial arrangements and technical management will determine the extent to which it is used by the private sector. As it will be a wholesale only business there will be an incentive to interconnect with all available customers.

3.2 Private Sector

- Terracom – commercial considerations will lead Terracom to consider leasing circuits from either RwaSOB or Elecrogaz, particularly on main trunk routes. The commercial access arrangements will be the deciding factor. As a company offering both wholesale and retail services has an incentive to market wholesale service, but deny access for competitors to retail customers, particularly across the local loop. The wholesale marketing department will face pressure from the customer services (retail) business to favour their needs over the needs of competitors. Even regulatory provisions requiring access can be frustrated by the inevitable conflict of interests.

- MTN-Rwandacell – to develop services MTN will need to lease circuits in major population centres and lease circuits that close microwave rings, increasing protection against network failure. If high quality SLAs can be relied upon, then the leasing circuits from any provider of backbone services would be commercially attractive to MTN. Currently MTN possesses very little fibre, but will need to install more if access is denied, obstructed or unreliable.

- Artel International - currently, needs to expand the reach of its existing VSATs or configure them into a mesh network by combining the use of VSATs with terrestrial broadband wireless and fibre-optic backbone links[8]. Financial outlay and potential return requirements are critical issues. The option of leasing circuits from any backbone provider is considered feasible. Similar arrangements exist already with microwave circuits leased from Terracom and MTNRwandacell.

3.3 Law on Interconnection

Access is currently required by the Telecommunications Law of Rwanda[9]. In definition 9 of the Law, Interconnection is defined as "reciprocal services (but not necessarily the same services) offered by two operators providing a public telephone service in order to allow all users to communicate freely amongst themselves, regardless of the telecommunications networks to which they are connected or the telecommunications services they use."

3.3.1 Any to Any

This Law enshrines the fundamental principle of telephony: a user of electronic communication must be able to communicate with any other user, no matter what network either is connected to. This ability to interconnect is called "any-to-any connectivity" and is one of the most important features of electronic communication.

To achieve interconnection, competitors must make agreements with other network operators. This gives existing operators the market power to overcharge for interconnection or delay new entry. Interconnection charges that are inefficiently high or negotiations that cause delays for competitors entering the market can result in higher prices for end users.

[8] In rural areas service provision has lower requirements for service and availability as low as 95 percent is tolerable.

[9] Law N° 44/2001 OF 30/11/2001 Governing Telecommunications

New technologies and new networks (e.g. wireless local loop, mobile, WIMAX) are developing that may over time break down some of the market power of incumbent operators. To help overcome this problem, Article 39 requires all public telecommunications operators to interconnect their networks with those of the other operators. If operators cannot reach agreement, any operator may refer the matter to RURA[10]. RURA may impose interconnection terms on both parties if there still is no agreement, thus offsetting some of the market power of the existing operators.

3.3.2 Discrimination

Article 39 also forbids discrimination in matters of interconnection. A public telecommunications operator shall apply similar conditions in similar circumstances to organizations with which it is interconnected and which are providing similar services. Also

3.3.3 Standard Interconnection Offer

Article 40 requires dominant organisations (i.e. the incumbent operator at the time the law was passed) to provide a standard reference interconnection offers that itemises each interconnection facility offered together with the associated terms and conditions within agreement including tariffs. Each offer should be approved and published by RURA. A similar provision exists in the RURA Law (Article 49).

So far no Standard Interconnection Offer has been provided to RURA under this Article, because no operator has been designated as a dominant organisation[11]. Operators requiring interconnection are entitled to rely solely upon the reference interconnection offer and related requirements. The contents required to be included in the offer are elaborated in Ministerial Order N° 5/DC/04 OF 07/06/2004, Chapter IV Articles 11-13.

3.3.4 No distortions

Article 41 (1) requires that any differentials in charges, terms and conditions offered by a public telecommunications operator do not result in distortion of competition. 41 (2) requires operators apply the same charges terms and conditions to their own subsidiary or affiliated companies as they offer to other public telecommunications operators. 41 (3) requires that all dominant organizations operate a cost accounting system to enable them to identify the costs associated with interconnection. The proviso in footnote 11 above applies to this issue as well.

3.3.5 Composition of Agreements

A Ministerial Order[12] (regulation) requires that "the general conditions and pricing principles in Interconnection Agreements should be freely worked out by operators through negotiations." Article 4 requires that all Interconnection Agreements shall specify:

"(i) the circumstances in which each party will be obliged to provide Interconnection,
(ii) the terms and conditions for re-negotiation of the Agreement,
(iii) commercial relations including billing, recovery procedures and payment,
(iv) rules concerning transfers of essential information,
(v) terms for modification of the Agreement ;
(vi) conditions for transfer of the parties' rights and obligations ;
(vii) liability and compensation between the parties."

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[10] In the Law Reference is made to the Regulatory Board, but this was replace by Article 7 of LAW N°39/2001 of 13/09/2001 Establishing an Agency for the Regulation of Certain Public Utilities

[11] RURA Annual Report 2004 (section II), reported Decision n° 02/2004 of 9 September 2004 that declared RWANDATEL dominant operator in the field of fixed telephony and RWANDACELL in the field of mobile telephony. However, in an unpublished decision a few days later this decision was rescinded.

[12] N° 5/DC/04 OF 07/06/2004 on the General Conditions and Pricing Principles to be Respected in Interconnection Agreements

Article 5 of the same Order requires specification of the interconnection services provided, including, measures to ensure users' equal access to the different networks and services, format standardization, and number portability, health and security, electromagnetic compatibility between telecommunications equipment and installations, proper use of the radio frequency spectrum etc.

3.3.6 Keeping Accounts

So that RURA may intervene on an informed basis, Article 10 requires that all Operators keep accounts allowing them to identify the following different types of costs:

(i) network costs related to users and costs related to interconnection services,
(ii) costs attributable specifically to these services alone,
(iii) costs specific to services other than Interconnection, alone.

This information must be made available to RURA on request. Overall network costs are divided between the costs of Interconnection services and the costs of other services on the basis of the actual use of the entire network by each of these services. Assessments must be undertaken annually and communicated to RURA.

Article 14 requires that pricing shall be shall be cost-oriented and "sufficiently unbundled" so that the applicant is not required to take or pay for any facility not strictly related to the service requested. Unbundling is discussed in more detail in 5 below.

Article 23 places a complete ban on restricting access to public networks or public telecommunications services except in the circumstances authorised by the Article. These include when catastrophic conditions prevail. Operators must make every endeavour to maintain the highest level of service on the public networks. Any necessary restrictions on access to networks or the provision of services, shall only be in proportion to the harm suffered by the network. Discrimination even under catastrophic conditions must be on purely objective grounds.

The Law is even more specific when in Article 37 it creates an obligation to lease lines on a non-discriminatory basis. Information on the tariffs charged for leased lines must also be provided to RURA. This is reinforced by Article 48 that creates a obligation to share facilities, for reasonable financial consideration. The terms of sharing should be determined in the first instance by negotiation, but RURA has a role to play in resolving disputes.

3.4 Comment

What is clear is that the law facilitates access to backbone infrastructure. In the Developing World, Rwanda's law is one of the most clearly favourable to third party access to infrastructure, infrastructure sharing and access to the backbone network. The fact that neither of the two principal operators is designated as a dominant operator does not seem to be any impediment to RURA obtaining information from the operators. While the principal focus of regulation is the Backbone Infrastructure, the provisions seem sufficiently broad to require access to the local loop as well.

5. Unbundling,

4.1 Definition

Unbundling is a term increasingly used in telecommunications literature to describe structural separation of predominantly monopolistic elements of a telephone company from those elements that are predominantly competitive. The purpose of unbundling is to improve the transparency of operations and to facilitate improved access to essential backbone facilities.

Telecommunications is one examples cited in an OECD paper on Structural Separation in Regulated Industries[13].

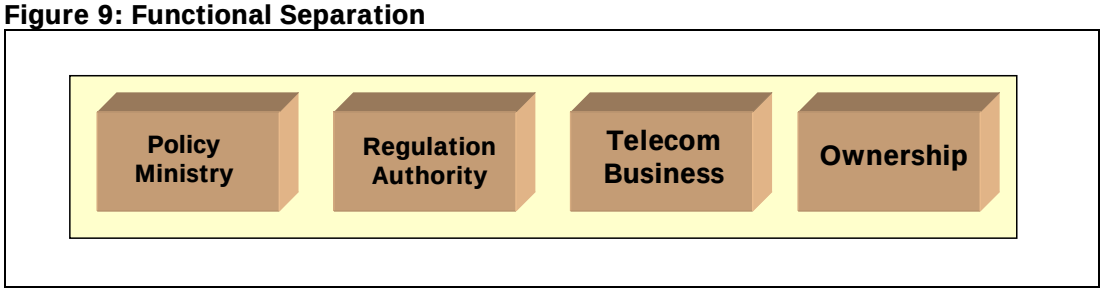
4.2 The Law

In Rwanda Article 29 of the Telecom Law requires that Tariffs are "sufficiently unbundled," so that users of services are not obliged to pay for facilities not required. Similarly, in Article 40, charges for interconnection should be sufficiently unbundled for the same reason. Unbundling is, therefore about transparency so that users may know what they are paying for an only pay for what they need. It is necessary to briefly review why unbundling is an issue in telecoms.

4.2.1 Functional Separation

The use of structural separation as a regulatory tool can be illustrated by two diagrams. Telecom businesses usually began in the private sector, but eventually became part of the state sector[14]. In the state sector they were often treated as ministries and policy, regulation, business management and ownership were in the same agency. This was justified because they were considered "natural monopolies." In order to subsidise loss making services telecom companies needed to overcharge elsewhere. It could only do this without competition or it would lose profitable services to a competitor.

Figure 9: Functional Separation



Source: DBA

From the early 1980s it was realised that transparency and efficiency increased if the Policy Regulatory and Ownership functions were separated into different agencies, so called "Functional Separation." This helped ensure that governments received all competing streams of advice. The government can then make the critical decisions rather than officials. Functional Separation is illustrated in Figure 9.

This configuration is appropriate where the business is a state owned, integrated business, without competition. However, from the mid 1980s it was appreciated that competition in telecommunications led to improved performance as in other sectors. Not only was improved performance possible, but it facilitated the development of new services and technologies.

There was also a growing realisation that there were better ways to deliver uneconomic services than grant a monopoly. Indeed the idea of an uneconomic service was becoming less and less of an issue as new technologies pushed out the hinterland of economic service provision.

4.2.2 Different Businesses

What was also apparent was that the old system of licensing technologies was not only at odds with this model: it inhibited competition, delayed the entry of new technology, increased costs and delayed the introduction of cost saving innovation. Accordingly, many countries now licence neutrally. The easiest way to do this is to have two basic types of licence: services and network infrastructure. Although some countries (Tanzania and Malaysia) separate network ownership and operation into two different licences the principle is the

[13] Organisation for Economic Co-operation and Development, DAFFE/CLP(2001)11, 10 April 2001.
[14] And in many cases were bundled with the post office although this was never the case in Rwanda.

same: services are distinct from network infrastructure and network operators should be allowed to use any technology they deem appropriate for their needs.

Figure 10: Different Businesses

	Network Company	Service Company
Product Life	long	short
Complexity	low	high
Information	public	private
Risk	low	high
Return	low rate	high rate
Best Investor	low risk pension fund	high risk venture fund

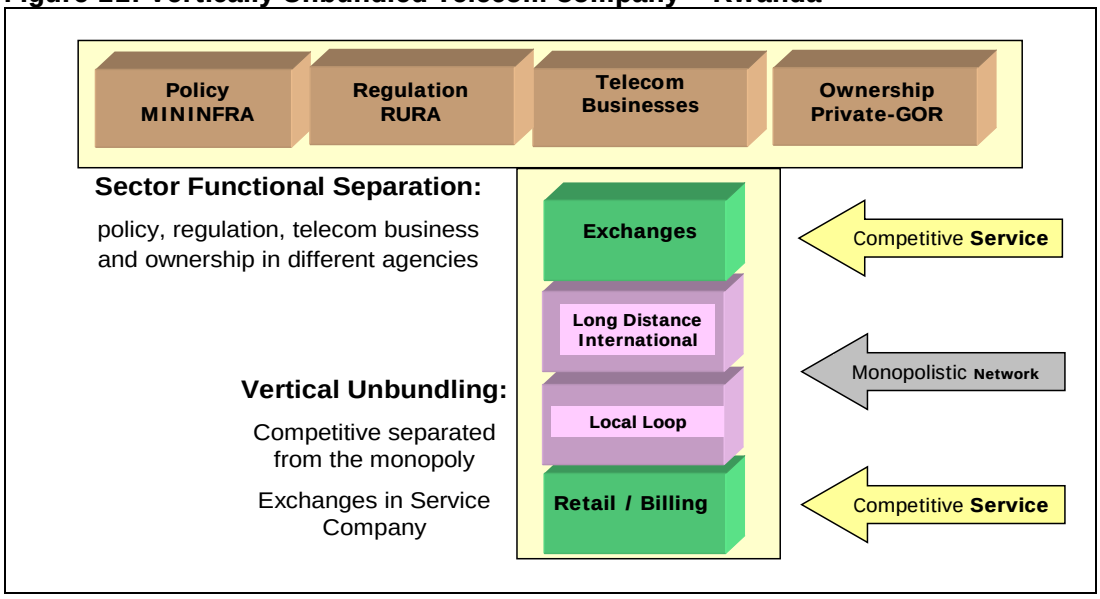
Source: GGI Wellington

There is a rational basis for this approach. Figure 10 shows how the different characteristics and risk profiles of network management on the one hand and operating a customer services business on the other mean that different owners are appropriate. The analysis can be taken further. An infrastructure business will generally sell for 10 times annual earnings, as it is expected to last a long time. By contrast a service business will sell for as little as 4-5 times earnings, because it faces so many more business and technology risks. If the two are added together the combined risk drives down the value of the combined business.

4.2.3 Vertical Unbundling

A further structural solution to a regulatory problem has come with the increased attention to vertical unbundling as a solution to the natural monopoly problem. Functional Separation introduced some transparency by removing policy, regulation and ownership issues from a single entity. However, it was realised that the only truly "natural" monopolies are the backbone network and the local loop. These are natural monopolies because they are expensive to reproduce (although costs are falling).

Figure 11: Vertically Unbundled Telecom Company – Rwanda

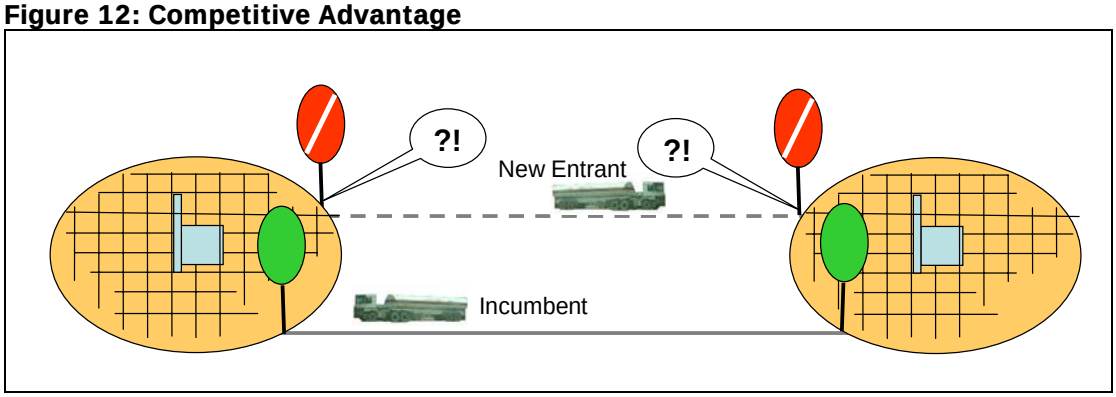


Source: DBA

Accordingly, new competitors require access to the backbone and the local loop if they are to compete. If an incumbent company controls both the network and the largest service business there is a large financial and institutional incentive for the services division to put pressure on the network managers to deny or delay access to the network to competitors. This delays competition to the detriment of consumers. Conventional regulation using the law to change the behaviour of companies[15] has generally failed to modify these incentives.

This leads to regulators looking at the telecom sector the same way that we look at roads, airports or other network industries. In these, generally only the network is regulated. Focusing regulation on the network has many advantages in terms of simplification of regulation, greater transparency and changing incentives. Accordingly, telecom companies (sometimes under regulatory pressure) have been reorganising themselves to cope with vertical unbundling. This sees the competitive and network aspects of the businesses placed in different businesses. It is illustrated in Figure 11.

Figure 12: Competitive Advantage



Source: DBA

4.3 Possible Solution

In paragraph 4.2.3 above it is noted that "If an incumbent company controls both the network and the largest service business there is a large financial and institutional incentive for the services division to put pressure on the network managers to deny or delay access to the network to competitors." This is usually expressed as companies seeing their ownership of their network as their competitive advantage.

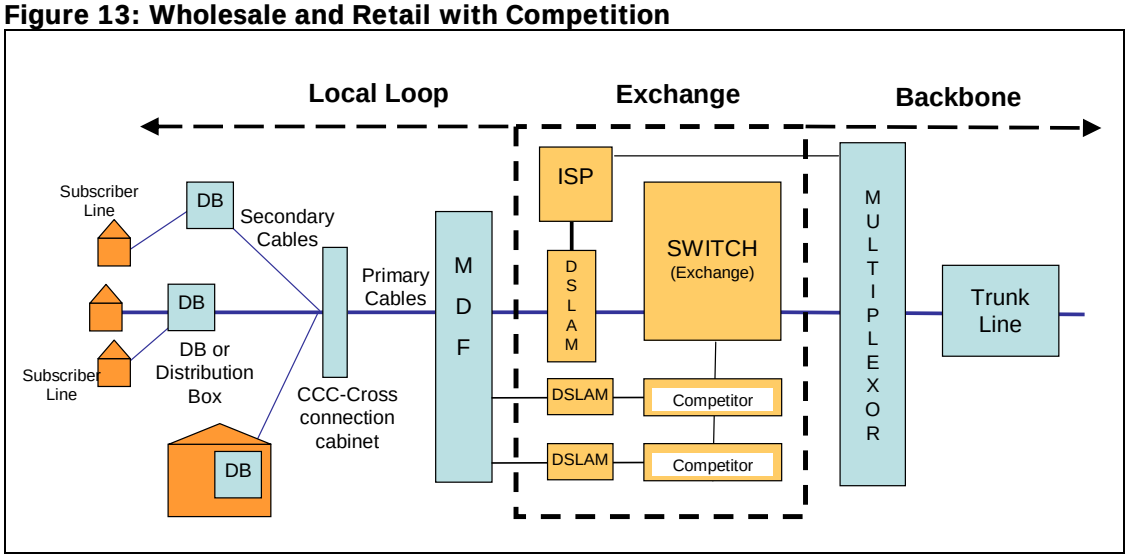
The application of this principle to road transport is illustrated in Figure 12. However, the countries that allow private road construction do not allow one company to use its ownership of the roads to deny access to roads by competitor transport companies.

In essence then, the issue is distinguishing wholesale from retail. By distinguishing the two businesses not only is there increased transparency, the need for regulation is minimised. The costs of network infrastructure are well known and easily calculated. They are the principal cost of relevance in interconnection and the separation can simplify interconnection negotiations. New entry by competitors is facilitated.

The main reason for the change is that wholesale companies are indifferent as to whose data they carry and have an incentive to maximise throughput. If the wholesale company owns the building occupied by the exchange (but not the exchange itself) it is easy for new entrants to place their switch alongside the incumbents and all they will need is a delivery contract with the wholesale provider. This is illustrated in Figure 13, which is identical to Figure 1, except the switches of new entrants are included.

[15] Often called "Behavioural Regulation"

Figure 13: Wholesale and Retail with Competition



Source: DBA

4.4 Comment

Vertical unbundling, or wholesale-retail separation, offers a potential solution to the issues raised in respect of appropriate governance arrangements for Electrogaz and RwSOB. The GOR can resolve to reorganise its own entities in this fashion and create some incentives for the private sector to do likewise. If the GOR creates open access to its backbone infrastructure and allows the private sector a substantial say in how it is managed there is an incentive to economise on investment.

In this way the incentives in the sector are changed dramatically. Instead of infrastructure owners having an incentive to deny access to competitors they have an incentive to increase the throughput of data from any source and reduce unit transmission costs. Retailers will have an incentive to focus on their customer needs and not seek to hide any failings by denying access to competitors.

Increased throughput, reduced costs and improved customer services are clearly the appropriate policy focus in Rwanda. Conventional approaches to regulation, which focus on penalties for denying access, do not address these issues. Incentives are preferable to penalties. An appropriate transition path should include the points contained in paragraph 4.5:

4.5 RECOMMENDATIONS 3.

RECOMMENDATION	REASONING
Suggested Approach • After an appropriate process of consultation, the Board of RURA should resolve that all existing licence holders should be issued amended licences as specified in Articles 9 and 22 of the Telecommunications Law. The reissued licences will apply, in an objective and non-discriminatory manner, regulatory changes intended to ensure equal opportunities and effective competition in telecommunications markets in both rural and urban areas, The regulatory changes will be: • That each organisation will receive one licence to govern the operation of wholesale network services, and another to govern the delivery of final customer	The relevant paragraph has outlined the need for assistance in these areas. The primary requirements are: more people and expertise transfer.

RECOMMENDATION	REASONING
(retail) services, • The wholesale licence will be completely technology neutral and empower the licensee to use any technology to connect any subscriber with any other subscriber using any electronic or other communication network and connect with any backbone system operating in Rwanda or neighbouring countries, • The retail licence will empower the retail service provider to offer any legitimate retail electronic communications services (i.e. excluding, illegal or immoral services as defined elsewhere), • The Board of RURA will in future issue new telecommunications licences for either, wholesale network ownership, operation and management, or the provision of retail services, but not both. This will apply to both Electrogaz and RwSOB, who will both receive network (wholesale only) • The Board of RURA shall further indicate that its preference will be for existing companies to voluntarily separate their wholesale and retail operations into separate subsidiary companies (or in some other equivalent and appropriate institutional form) and offer wholesale services in an objective and non-discriminatory manner, to ensure equal opportunities for wholesale connection and effective competition for retail services in telecommunications markets in both rural and urban areas, • To that end, the RURA Board will expect that existing operators will adopt accounting systems similar to those described in Article 51 of the Telecommunications Law to apply to dominant organisations. While these provisions are designed to apply to Dominant Organisations and currently no organisation is designated as a dominant organisation RURA will assess the need to designate depending Dominant Organisation based on the performance of the existing operators in terms of independent verification of accounting separation and reported wholesale costs. Wholesale cost information should be disclosed publicly. • The Board of RURA will engage independent monitors to report regularly on the performance of existing operators in terms of declaring their wholesale network costs and wholesale market offerings. • Wholesale prices will be monitored on an ongoing basis, but there will be neither monitoring or controls of any kind imposed on retail prices, although RURA will reserve the right to investigate retail prices should there be substantial complaints. • The Board of RURA should resolve to review the position in 24 months. If by that time existing companies are operating wholesale and retail operations in separate subsidiary organisations, such as subsidiary companies and offer wholesale services in an objective and non-discriminatory manner (i.e. on the same terms that they offer them	

RECOMMENDATION	REASONING
to their own affiliated service operation), there will be no further need for regulatory intervention, • The Hon Minister should indicate that should the powers of the existing act prove inadequate to implement the proposed regulatory scheme, amendments to the Law will be promoted that will ensure that adequate powers exist, but that his preference is for these matters to be resolved by agreement within the current law.	
Consumer Protection • The private sector retail service providers will be encouraged to appoint a retail ombudsman, funded by the private sector but tasked to investigate consumer complaints regarding retail services from individual companies, • Similarly, the private sector will be encouraged to appoint a technology competent consumer advocate to investigate and report on disputes that arise in respect of technological factors are unlikely to be understood by ordinary consumers.	

6. Numbering Plans

Chapter X and Article 45 of the Rwanda Telecom Law relate to Numbering. Under Article 45 RURA must investigate the possibility of number portability use in Rwanda or elsewhere and submit a yearly report to the Minister responsible for telecommunications. The Law also required the President, by decree, to set out RURA's responsibilities with respect to numbering.

RURA must not discriminate between telecommunications operators when assigning numbers. It is required also to act at all times in an open, transparent and objective manner. Operators can only allocate the number ranges that have been allocated to them.

5.1 The Issue

Telephone numbers have great economic and public interest significance. For example, a company that is allocated a number that is simple to remember has a competitive advantage compared with other companies (think of the difference between 388-888 and 326-437)

In a competitive environment, with more than one company vying for business, a new entrant telephone company allocated insufficient numbers will find it hard to develop business. In years gone by, there were examples of incumbents that retained control of the numbering plan and tried to require competitors' customers to dial a code, like a long distance code to gain access to the new network. This was designed to frustrate competition.

In terms of access to the international backbone, the International Telecommunication Union (ITU) assigns signalling point numbers for the international signalling network[16] CCS7. Finland, for example, with some 2.9 million fixed telephone lines and 3.4 million mobile

[16] SS7 is the international standard for the common channel signaling system. SS7 defines the architecture, network elements, interfaces, protocols, and the management procedures for a network which transports control information between network switches and between switches and databases. The North American version is also sometimes referred to as CCS7.

phones has 48. This range of numbers is a scarce resource. The total amount of such numbers world-wide is fixed and cannot be increased unless the signalling system CCS7 is replaced or a similar change is made to CCS7.

Each new international operator needs its own number. This restricts the amount of new international operators in Rwanda. If numbers are not available new operators cannot join the network or will have to share with an existing network.

5.2 National Plans

For economic and development reasons, national signalling network numbering may need similar administration, even if national numbering is not a bottleneck. In essence a telephone numbering plan allows subscribers to make and receive telephone calls across long distances. The area code is that part of the subscriber's telephone number specifies a telephone exchange system.

Numbering plans assign area codes to exchanges, so that subscribers may dial telephones outside their local area. Area codes usually indicate geographical areas. Numbering plans and area codes enable telephone calls to be directed to particular regions on a public switched telephone network (PSTN). Termination of the call is carried out by the local network.

It is each country's responsibility to define the numbering within its own network[17]. Traditionally telephone numbering related only to telephone networks. Increasingly, other telecommunications numbering exists, for example CCS7 numbering, Internet TCP/IP numbering such as the BBC DNS number 212.58.226.29 and domain names based on text addresses such as rita.rw).

One purpose of numbering is for telephone numbers to tell citizens about the charging of calls. For this purpose the first digit often tells whether the call is a local call, or has some kind of special charging, such as mobile, long-distance or international.

Another purpose is to ease routing of calls. Dialled telephone numbers are instructions to the telephone exchanges for routing purposes. The following are the conventions that have been adopted by many jurisdictions:

- first digit 0 - is usually allocated for calls outside the local call area, or calls outside the subscribers mobile operator's network. Examples are national and international long distance calls and calls to mobile telephones.

- first digit 1 is usually allocated to special service calls or special codes such as operator selection for local or national long distance codes (where there is call-by-call selection on the user side of the network termination point).

- first digits 2, 3, ... 9 are used for ordinary telephone numbers or services charged as normal local telephone calls. This means that calls starting with 2, 3 etc. are charged as ordinary local telephone calls. Special services are usually excluded from these numbering blocks. These numbering blocks can be used for calls to Internet, paging, direct dialling-in into PABXs, etc. when local calls.

Currently in Rwanda only three operators have numbers: MTN Rwandacell is using two numbers starting by 03 and 08. Rwandatel /Terracom is using numbers starting by 2, 5 and 05 and Artel is using the 06 number range. Other numbers are still free for future usage

The ITU promotes common standards among nation states. However, numbering plans take different formats in different parts of the world and are difficult and expensive to change. For example, the ITU recommended that member states adopt 00 as their international

[17] Many of the technical details that follow draw on analysis from a Discussion Paper by Arno Wirzenius, during his ITU mission to Cambodia on Telecommunication Regulations, in April, 2001.

access code. However, the United States, Canada, and other countries and territories participating in the North American Numbering Plan have not adopted this practice.

5.3 Impact of Plan Hierarchy

In a multi-operator environment a numbering plan is usually done on two levels:

- regulatory plan, the regulator assigns blocks of numbers to operators, and
- operator plan, each operator plans utilisation of assigned numbering blocks.

Number extension (from six to seven digits for example) is a regulatory decision and not part of the operator numbering plan. Currently Rwanda's fixed lines use six digits and mobile lines use eight. Interconnection agreements should provide for operators to co-operate and notify each other routing of calls to different interconnection points. RURA should not need to intervene in routing matters.

All operators are obliged to maintain their own numbering plans within these ranges. Operators need to take account of the need for future expansion, including reserves for in-dialling into PABXs, which consume considerable numbering capacity. They are also obliged to inform other operators as relevant on call routing to different Points of Interconnect, if relevant, in accordance with their interconnection agreements.

5.4 Number portability

When a customer moves from a place served by one exchange to another, or changes operator, the traditional practice has been to receive a new number. This may cause many inconvenience. Modern technology gives the possibility to avoid that. Call forwarding and other technical solutions are available. Many industrialised countries have already imposed mandatory number portability. As was noted in paragraph 2 above, the law of Rwanda places a high priority on moving to number portability.

5.5 Comment

While there are many important issues in numbering and numbering plans, there is no evidence at the present that numbering is a significant issue in respect of access to the backbone infrastructure. Number portability is not yet a reality in Rwanda as this does require some investment by the incumbent companies and they see it as not in their interests to make an investment that result in fewer customers.

7. Radio Frequency Spectrum

The radio spectrum is an important resource managed by the RURA on behalf of the people of Rwanda. The efficient use of this resource to provide telecommunications and broadcasting services is essential to the functioning of a modern economy.

6.1 Spectrum in Rwanda

Similar Issues apply in respect of the Spectrum as apply in respect of Numbering. However, it should be noted that while in most of Europe and North America spectrum is a very scarce resource, currently in most of Africa it is an abundant resource. In most countries use of the spectrum is still in the early stages of exploitation. RURA drafted a TOR for consulting assistance in 2003 but so far none has been fielded. The only policy in existence was drafted for use by NGOs and other services. It is specific for frequency band between 147 to 176 Mghz, but this is not a general policy. Spectrum policy usually takes one of two forms: administrative distribution and some kind of market linked allocation system.

6.1.1 Administrative Licensing

Under administrative licensing, frequency bands are allocated to various services in accordance with international practices, technical standards and policy directives. Persons wishing to utilise frequencies in accordance with these plans apply for a Licence for which a licence purchase fee and an annual fee are charged. These fees would cover any costs incurred by the RURA in the administration of the system, should one be set up.

6.1.2 Tradable Rights

An alternative method of allocation of spectrum is through tradable long-term leases for lengthy periods, up to 20 years. In such a system the law must provide for a Management Right over the range of frequencies concerned (e.g. 88MHz to 108MHz). The GOR would retain the Management Right and grant Spectrum Licences to frequencies within the band, as is the case with most radio and television broadcasting bands. Except for frequencies reserved to meet specific public policy objectives Management Rights and Spectrum Licences should then be allocated through public spectrum auctions or tenders.

In order to increase the efficiency of usage there should also be the right to sublet the use of the Spectrum. Technology is developing fast and more and more data can be transferred through narrow and narrow bands of spectrum. The right to use this spectrum should be transferable to other parties, provided the subletting of the resources is notified to the register. In this way central control and ownership is retained, but flexibility and economic benefits are maximised.

6.2 Radio Frequency Register

A public register, is required to record creations, transfers, cancellations, mortgages and caveats, in regard to management rights and spectrum licences. Radio Licences can also be recorded in the register. Such a register could also perform a vital role in the co-ordination and engineering of new licences.

6.3 Comment

Currently the RURA is responsible for the allocation of spectrum. However, it has virtually no capacity to discharge this function. It needs to develop enhanced capability in terms of:

- Spectrum Policy and allocation,
- registration and access to spectrum, through Radio and Spectrum Licensing,
- compliance and enforcement,
- interference resolution, quality assurance and standards,
- spectrum band plans and use forecasts, and
- international relationships.

Tradable long-term leases to spectrum combine the benefits of enhanced efficiency of use with retaining ultimate government control. This is an issue that must be addressed in Rwanda at some stage. The main requirement is to ensure that decisions taken now do not foreclose options that will be attractive later. However, there is no evidence that RFS is a barrier to access to the backbone network although with the emphasis on the transition to a knowledge based economy planning now can result in big benefits later.

RECOMMENDATION	REASONING
RFS Allocation	

RECOMMENDATION	REASONING
• Radio Frequency Spectrum Allocation should be by the allocation of tradable (sub-let or sub-leasing) long-term leases for lengthy periods, up to 20 years. • The law should provide for a Management Right over the range of frequencies concerned, the GOR would retain the Management Right and grant Spectrum Licences to frequencies within the band, • Except for frequencies reserved to meet specific public policy objectives Management Rights and Spectrum Licences should then be allocated through public spectrum auctions or tenders.	Tradable long-term leases to spectrum combine the benefits of enhanced efficiency of use with retaining ultimate government control. This is an issue that must be addressed in Rwanda at some stage. The main issue is to ensure that decisions taken now do not foreclose options that will be attractive later. There is no evidence that RFS is a barrier to access to the backbone network although with the emphasis on the transition to a knowledge based economy planning now can result in big benefits later.

8. Conclusion

GOR has a policy of open access to the national telecommunications backbone infrastructure. To assess the impact of current infrastructure, legal provisions and market environment on this policy the regulation of interconnection / infrastructure unbundling, licensing conditions, numbering plans and access to radio frequency spectrum have all bee assessed.

The basic configuration of the network was analysed with core components elaborated. Technically there is no impediment to access to backbone facilities, where these are currently accessible. There are significant areas of Rwanda where the lines and connections do not exist at present but the GOR is taking steps to ensure that the access to the backbone is enhanced. Not only will the nation and the economy benefit, but the value of the networks increase too.

It is also is clear is that the law facilitates access to backbone infrastructure. Rwanda's law is one of the most clearly favourable to third party access to infrastructure. The fact that neither of the two principal operators is designated as a dominant operator does not seem to be any impediment to RURA obtaining information from the operators. While the principal focus of regulation is the Backbone Infrastructure, the provisions seem sufficiently broad to require access to the local loop as well.

Vertical unbundling offers a potential solution to the issues raised in respect of appropriate governance arrangements for Electrogaz RwSOB and EASSy. The GOR can resolve to reorganise its own entities in this fashion and create some incentives for the private sector to do likewise. In this way the incentives in the sector are changed dramatically. Instead of infrastructure owners having an incentive to deny access to competitors they have an incentive to increase the throughput of data from any source. Service companies have an incentive to focus on their customer needs and not seek to hide their failings by denying access to competitors. This is clearly an appropriate policy focus in Rwanda and conventional approaches to regulation cannot tackle a complex situation like this with anything like the simplicity and benefits.

While there are many important issues in numbering and numbering plans, there is no evidence at the present that numbering is a significant issue in respect of access to the backbone infrastructure. Currently the RURA is responsible for numbering plans and the allocation of spectrum. However, it has virtually no capacity to discharge these functions. It needs to develop enhanced capability in terms of Policy and allocation, registration and access to spectrum, compliance and enforcement and other critical capabilities.

However, there is no evidence that RFS is a barrier to access to the backbone network although with the emphasis on the transition to a knowledge based economy planning now can result in big benefits later.

Appendix 1: Technical Explanations

See: http://searchnetworking.techtarget.com/sDefinition

IDF - Intermediate Distribution Frame

IDF also stands for interface device. An intermediate distribution frame is a free-standing or wall-mounted rack for managing and interconnecting the telecommunications cable between end user devices and a main distribution frame (MDF). For example, an IDF might be located on each floor of a multi-floor building routing the cabling down the walls to an MDF on the first floor. The MDF would contain cabling that would interconnect to the phone company or to other buildings.

MDF – Main Distribution Frame

The MDF a connection point that allows multiple cables from IDFs, containing multiple signals for transmission through to a telephone company's exchange to use common lines. Multiple MDFs connect through to telephone company facilities where they are transmitted through DSLAMs to the switch or telephone exchange.

Multiplexor

Is a communications device that multiplexes (combines) several signals for transmission over a single medium. A demultiplexor completes the process by separating multiplexed signals from a transmission line. Usually a multiplexor and demultiplexor are combined into a single device capable of processing both outgoing and incoming signals. A multiplexor is sometimes called a mux and also spelled as multiplexer.

DSLAM

A DSLAM (Digital Subscriber Line Access Multiplexer) is a network device, usually at a telephone company central office, that receives signals from many individual multiple customer Digital Subscriber Line (DSL) connections and puts the signals on a high-speed backbone line using multiplexing techniques. Depending on the product, DSLAM multiplexers connect DSL lines with some combination of asynchronous transfer mode (ATM), frame relay or Internet Protocol networks. When the phone company receives a DSL signal, an ADSL modem with a Plain Old Telephone Service (POTS) splitter detects voice calls and data. Voice calls are sent to the PSTN, and data are sent to the DSLAM, where it passes through the ATM to the Internet, then back through the DSLAM and ADSL modem before returning to the customer's PC. The more DSLAMs a phone company has, the more customers it can support. DSLAM enables a phone company to offer business or homes users the fastest phone line technology (DSL) with the fastest backbone network technology (ATM).

TDM Multiplexing

Time-division multiplexing (TDM) is a method of putting multiple data streams in a single signal by separating the signal into many segments, each having a very short duration. Each individual data stream is reassembled at the receiving end based on the timing. The circuit that combines signals at the source (transmitting) end of a communications link is known as a multiplexer. It accepts the input from each individual end user, breaks each signal into segments, and assigns the segments to the composite signal in a rotating, repeating sequence. The composite signal thus contains data from multiple senders. At the other end of the long-distance cable, the individual signals are separated out by means of a circuit called a demultiplexer, and routed to the proper end users. A two-way communications circuit requires a multiplexer/demultiplexer at each end of the long-distance, high-bandwidth cable.

A typical analog Internet connection via a twisted pair telephone line requires approximately three kilohertz (3 kHz) of bandwidth for accurate and reliable data transfer. Twisted-pair lines are common in households and small businesses. Major telephone cables, operating between large businesses, government agencies, and municipalities, are capable of much larger bandwidths. For example a long-distance cable is available with a bandwidth allotment of three megahertz (3 MHz). This is 3,000 kHz, so in theory, it is possible to place 1,000 signals, each 3 kHz wide, into the long-distance channel. The circuit that does this is known as

a multiplexer. It accepts the input from each individual end user, and generates a signal on a different frequency for each of the inputs. This results in a high-bandwidth, complex signal containing data from all the end users. At the other end of the long-distance cable, the individual signals are separated out by means of a circuit called a demultiplexer, and routed to the proper end users. A two-way communications circuit requires a multiplexer/demultiplexer at each end of the long-distance, high-bandwidth cable.

WIMAX

WiMAX is defined as “Worldwide Interoperability for Microwave Access.” The WiMAX Forum was formed in April 2001 to promote conformance and interoperability of the standard IEEE 802.16, also known as WirelessMAN. The Forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL."

The WiMAX Forum is an organisation dedicated to certifying the interoperability of Broadband Wireless Access products. It defines and conducts conformance and interoperability testing to ensure that different vendor systems work seamlessly with one another. Those that pass conformance and interoperability testing achieve the “WiMAX Forum Certified” designation.