INTERNATIONAL TELECOMMUNICATION UNION

The Future of Voice

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New Initiatives Programme

THE FUTURE OF VOICE IN AFRICA

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1   INTRODUCTION

This paper draws on a report written by the author called African VoIP Markets[1] that looks in greater detail at some of the issues covered.

This paper seeks to identify the changes that VoIP has made in how the African telecoms and Internet sectors operate and looks forward to the new developments that will flow from the transition to IP. Africa has become one of the first developing world continents where major markets have been opened up to the legal use of VoIP. Therefore its experience as a continent has relevance to other countries struggling with the challenges VoIP poses.

The paper has four sections that cover the following:

Section one looks at the impact of VoIP as a disruptive technology in Africa, covering: how grey markets have provided surrogate competition to established operators; the fall in international calling prices; the arrival of PC-to-PC calling.

Section two looks at the changing market and policy context that led to the introduction of legal VoIP. It looks at: how VoIP went from being a threat to something that will be embraced; different ways of looking at what legal VoIP means; experiences from "early adopters"; and issues to be considered for protecting consumers in a VoIP future.

Section three discusses the kinds of changes that the wider transition to IP is bringing about. It looks at: changing market models; the birth of the African VoIP service provider; the technical transition among African carriers; and the realities of convergence in Africa.

Section four concludes with a look at the broader implications of the African experience in terms of: changing industry practices; VoIP peering; and concluding with a summary of the changes needed for future development.

For shorthand purposes, the term incumbent operator is used to refer to the incumbent telephone company or what is sometimes referred to as the historic operator.

2   BACKGROUND CONTEXT

VoIP has been in use in Africa for international calling at least 8 years and has recently been legalised in a significant number of countries. In a few short years VoIP in Africa has gone from being seen as a threat to the existing order to something that is now viewed as an inevitability. For the majority of Africa's policy-makers and regulators, the discussion is now not about if but how they can legalise VoIP.

VoIP is part of the broader transition to IP networks happening globally that has gathered momentum over the last five years. As a major technical change, it raises significant challenges for those involved. One of the main drivers for change has been cost as IP networks offer cost-savings. The level of cost-savings may be a matter of some debate but few doubt that there is some level of cost savings in building new networks or replacing legacy equipment. Another cost-related driver of the transition is also the ability to shift all forms of traffic on to a single network.

Beyond VoIP's claimed cost advantage is its ability to offer a range of converged services, bringing together voice, data and images. Like all technology changes, it has thrown up the opportunity for new services like "push-to-talk" and integrated cellular and WLAN networks. In the particular context of Africa, some of these will be relevant and successful, whilst others will fall by the wayside.

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[1] http://www.balancingact-africa.com/publications.html

Taken together with lower cost forms of wireless delivery, VoIP has already and can in the future offer African operators significant opportunities both to do things in more cost-effective ways and to do things differently.

But VoIP's main impact has been as a lightning rod for some of major changes taking place in the liberalisation of telecoms services globally. At this international level, VoIP traffic is often described as "by-pass" or "lost" traffic but this traffic has driven the development of new service providers both in the developed and developing world. These VoIP service providers have contributed to lowering the cost of international calling from Africa, something that has made Africa globally more competitive for new business areas like call centres.

Taken together with IP networks, VoIP offers the potential for creating new market structures that can simultaneously encourage local investment <u>and</u> deliver lower cost voice and data services to consumers. Some African countries have taken the first steps down this road and therefore this report can only be seen as a first draft of African telecoms and Internet history as it is being made.

3 VOIP AS A DISRUPTIVE TECHNOLOGY IN AFRICA

3.1 Grey markets as surrogate competition

African VoIP grey markets have provided a form of largely invisible, surrogate competition to the protected monopolies of the continent. Whatever the rights and wrongs of the operation of these markets, they have kept the pressure on all carriers to lower their international prices. Although the scale of grey markets varies considerably, it is in nearly all cases of considerable scale (see table below). As a result, it is now possible at the time of writing this report to call the main international destinations from a significant number of countries for under US25 cents a minute: for example, calls to main international destinations from Nigeria are US16 cents a minute.

Box 3.1: Examples of Grey Market revenues as a % of overall international call revenue	
Overall average	20-30%
Cameroon	30%
Lesotho	17%
Sierra Leone	47%
Equatorial Guinea	20%

Note: Incumbent and Balancing Act estimates

Price arbitrage has been the basis for this competitive challenge. Arbitrage is a term used to describe a situation where one buys at a cheaper price in one market to sell at a higher price in another. The growth of VoIP for international calling has been built on the wide gap between retail and wholesale calling prices in many parts of both the developed and developing world. These differences are a function of the uneven introduction of competition in voice markets around the globe.

In Africa for example, it may cost an individual caller (at the retail rate) between US50 cents and US$1 to call Washington DC but the same call is bought by the incumbent operator (at the wholesale rate) for between US1-3 cents. Where this circumstance exists, incumbent operators are able to maintain high margins because they either have monopolies or limited competition.

But although the grey market provides surrogate competition to the telco incumbent and mobile operators, it does so within a set of constraining factors. If a grey market operator gets too big, it is liable to come to the attention of the authorities and have some form of action taken against it. Also in some cases, incumbent operators have sought to come to terms with larger grey market operators and sell them minutes at an agreed price.

In some countries, the grey market operators face different levels of attempts to clamp down on them. This might vary from physical raids and confiscation of equipment in places to filtering of traffic to make VoIP calling difficult if not impossible. In a limited number of cases the jail penalties for VoIP calling are as severe as for drug smuggling but even under these circumstances a considerable number of minutes go through the grey market. Despite all of these constraints, the grey market has continued to flourish although at very different levels in different countries.

Many incumbent operators are going through the process of "rebalancing" their tariffs in line with the costs of providing services and to compete with the grey market. In the pre-competition days, high international rates were used to cross-subsidise rates on domestic networks. With competition in the largest voice markets having driven down international rates, and as various operators are mandated by law to ensure that tariffs are rebalanced within a given period, this business model is unlikely to be sustainable.

3.2   The fall in international calling prices

The retail price of international calling is a key factor in determining the level of competition from the grey market. An analysis of international retail calling prices from Africa over the last two years (2005 and 2006) can be used to illustrate the overall trend. Destinations chosen for the analysis reflect the most popular destinations according to the international language in use: so for example, for Francophone countries it uses France and for Anglophone countries the UK and the USA.

The headline story is very clear: prices have fallen rapidly in a wide range of countries across the continent. In order to fill in where data is missing, the price analysis is grouped into three tiers: top band (US$1 or over); middle band (US25 cents to US0.99 cents); and bottom band (US0.25 cents or below). On this basis, in 2005 there were 47 out of 54 countries and territories that were charging US$1 or over. In 2006, there are only 19 countries charging US$1 or over and 27 charging between US25-99cents.

Figure 3.1: African international retail rates
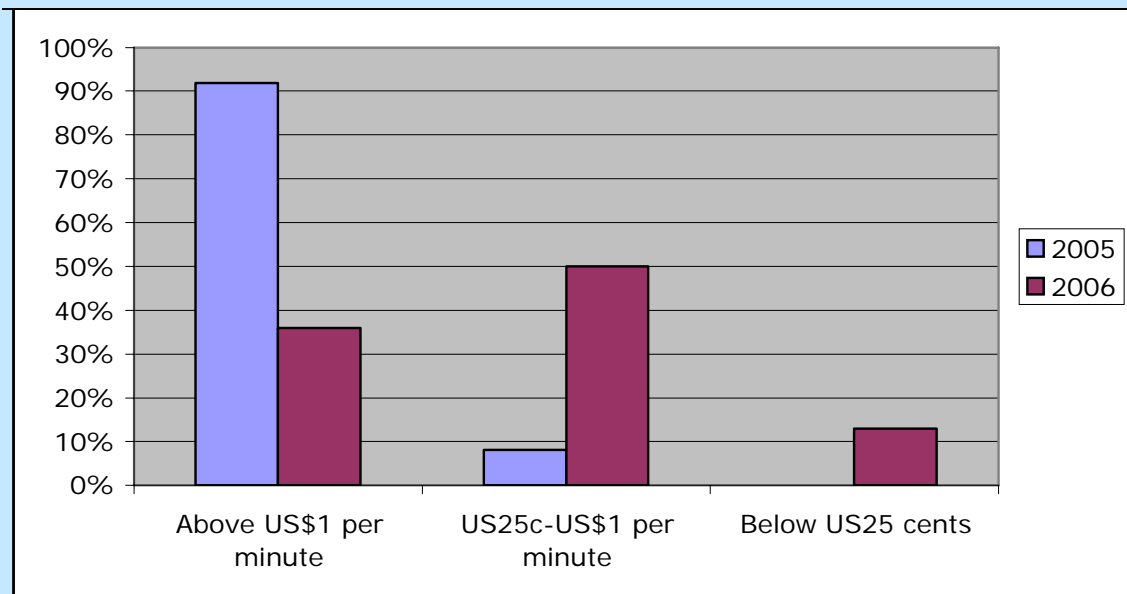
Most significantly, there are now 6 countries charging below US25 cents a minute. And this is clearly where all of these rates will go over the next 1-2 years wherever wider competition is introduced. Indeed in markets where VoIP is legal, mobile operators have needed to compete with these lower prices and have had to reduce their international calling rates. For example, Tanzania's mobile operators have bought their

international rates down to the US20-25 cents a minute range. In this instance, traffic appears to have increased enough in terms of minutes to more than outweigh any loss of income through the reduction in rates.

Whilst the speed of the collapse of international prices is striking, it should be remembered that the price the grey market operator buys at is in the US$0.04-0.05 cents per minute range. So even some of the retail prices below US25 cents will continue to allow some space for the existence of a grey market.

Interestingly in markets where VoIP is legal, the arbitrage point shifts from the international to the national. So for example, it may become cheaper to call a popular international destination than it is to call from the capital of a country to another city. In these circumstances, rebalancing of international and domestic rates is not possible as market pressures make it necessary to keep prices down at all levels.

3.3 The arrival of PC-to-PC calling

The pressure from the grey market has been compounded by the launch of popular, widely distributed PC-to-PC voice clients like Skype and Net2Phone. Skype's popularity has exploded with a claimed 100 million users currently signed up for the service worldwide in April 2006. However, only between 5-7 million of these users are online at any given moment. It has sought to make alliances with equipment manufacturers like Motorola to expand its reach.

Excluding the cost of access, PC-to-PC calling is free. So how is the company making money? It is connecting computers to telephones via its SkypeOut service, offering calls to landlines and mobile phones at low rates. To some of the most popular destinations Skype has one unified rate, the SkypeOut Global Rate, which is 1.7 Euro Cent (approximately 2 US cents per minute). Unless it is specifically mentioned, the SkypeOut Global Rate is only for calling landlines. Calls to mobile phones are more expensive. Other destinations have individual rates but with Skype what matters is where you are calling to not where you are calling from.

It is hard to know exactly how many Skype users there are in Africa but checking how many users are online at any given moment gives some scale to what is happening: the number involved is nearly always in the low thousands. The service works best with a broadband connection and the number of people or organisations with access to both of those things limits the spread of its use. Nevertheless anecdotal evidence from a wide range of countries shows a growing number of people using both the free and pay-for services. In Senegal, Skype use has been credited as one of the factors that drove DSL take-up.

What the popularity of Skype has obscured in Africa has been the rise of what might be described as Internet Telephony Service Providers (ITSPs). There are now between 5-10 of these companies operating internationally including : Net2Phone, Delta Three, Callserve, Dialpad and Go2Call. These companies existed before Skype and for them Africa may not have been their largest market by value buit it was certainly one of the fastest growing ones.

4 THE ARRIVAL OF LEGAL VOIP – NOT WHEN, BUT HOW?

4.1 Reasons for a change of heart amongst policy-makers and carriers

VoIP has been legalised in a significant minority of African countries and there is a growing list of countries in the queue preparing for legalisation. In under five years, VoIP has gone from being a dangerous and threatening technology to one that is being increasingly being embraced by even the most traditional of African carriers.

ISPs became noisy proponents of the need for legal VoIP and made the argument over and over again that it was likely to be more cost-effective for African carriers. New Second National Operators like Arobase in Cote d'Ivoire, KDN in Kenya and MTN in Uganda introduced IP-based fibre rings and were less hidebound by historic ways of doing things. This did not mean that they were immediately able to introduce VoIP but they were at least clear that the possibility existed. The discussion of the EASSy cable along the east coast of the continent focused attention on the price of the international IP fibre backhaul.

The tipping point in the arguments around VoIP seems have to come some time in 2004. VoIP went from being something difficult to discuss to becoming part of what was being going to be implemented by a significant number of carriers at an international level. Both operators and regulators began to preface discussions of VoIP by saying it was a case not a case of if but when.

African regulators in the vanguard of liberalisation began to promote VoIP as a means to increasse access to telephony. Ernest Ndukwe, Executive Vice Chairman of the Nigerian Communications Commission (NCC), has described Voice Over Internet Protocol (VoIP) as "the engine that will drive telephony in developing countries". A recent study, he said, found that "a sure way to promote universal access to telecommunications services, at this stage of the industry's development is to evolve a policy framework that recognises the issues relating to VoIP as an engine for the development of telephony in the country. Nigeria welcomes the use of VoIP and encourages telecommunications operator to deploy it where applicable".

For operators, as the investment cycles on more traditional pieces of equipment fell due, it was clear that things like soft-switches were not only an effective way of making sense of equipment that originated from many different companies but were also considerably cheaper than traditional hardware. Metropolitan fibre rings allowed telcos and their corporate customers to install VPNs.

Vendors were increasingly selling equipment that combined voice and data, most notably CDMA fixed wireless phones. Sold as a substitute for fixed line service, particularly by newer low-cost vendors, they again became a bridgehead for IP network practice.

4.2   What is legal VoIP? Different ways of assessment

In policy and regulation terms, VoIP as a technology gets mixed up with its impact on the market. The majority of Africa's regulators will now say that existing or future regulation will be "technology neutral" and that VoIP is simply one more technology. In some instances, the more progressive regulators promote its use.

But VoIP as a technology is not really what all the trouble's about. If there's only one or two licensed carriers who can use the technology, its impact will be very limited. VoIP as a technology will not cause existing licence-holders to change their behaviour. Over a quarter of Africa's telco incumbents have international VoIP gateways but far fewer have passed the savings made on to their consumers.

It is VoIP taken together with wider competition that produces real change in how markets operate. Therefore the real litmus test for legal VoIP rests upon competition criteria:

- *The number of international gateways for both voice and data.* The majority of African countries have only one gateway (operated by the incumbent) that means there is no competition at this level. Some have international gateway licences for the incumbent and all the mobile operators. But as mobile operators have (in the main) higher international tariffs than fixed carriers and are usually few in number in a given country, this produces some (but not a great deal) of competition. Where there are over five international gateways and few restrictions on obtaining a licence for one, wider competition ensues and rates come down. For example, Kenya now has over 10 international gateways.

- *The existence of niche VoIP service operators:* The ability to operate VoIP voice services is given to smaller niche operators, outside of the major operators (usually the incumbent and the mobile operators). These are usually the local VoIP service providers that provide much needed niche competition and incentivise local operators to upgrade their networks to IP and cut their cost base. These will not be (in the African phrase) "briefcase" operators but legitimate, locally-funded service providers. These now exist in Algeria, Kenya, Mauritius, South Africa, Tanzania and Uganda.

  For example, the Ugandan regulator UCC has granted a telecoms services licence to local operator TalkTelecom to be able to provide services to both residential and corporate customers. It is planning to offer VoIP telephony and international calling cards at prices below the three major operators up. TalkTelecom will offer international calls for as little as Shs500 (US27 cents).

- *The existence of workable and equitable interconnect agreements.* In the first instance, incumbents and mobile operators need to agree to interconnect and after they do, fair rates need to be established. The interconnect rates between these new service providers and the major carriers need to be relatively swiftly resolved. The major carriers need to be assured that the new service providers will cover the cost of paying for their networks. And the VoIP service providers need to get realistic prices that will allow them to compete.

  In Kenya the incumbent Telkom Kenya has been offering the new VoIP service operators draft interconnection terms. However, Kenya's mobile operators have been more reluctant to reach agreement with the new competing operators. In South Africa, two detailed draft interconnection agreements (one for IP calling and the other for TDM) have been put to operators by Telkom SA.

Longer term there will need to VoIP peering agreements in place as the number of operators interconnecting with each other expands enormously (see section 4. below) once there is a legal space for VoIP voice operators beyond just incumbent and mobile operators. For example in South Africa there 300 independent operators beyond the country's fixed and mobile operators. In order for even a small proportion of these operators to interconnect with the fixed operator and the three mobile carriers, there will need to be a significant number of interconnection points. Initial informal discussions about VoIP peering have taken place in both Kenya and South Africa.

Currently 36 out of 54 countries and territories in Africa forbid the use of VoIP by regulation or by law. Of these 36 countries, 29 have only one international gateway and there are a three countries that want to return to having only one international gateway (see pie chart below).

Figure 4.1: Regulatory position on VoIP
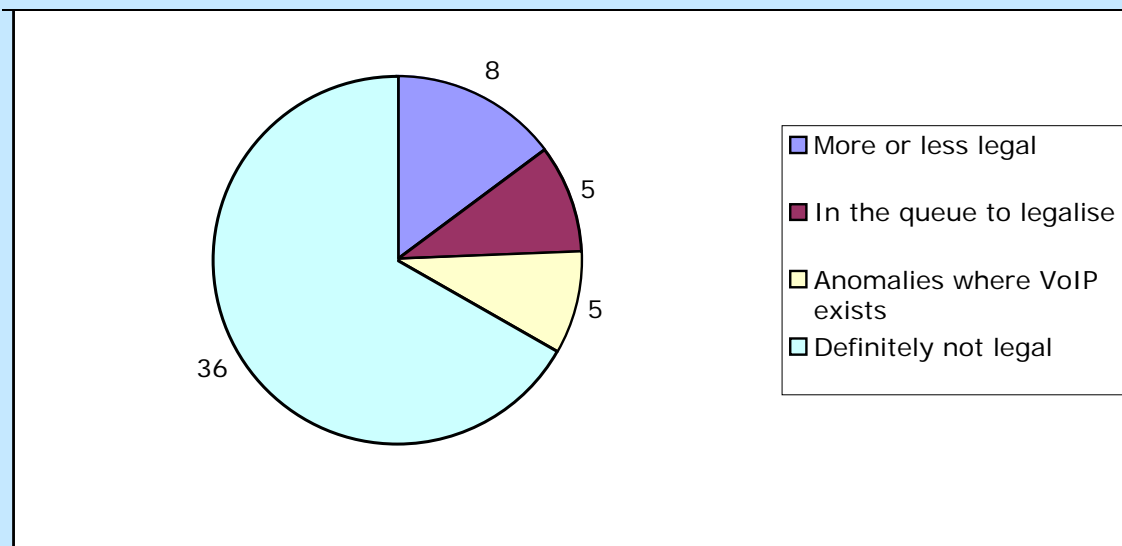
There are seven countries where VoIP is more or less legal on the basis of some of the criteria described above: Algeria, Kenya, Mauritius, Somalia, South Africa, Tanzania and Uganda. Although this number seems small, there are at least another six countries in the queue waiting to legalise VoIP. Of these, Egypt has already legalised the use of VoIP over VPNs and PC-to-PC calling. It has also said privately that it was going to issue VoIP-specific licences in May 2006 but this has clearly been delayed.

Of these, Kenya has over ten international gateway licences and once it is connected to an international fibre routes, prices will come down again. South Africa had until the start of the SNO Neotel only one international gateway licence with fibre access but is planning to open up licences to its mobile operators and offer VSAT licences more widely. Its VANS providers have also now been told that they can self-provision infrastructure. All of these developments will encourage the further use of VoIP.

Box 4.1: VoIP issues to be addressed by African regulators

There are a number of issues that African regulators will need to address as part of the wider implementation of IP networks:

- Access to numbering resources and number portability.
- Access to emergency services with caller location.
- Functioning interconnect agreements that offer a level playing field.
- Clear universal access arrangements in place.
- Criteria for judging quality of service and availability.
- Legal interception.

4.3   Experiences from the "early adopters"

There are two African countries – Algeria and Kenya - that have legalised VoIP whose experiences provide different pointers to what happens when this happens.

4.3.1   Algeria

Algeria has struck out on its own by legalising VoIP but leaving a single international gateway in place. This has caused a number of regulatory problems as the regulator has in effect had to intervene to fix prices to defend incumbent Algerie Telecom's revenues.

The legalisation of VoIP in Algeria has been a long process that started in 2002 when the Algerian regulator ARPT asked the Government to change IP telephony from the position where it had to be licensed to one where it can now simply be authorised. A year later ARPT allowed ISPs to offer VoIP services for an experimental period of three months.

In December 2004 the regulator issued a decree that set out the framework for obtaining authorisation to operate VoIP services. These included:
- a fixed amount of 30 millions dinars (US$416,400) to be paid up front
- a variable financial contribution calculated on the basis of 10% of the annual turnover. This compares with about 2% paid by the major operators.
- commit to serving 5 Waliyas (regions) of their choice, the equivalent of "departments". This allows them to serve major urban areas but commits them to choosing at least some under-serviced areas.

If these terms and conditions are met, the operator gets a five year authorisation. The terms and conditions of the licence stipulate that operators provide solutions for emergency calling numbers and special numbers are designated for VoIP calling: 0820 and 0822 It all also insists that all calling charges and costs are transparent and that operators must supply quarterly information.

The first three authorisations were issued in April 2005 to the following companies: EEPAD, SmartLink Communication (SLC) and WebCom. Since April 2005 eight additional authorisations have been issued by the ARPT bringing the total to 11 Algerian companies currently holding an authorisation to commercialise VoIP services.

In May 2006 the regulator ARPT decided to hold off on issuing any further licences and to carry out a study to look at the impact of the existing operators on the market. It also issued a ruling that the new interconnect

rate for incoming interconnect traffic must be no lower than US0.9 cents (6.5 DA) a minute. Although this approach can be seen as cautious, the impact has already seen call prices fall considerably for users: call rates vary from US17 cents to a French landline to US35 cents to a mobile number in Western Europe, USA and Canada.

4.3.2 Kenya

Kenya's regulator CCK started the legalisation of VoIP by offering seven ISPs new licences that gave them the ability to carry VoIP calls. Thus far the biggest independent entrants have been into the corporate market.

The companies offering corporates VoIP have all chosen to emphasise quality and use Tier One carriers to deliver this calling quality. One of the companies uses a Least-Cost-Routing PABX device that means companies signing up for the service do have to buy themselves VoIP-enabled phones.

Calling prices are around the US15 cents a minute to international destinations. This compares Telkom Kenya's VoIP card service that charges KS15 (US0.21 cents a minute) and its traditional fixed line services that varies between US0.64-0.90 cents a minute.

One of the obstacles that has taken time to unlock has been the signing of interconnect agreements between the established carriers and the new VoIP service providers. All carriers have been slow to come to terms with the new carriers although the incumbent Telkom Kenya has reached some agreements and is in negotiation with others.

Another layer of competitors have also entered the market: fixed wireless operators like Flashcom and Popote. But they too have had difficulties getting interconnect agreements and had practical difficulties interconnecting.

The mobile carriers (who have their own VoIP service offers) have been more slower to reach terms. One is now in discussions but the other is saying it will start discussions in its own time.

It is relatively easy to send outgoing calls internationally by IP without needing to interconnect with the established networks. But for a proper market to function – with incoming terminations to all operators and national and domestic routing of calls – there needs to be a proper interconnection regime between the new and the old operators. As ever with interconnection agreements, the devil in the detail.

Despite all this rate-cutting, the Kenyan grey market remains buoyant and has not yet reduced in scale to any great extent. However, the impact of new entrants has increased investment at a local level and reduced international calling rates for all users, whether individuals or corporates.

4.4 Safeguarding the consumer in a VoIP future

The introduction of VoIP and IP networks is likely to create different variants of existing versions of fraud that are being carried out on the Internet or by e-mail. They take existing scams and simply try to make them more convincing:

SPIT: The phone version of spam in which someone leaves voice messages on your phone. These are automated, pre-recorded messages selling things like cheap cruises. In some cases, the offers are fraudulent: people are being asked to buy goods or services that do not exist.

VISHING: A variant of e-mail fraud in which a person ringing from what appears to be a perfectly genuine number asks you for your bank details. When you ring back to check, it's answered in a way that leads you to believe it's genuine. In reality, the fraudster has simply set up a genuine number with the organisation's IP-enabled PABX that is then rerouted back to the fraudster.

At the heart of these problems in technical terms is the fact that VoIP has been set up using a protocol that is designed for open interaction whereas previous phone networks were not set up in this way. There are security solutions but there have been cases where VoIP-enabled systems have been hacked into. This has raised issues for example about whether providers tell customers that their credit card details have been obtained by others.

Another issue for consumers is Quality of Service. In a circumstance where there are a limited number of operators in a market, it is challenging but not impossible to check both the retail and wholesale Quality of Service (QoS). Checking the quality of wholesale interconnections becomes particularly important where are several operators, as liability for loss of QoS may not lie directly with the company providing the consumer with service.

For example, if terminations on another mobile network are particularly bad, then the consumer may or may not understand that this is probably not the fault of their provider but of the company it is interconnecting with. More sophisticated consumers might see where the fault lies but there is no guarantee that this would be the case.

In a market where there is more than one infrastructure provider and for example many VoIP service providers without their own networks, a call from one person to another may travel across at least four different networks and sometimes more. Identifying where there is loss of QoS will need an effective approach to monitoring wholesale interconnect quality.

The problem will again be present when mobiles are able to use a variety of wireless networks to send their signal. For example, a mobile might start out sending its signal via a Wi-Fi hotspot before entering one or more networks provided by mobile operators. If there is a problem either sending the call or of its quality, the consumer's immediate reaction might be to blame his or her mobile provider. Whereas it is possible that the fault may lie with the Wi-Fi hotspot provider, the regulator will need to untangle where the problem is occurring in order to improve QoS.

As operators are increasingly seeing their networks (particularly IP networks) as a means to sell a widening range of "value-added" services, QoS issues will become apparent across this portfolio of services. Issues around failure to deliver SMS messages and subsequent charges for notification are a simple precursor of this more complex world.

Increasingly mobile operators are selling data services using 3G-enabled networks. For a variety of reasons, download speeds vary enormously. For example, a particular part of the operator's network may be insufficiently provisioned to handle the volume of data users on a given day.

The net result will be that a download takes longer and the consumer is charged more. Therefore the same download may cost two entirely different prices to the consumer for reasons that he or she has no control over. Imagine being charged more for a three minute phone call because lines were heavily congested to get some idea of the potential problem. It is therefore important for regulators to check QoS issues for a basket of services, particularly when they are widely used.

In a world of increasing complexity, it is important that the consumer is as well informed as possible on these issues. Thus when they complain about fraud or QoS issues they are more likely to understand what is occurring and be helpful to providers and regulators who may be able to help them with issue involved.

Therefore the task for the regulator is one of creating a consumer education programme that warns consumers of potential frauds.

5   THE TRANSITION TO IP NETWORKS – THE BUILDING WAVE OF CHANGE

5.1   Changing market structures – layered market models

In order to see how VoIP works in market terms, it is useful to have an understanding of the layered network model: this both describes the way different parts of the technology interact but also provides a way of looking at the new, emerging market shape in Africa. In broad terms there are three layers: services and applications, transmission (or transport) and physical infrastructure. (see diagram below).

VoIP sits in the services and applications layer because it is an application. But it requires both transport and physical infrastructure to operate. However the key question is whether the VoIP service operator provides elements of both transport and infrastructure or simply purchases these services from another operator.

The introduction of IP networks has uncoupled the supply of transport and infrastructure from the provision of services. Put simply, the new generation of VoIP service providers do not need to build infrastructure but tap into (at an agreed price) others' infrastructure at an agreed price. This has created a new set of wholesale and retail relationships. Grey market operators were the precursors of this change: they bought their bandwidth and minutes from a supplier wholesale and then sold their minutes retail to their customers.

With traditional telephony, "intelligence" in the network is located centrally (in the functionalities of the switch) and usually controlled by one organisation. In its historic form, largely "dumb" devices (telephones) were attached to the network and these had a limited set of functions. The traditional telephone network's root and branch structure means that traffic flows to and from exchanges in ways that reinforce this pattern. For example, traffic for international destinations tends to go via a single international gateway. Telecoms carriers maintain bilateral relationships with other carriers and exchange revenue (to a much more limited extent than previously) through the Accounting Rate System.

By contrast, the IP network is one where no single entity has control, other than over the most basic transport to other networks. The service-providing "intelligence" is deliberately designed out of the network architecture. Indeed, put simply the network is "dumb" and intelligence is at the edge of the network. For example, a computer accessing the network has a far more complex range of service functionality in its application programmes that is not solely related to its size.

Traffic on the network is routed via the easiest route and therefore not always via central points. For example, international traffic can as easily flow from an ISP, a cyber-café or a telephone company: each has only to open a network connection and have the required capacity available. The ease with which these connections can be opened spawned the Internet Telephony Service Providers that have been the basis of Africa's grey markets.

Historically, a vertically-integrated organization like the telco incumbent carried traffic and offered services, usually from a monopoly position. A typical African incumbent operator would offer not only voice but also Internet services and if allowed by regulation, mobile voice services. In a more liberalised market, the same telco incumbent will be selling international transmission to both external ISP customers and to its own ISP, leading to inevitable accusations of conflicts of interest. Accusations of these conflicts of interest have arisen in a range of African countries. For VoIP service providers, the terms under which there is access to DSL broadband therefore becomes a key question. The question for the regulators is : has the incumbent granted itself particular commercial privileges that are not available to other operators in the market ?

With liberalisation and more entrants in the market, there has been an emerging separation of retail (services) and wholesale (infrastructure) functions. Alternative infrastructure providers like utility companies have begun to wholesale bandwidth capacity and operators like ISPs, VoIP service providers and MVNOs have begun to retail services to end users. The nature of IP networks has enabled this process and indeed encouraged changes in thinking about these two functions.

As a result, many telcos have separated out their wholesale and retail functions in order to better understand the underlying cost structure of different parts of the business. In some instances, this was prompted by regulators seeking to clarify terms of access to either the local loop or the network itself or by the companies themselves wanting answers to questions about costs of delivery.

5.2   The birth of the African VoIP service provider

The new VoIP service providers are often portrayed as getting a "free ride" of the investment of others but with legal VoIP and transparent and fair interconnect prices, they are in effect paying for their use of this infrastructure based on the same principle used by others like the mobile operators and the incumbent.

There are also commercial pressures that impel the new VoIP service operators towards providing some element of their own infrastructure. It is not comfortable to exist in the margin between low (and often getting lower) retail prices and a wholesale price controlled by large entities who would be only too happy to see the new operators squeezed out of existence.

Therefore where it is legal, the new VoIP service providers have a direct financial interest in building out local loop infrastructure as they can often compete effectively with existing carriers at this level.

Overall, the market is making a transition from one dominated by large-scale, vertically integrated operators (like the telco incumbents or the mobile operators) to one in which there are along with the large-scale operators many, smaller niche players, particularly in the services and applications layer.

At the largest end of the spectrum in for example, in South Africa there are well over 300 VANS that have set up since the market was liberalised. In places like Nigeria and Kenya, this independent sector is less large, numbering in the tens rather than the hundreds. Nevertheless the overall impact of competition, particularly around VoIP, will be the same in small or large country markets. There will be more players and greater levels of competition on price and service.

5.3   The technical transition – who's making the change?

Many of the world's larger carriers have been persuaded to consider VoIP because an IP-based network can carry both voice and data in one rather than two networks. In this way, operators will be investing a single network that can be used more efficiently for many different forms of traffic.

IP network deployment costs often come in smaller increments than those required for telco switching facilities and dedicated circuits. It is possible to add capacity incrementally in a manner that will realise return on investment more quickly than the traditional multi-million dollar telecom equipment investments, which require many years to produce the required return.

For example, Uganda's UTL made the transition from large numbers of traditional switches to a smaller number of "soft switches". Smaller investments can often be financed from of cash flow rather than requiring major external borrowing. Others like Kanar, the SNO in Sudan, have decided to build an IP-enabled network because it makes financial sense to do so if you are starting with a clean sheet as a new operator.

Some of the debate about IP cost advantages tends to centre on both the soundness or integrity and cost of the newer generation of network equipment - including Wi-Fi and Wi-MAX – as part of an IP network roll-out. These new wireless technologies can and are being deployed both to create local loop VoIP access and for backbone links.

Nevertheless one of Africa's largest mobile operators (MTN) is already operating these technologies and another (Vodacom) has announced its intention to do so. Indeed the latter has bought a minority shareholding in a Wi-Fi equipment company called iBurst. At least ten operators are testing these technologies. And Africa's traditional incumbents are also deploying these technologies and at the same time as they are threatened by them. One of those testing the new technologies, the Madagascar incumbent Telma is testing both voice and data and is intending to use it for voice when it becomes legal for it to do so in 2008.

VoIP can be carried most cost-effectively across IP networks rather than changing it in and out of packets to travel across other kinds of networks. However no transition of this kind happens simultaneously across all networks so it is worth understanding how it spreads across different levels.

In essence there are four levels in the network that IP will eventually be implemented in: the international gateway level; trunking within a national network; the local loop and at the user level.

Around quarter of Africa's incumbent carriers have some form of international VoIP gateway through which some proportion of their international traffic flows. A number of international carriers – most notably Gateway, iBasis and ITXC (first part of Teleglobe, now part of VSNL International) – offered African incumbent telcos (and sometimes grey market operators) the opportunity to install international VoIP gateways.

International carriers find it is possible to get IP terminations in all African countries which means that every country is served by an incumbent's VoIP gateway or a new second national operators or by grey market operators or by "back-door" terminations in incumbent telcos. From the other end of this transaction, the main international minutes carriers are currently carrying anything between 5-100% of their traffic into Africa using VoIP.

At the IP trunking level, there are around 20 carriers that are already carrying some proportion of their traffic using VoIP and around a further 10 that are planning to implement IP trunking in the next 12 months.

A typical example is South Africa's third mobile operator, Cell C that has deployed a next-generation-network using Multi Protocol Label Switching (MPLS). Initially the network will carry Cell C's data traffic (GPRS and EDGE wireless services), but, in due course, the full capabilities of the network wil be used to transmit voice traffic using VoIP.

Perhaps a more typical IP network implementation is Uganda's UTL that took the decision for cost reasons when faced with the need to accommodate a new numbering system. The project was carried out in two phases, the first of which was to go over to soft switches in the core network using Cisco's MPLS. In October 2006, it had only two switches left to complete. Phase two was to: migrate (where possible) existing TDM traffic from the existing network; extend the level of services managed on the softswitch; and to manage the legacy switches. The remaining legacy switches are only two years old so will be left in place for another five years before they are replaced.

Other than the relatively small number of new VoIP service operators, there are very few local loop operators offering IP services at the moment but this position will change as the number of countries offering legal VoIP increases.

At the user level, VoIP services can be accessed in a number of different ways including :

•   PIN-activated, pre-paid calling cards that can be accessed on almost all voice-enabled devices.

•   Fixed phones that have been VoIP enabled or specific VoIP-enabled handsets combined with either wireless or DSL broadband supply.

•   Fixed wireless phones that can offer voice and data capability. (Currently available)

•   Mobile IP phones that offer data capability (not properly available until some point in or after 2007).

The issue for African VoIP users will be the cost of handsets. Current VoIP-enabled fixed line or fixed wireless handsets are not particularly cheap (US$50-100) but mobile VoIP handsets are still expensive in terms of disposable income on the continent. The cheapest of the latter – Hop-On's HOP1502 Wi-Fi IP mobile phone - is selling for US$39.

Given these barriers at the user level, Kenyan incumbent Telkom Kenya chose to launch its VoIP service using a pre-paid card with an access code.

Box 5.1: VoIP Transition (An African checklist of progress)

Short to medium-term evolution

Technical aspects

- PSTN and VoIP services exist in parallel (Happening in countries where VoIP legalised and in some others)

- PSTN-IP network gateways are needed in most cases (A minority of operators)

- E.164 numbers are (mainly) used, additionally ENUM use of E.164 numbers is increasing (No ENUM trial yet)

Transition period for the market

- New type of competition with possible advantages of cost structures and with new innovative services (in particular nomadic use of IP/Internet telephony) and lower level charging models. (Happening in countries where VoIP legalised but not much sign yet of spread of innovative services.)

- Voice traffic is shifting to IP based traffic and revenues from traditional phone services are decreasing. (Biggest shift at international level, currently early adopters starting IP trunking)

Regulatory model

- Changes are required to the current reulatory regimes, need to take into account long-term industry changes. (Happening in a significant number of countries but majority have not yet started.)

- Should balance basic main objectives :

• to enable the development of innovative services (little sign of encouragement for innovation, only early progress on convergence).

• to ensure acceptable social and consumer protection (early days)

• to use the cost effectiveness of the technology to deliver wider access (see Algerian example)

Long-term change to all IP future (five to ten years for some? Sooner for others ?)

Technical concepts

- IP/NGN networks and VoIP services are prevalent.

- Subscribers and services are addressed mainly by different types of Internet addresses ;

- however, E.164 numbers are likely to prevail at least in the global context.

- New terminals available to users (for example, combined GSM/UMTS/WLAN phones supporting I{/Internet telephony at home and other WLAN coverage areas.

- VoIP is just one service within a larger bouquet of services.

Market and competition structure is changing :

- Integrated, innovative and personalised services.

- Nomadic use becomes prevalent and an increasing amount of cross border services.

- Cost and revenue model of service providers has changed radically.

- The separation of the transport network and the services delivered on top of that network.

Regulatory model :

- New legal framework/regulatory model is needed.

5.4   Convergence in the African context – new services

Because VoIP has largely been seen as a way of cutting costs, its ability to offer new services is only just beginning to make an impact. For example, "Push-to-talk" is the term used to describe what most people would understand as "walkie-talkies": instantaneous, direct two-way conversations between two individuals based on IP software that sits on a mobile phone.

The first "Push-to-talk" service on the continent was offered by Morocco's Maroc Telecom but it will be joined by Namibia's mobile operator MTC that will launch its service in January 2007. It has conducted a test deployment with the Namibian police service.

Another area of development will be the roll-out of products that integrate cellular and WLAN networks and provide voice from a WLAN device. There is already a working application in South Africa in a casino where staff are able to use voice-enabled handheld computers and phones to call both within the company's premises and to outside numbers. However a voice application of this kind would be ideal in the African context for a hospital or university premises spread out over several buildings over a wide area.

The convergence of voice, data and images on IP networks allows users to combine these different forms of traffic and significantly expand the range of product and service offerings. For example, call-centre software can include a range of features such as productivity management, real-time   database access and cost-effective call routing. Convergence also blurs the line between voice, data and television programming. A number of African operators are now offering the so-called "triple-play" option that combines all three in a single service. These include : Maroc Telecom, Telecom Egypt, Sonatel (Senegal) and Mauritius Telecom. In addition, Telkom South Africa has applied for a pay-TV licence and said that it will invest a considerable sum in becoming a content provider using IP-TV.

This form of delivery has implications for competition as users increasingly seek a single provider and billing option. A single bill for all these services is undoubtedly convenient for consumers but the cost of each service is not transparent, making comparisons between services difficult for users. However, triple play, also has the potential to open up television as a delivery platform for a far wider range of rich, multimedia services, overcoming to some extent, the lack of installed, Internetconnected computers in developing countries. While this may be a solution for the urban poor, it   still will not address lack of

Internet access for those in rural areas without electricity or television coverage. Yet, while this may not be tomorrow's market, it is certainly going to be relevant in the medium-term.

6 CHANGING INDUSTRY STRUCTURES

6.1 Internet vs telecoms practices

VoIP and IP network implementation may begin to change industry practices. Telecom and Internet operators do it differently at a number of levels. Put simply, at an international level telcos charge for "half-circuits" whereas the Internet operators charge for a full circuit. Telcos base their charges on geographic distance whereas distance is much less relevant for Internet operators. Telcos charge for time whereas Internet operators charge for capacity.

With the increasing uptake of VoIP by traditional voice operators, larger amounts of traffic are based on IP data. Whereas in the past these two different parts of the industry operated in completely different currencies (minutes and bandwidth), they now have a common currency (bandwidth). So whether the telco peers with an ISP to carry VoIP-based traffic on the Internet or buys dedicated bandwidth for those calls, it increasingly takes on the business practices of those that carry data.

Like all transitions in industry practice, this will not happen overnight and the picture will look much more confusing than the future that we describe below. Several large telco carriers are both voice operators and ISPs and they will continue to use both sets of industry practices for some time to come.

There is also a shift from minutes to "free" and bundled voice access. Internet companies sell capacity and have continued to do so in offering new VoIP-based services. Most of the current packages include a monthly payment (usually based on broadband capacity) and allow users to call other subscribers for free.

Both elements allow for unlimited voice use limited only by time itself: the number of hours an individual can talk. "Break-out" calls that go to PSTN numbers are charged for by the minute but it is arguable that this may just be a transitional element of old telco practice.

This shift is happening fastest in traditional voice-telcos that are seeking to leverage the use of their fixed line assets to become the largest broadband players in their market. In this way, these operators feel they can re-invent their former central position with IP-implemented services.

This transition in underlying industry practice will play a key role in the coming changes brought about by VoIP in Africa. VoIP peering – carriers and corporates

The shift to Internet-based practices will be driven by a desire to get rid of the inefficiencies of the existing hybrid practice. Currently if you use an African VoIP provider, your calls will need to travel across the PSTN's TDM network at some point, despite the fact that both the VoIP provider and the telco are using IP-based networks to connect the calls. The same situation is mirrored in the corporate world. Two companies may both have installed VoIP systems but in order to ring each other they need to go through the PSTN.

In Africa, these calls will nearly always need to go through the PSTN and be subject to a packet-to-circuit-to-packet conversion. This conversion process is inherently inefficient and leads to a reduction in call quality. As the transition to VoIP in the early stages involved only a relatively small amount of traffic, both parties have been willing to put up with these inefficiencies. With greater levels of traffic, VoIP operators inevitably began to ask themselves why should they continue to "subsidise" the analogue sunk costs of the PSTN when it can be done cheaper using direct IP connections?

Therefore the next stage is the creation of VoIP peering exchanges where a variety of carriers can exchange their VoIP traffic directly, particularly in urban centres. Although technically very different, their role is very similar to the current range of Internet exchanges. At the international level, organisations like VoIP Peering Fabric and Xconnect have already been set up to play this role between international carriers in most major markets. These exchanges appear to function well for both small carriers (like those in Africa) as well as larger global carriers.

The creation of VoIP networks and their interconnection parallels the rise of the public Internet itself. Once common interconnection points are defined, VoIP networks will find their way there and peer with each other. It becomes cheaper to peer with those offering flat rate transit than those charging by the minute. The "islands of VoIP" may also involve corporate users with VPNs who choose to make connections between each other.

Leaving aside the obvious advantages for corporates operating VPNs, there are two sectors in Africa that are likely adopters of IP PABXs and VPNs: large government entities and educational institutions. In the developed world, these users often have high-end data equipment with bandwidth-intensive networks. Both also have multiple sites that need connecting. For example, ZDNet Australia reported in 2005 that Deakin University had deployed 4,500 VoIP handsets.

One of the "early-adopters" is the municipality of Knysna in South Africa . Working with a private sector partner, it has created its own VoIP network using Wi-Fi that allows offices to talk to each other and council service users to ring in for free when making queries. Opting out of the incumbent's relative expensive domestic calling will undoubtedly save money but it does not take much to imagine the same municipality peering with other networks at a local level. Cheaper calling for Africa's consumers "in the public interest" will be one more pressure for an overall reduction in calling costs.

6.2   Changes needed for future development

For Africa to take full advantage of the "early gains" it has made in implementing VoIP two things need to happen to increase the speed of implementation and potential cost savings:

6.2.1   VoIP peering

There needs to be mechanisms like VoIP peering exchanges at both a national and regional level. This development needs to parallel the roll-out of regional and local Internet Exchange Points. With these kinds of mechanisms in place, regional calls can more easily be routed directly without needing to leave the continent. Policy-makers and regulators need to encourage cheaper regional calling rates using these kinds of mechanisms.

6.2.2   ENUM or its equivalent:

The IP-based call needs to be able to find the exact location where the call can terminate, whether this an existing PSTN number, a VoIP provider allocated number or an IP address. So for example there is a European peering network brokered by a company called e164 info that has built a database of VoIP telephone numbers. Africa needs to implement an eNUM trial so that it leads rather than follows the one of the key next stages of IP implementation.