Regional IXPs: the need for regional interconnection in Africa

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The concept of a 'regional IXP' has been discussed in a number of African circles recently. Internet exchange points (IXP) are an essential component of the internet – indeed Cisco Systems likens them to the 'building blocks' of the Internet. IXPs are crucial for the development of the internet, as not only do they reduce the cost of internet traffic by keeping local traffic local, but more importantly, they enable additional applications, which have a considerable multiplier effect on the economy. This article highlights the necessary conditions for regional internet traffic exchange for the effective exchange of Internet traffic between neighbouring countries.

It has recently become politically popular to speak of the need for, and the desire to implement, 'regional IXPs' in Africa. However, there appears to be a general lack of understanding of the prerequisites for such an endeavour. An internet exchange point (IXP) is a common location (which may, on occasion, be distributed over several interconnected physical locations) at which internet service providers (ISPs) exchange data traffic with each other. Most commonly, the traffic is exchanged to their mutual benefit and with no costs applied. In this case, it is referred to as 'peering'. The data traffic that is exchanged is that which originates or terminates in the networks of the peering partners. Traffic that passes through a network to that of a third party is referred to as 'transit' traffic, and is generally carried under some commercial arrangement.

More IXPs in Africa

The African ISP Association, AfrISPA, has been active on the African continent over the last several years, and has had a significant influence in increasing the number of national IXPs operational in Africa, which now stands at 14. Each of these national IXPs represents not only a significant cost saving for the participating ISPs, compared with transporting the same traffic over long, slow, expensive international links, but more significantly, the improved performance resulting from the short, fast, cheap local links means that the quality of service (QoS) that the ISPs can provide is increased. This increase in QoS means that additional applications, such as local website and application hosting, internet banking, online sales, ticket bookings, employment agencies and other applications dependent on fast cheap communication become feasible. This has a considerable multiplier effect on the economy of a country where an IXP is installed and all ISPs exchange all their local traffic.

Requirements for a national IXP

The prerequisites for a national IXP are illustrative for the case of a regional IXP. In order to implement a national IXP, the following requirements must be met, in increasing order of importance:

- A suitable neutral location must be found. While this can be a political 'hot potato', it is actually a relatively trivial issue. The requirements for the hosting location are:
  - It must be reasonably centrally located – specifically so that all participants can connect to it easily and relatively cheaply.
  - Physical access is required to the hosting location at any time by the participants' representatives. When a router breaks, it must be fixed quickly.
  - Physical security must be effective. It is no good if the equipment is stolen. Only authorised representatives of the participants should have access.
  - Security of power and environment is needed. Air-conditioning, uninterruptable power supplies (UPS) and back-up generators are usually required.
  - In the case where the IXP is hosted by one of the participants, the perceived benefit to him (no need for a telecommunications link of any sort) is usually balanced by his meeting the operating costs of the IXP (rent, electricity, security).
- Suitable central equipment must be obtained. Note that very little is actually required, usually only two pieces of equipment (a switch, and optionally, a router, in a suitable secure room, sometimes with duplicates of each), together with a rack to mount them and the equipment (routers, modems) belonging to the peering partners. The cost of this central equipment is typically less than $5,000. From the fuss made about IXPs, one would think that these were multi-million dollar installations. In reality, it is 10 per cent technology and 90 per cent politics.

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- Connectivity between the offices of each participating ISP and the IXP is essential. How this is implemented varies from country to country. In some countries, the ISPs use wireless links to the IXP. This is cost effective over relatively short distances and provides adequate reliability and quality. In other countries the ISPs lay their own fibre. This is an ideal solution, as it provides effectively unlimited capacity at a low operating cost and excellent quality. In still other countries, the ISPs rely on the incumbent telephone company (telco) for their connections. These range from a subsidised rate of $50 each per month, to extremely expensive. This issue is critically dependent on the progress of telecoms liberalisation within the country.
- A neutral management body is required to set the rules for the IXP. This is usually composed of the IXP participants themselves, who elect or select some from among their number to be responsible for the setting and administration of policy. The most common policy in an African environment is 'mandatory multilateral peering', i.e. everyone peers with everyone else, or with no-one.
- Agreement between three or more of the ISPs that they will peer with each other. While there is a clear economic case for

peering, there are often issues of trust, as well as concerns about the benefit to others. A sensible businessman considers only the benefit to himself, while ensuring that the benefit to his peering partners is positive (otherwise the partner will not wish to peer). However, emotions and politics can too often get in the way of common sense. Thus, it frequently takes the intervention of a neutral third party, such as AfrISPA, as well as some time, to persuade the potential participants in an IXP actually to progress with the process.

- A point that is occasionally forgotten is that unless it is significantly cheaper to peer locally than via international transit, the IXP will be an abject failure.

Joining an IXP later

Once an IXP is implemented and ISPs are connected to it, exchanging routes and ever increasing traffic volumes, then it becomes clear to the doubters that the sky will not fall down, their networks won't break, and one soon finds close to 100 per cent buy-in. The exceptions tend to fall into one of three categories:

1 Those who are too small to make the expenditure on a suitable router and connection to the IXP worthwhile

2 Those who don't have the technical skills to configure their router – and neglected to attend an AfrISPA workshop or to ask for help

3 Those who have a political agenda, and haven't yet realised that it harms their business.

National and provincial IXPs

Thus, an IXP is a place where ISPs operating in a geographical region physically and logically exchange traffic with each other, thus effectively keeping local traffic local. In Africa at present, AfrISPA's initial effort is aimed at enabling a single national IXP to become operational in each country. However, there are a number of countries where there is more than one major population centre, and where these cities are remote from each other. In this case, it can make sense to have additional, provincial IXPs. A provincial IXP enables ISPs operating in that area (province) to exchange their provincial traffic in the remote city or town, rather than shipping it to a national IXP at a major city, and then back. This does raise certain economic issues, such as if ISP A & B are exchanging traffic in cities X & Y, and if traffic needs to flow between ISP A in city X and ISP B in city Y, who is responsible for the transit between the cities? Where local carrier capacity between cities is cheap, this isn't a major issue, but in some African countries the cost of national transit is high. (South Africa being a particular example, where the current cost of a 2Mbps link from Johannesburg to Cape Town is over 12 times the projected cost of 2Mbps of international traffic over the East Africa Submarine System (EASSy) scheduled to begin operation in 2007 (www.eassy.org). Fortunately, some simple rules, and the application of some simple technology already available in the routers commonly used, can obviate the arguments over who pays for transit, but won't address the costs of transit.

What is a regional IXP?

In essence, a regional IXP is a mechanism whereby ISPs in different countries can exchange traffic with each other. As with the provincial or national IXP cases, it's essential for success that the connections between these ISPs, via the IXPs, be fast, efficient, and cheap.

Enabling factors for a regional IXP

Let us assume that several neighbouring countries already have operational national IXPs, and that they wish to implement a regional IXP. What's needed to make this a reality? By analogy with the criteria for a national IXP, one can then easily identify the enabling factors for a regional IXP:

- As to location, there are two possible answers to the question of where a regional IXP should be sited:
  - At one of the existing national IXPs, preferably one that is centrally located between the participating countries
  - A 'logical' or 'virtual' IXP doesn't actually require a single central physical location, provided the existing IXPs are interconnected. Thus, while one can truthfully say one has an operational regional IXP, it can actually be distributed between the existing national IXPs. In this case, the ISPs connected to each IXP peer with each other, over some connection between the IXPs. A regional carrier is an ideal solution.
  - While a separate, dedicated, location for a regional IXP may be considered, there is no benefit to be obtained from this, merely an increase in costs.
- No additional equipment is required at any of the IXPs, other than that associated with the cross-border communication links.
- Connectivity is the crux of the matter. Without fast, cheap, fibre cross-border connectivity between the national IXPs, one can't even begin to talk about a regional IXP. This brings us back to the issue of telecommunications liberalisation. Many African countries have licensing and other restrictions on who may lay fibre where and in particular about that fibre crossing national borders. (This is known as an 'international gateway', usually attracting wholly unreasonable license fees, where it's possible at all.)
- No additional management of the regional IXP per se is required. However, the management of the cross-border connectivity by the regional carrier is essential.

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- Agreement to peer from the ISPs will flow naturally from the reduction in costs and improvement in performance that they could enjoy. However, agreement is required from a number of parties in order to make the cross-border connectivity possible and economically viable. These parties may include government, regulators, regional carriers, telcos, utility companies and others.
- As should be apparent, unless the cross-border connectivity is available at a significantly lower cost (and better quality) than existing international transit connectivity, a regional IXP will never become a reality.

Connectivity is key

It should be clear from the discussion above that connectivity is the key to the concept of a regional IXP. There is no point whatsoever in ISPs in neighbouring countries peering via their existing multi-hop satellite connections. It is expensive, slow and inefficient, and will bring few of the potential benefits of a regional IXP.

An ongoing debate exists as to exactly how the connection between ISPs should occur, assuming that a suitable connection exists between the IXPs. There are several possible answers to this issue:

- The links between the IXPs are owned/operated/leased by the IXPs concerned, even though the actual peering links are (usually) between pairs (or groups) of ISPs. While this solution is superficially attractive, purists shudder at it, as it may mean

that the IXPs are effectively competing with their own members, the ISPs. This threatens the long term stability of the IXPs.

- Each ISP makes its own arrangements for the cross-border links. Even if we assume that liberalisation has progressed to the point where an ISP may lay its own fibre from its home city to a city in a neighbouring country, or alternatively that carrier capacity from the incumbent telco is equivalently cheap (an inevitable consequence of the liberalisation postulated in the former case), this is not an ideal solution. The reason is that the trouble and expense of many duplicated smaller links may be inefficient. Note that duplication itself is not a bad thing – it leads to 'redundancy' of lines or equipment, which in turn increases reliability, an essential feature of the internet. However, two to five links are good, 20 would be excessive.
- Cross-border links may be operated by two or more third parties. This is in many ways the ideal solution, and is effectively a compromise between the first two options above. One may ask: "Why not simply use the existing telco's facilities?" The answer to this is that if it was currently feasible, it would be happening already. African telcos tend to classify cross-border traffic as 'international transit', and have simply priced it out of the market. Furthermore, where cross-border links operated by telcos exist, they typically are very low capacity, low quality links, designed only for minimal voice traffic between the neighbouring countries.

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Regional carriers

The issue of cross-border connectivity is crucial to the success of peering between African countries. The problems and choices outlined above have a simple solution – a 'regional carrier' acts as the third party. AfrISPA has encouraged the formation of two such networks in Africa, which will offer services between ISPs in various countries. Since the IXPs in those countries form a natural traffic aggregation point, the regional carriers will offer connectivity to the ISPs at the IXPs, to any other ISPs at other IXPs. Initially, the regional carriers' networks are based on satellite for most of the links, but these will gradually migrate to fibre as it becomes available. Note, however, that these satellite links are 'single hop' links, so that the data doesn't actually go outside Africa. This provides sufficient QoS and low enough costs to make direct internet traffic exchange between African countries a viable reality.

Existing fibre network projects

Implementation of most of the large, multi-government fibre projects in Africa has been so slow as to render them effectively failures; however, there is a growing number of fibre links between countries owned by various electricity, rail, road, water and gas utilities. Most of these fibre links are not operated as communications links, other than for the limited signalling needed by the utility itself for its internal purposes. The reason for this is partly because the utilities (usually) are not in the telecoms business, but mostly because existing legislation in much of Africa prevents them from doing so.

Telecoms liberalisation is essential

The solution, therefore, is simple, although frequently obscured by vested interests and bogged down in politics. Liberalise the telecommunications markets in all countries that have an interest in a regional IXP to the point that any 'operator' (using the term in its loosest sense) may either lay his own fibre, or lease/buy existing fibre from any source, and may sell the non-exclusive use of that fibre to any third party, in their own or any other country. Thus, the competitive regional carriers will be able to improve their network capacity and performance.

When considering licensing fees, if any, regulators and governments should note well that the World Bank estimates that an increase in retail costs of 10 per cent above the EASSy base case represents a potential loss over a 10-year period of US$2.5 billion to the economies of the participating countries. Governments and regulators should not be tempted to set high licence fees, but rather to wait for the secondary economic benefits that will flow from increased trade and prosperity as a direct result of increased data flows.

Conclusion

One may therefore summarise the necessary preconditions for a regional IXP as follows:

1 National IXPs must be operational in all countries that wish to be party to the regional IXP.

2 The telecommunications market in all countries concerned must be liberalised to the point that any 'operator' may lay his own fibre, or lease/buy/resell fibre from others, and sell its use to anyone, including over national borders.

3 African countries need to liberalise and harmonise their telecom regulations to the point where it becomes viable for regional carriers to offer cross-border services in all countries.

4 Such regional carriers actually exist, are appropriately licensed, and are able to offer services between the participating countries, and their costs are sufficiently low to make the regional IXP a reality.

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AfrISPA is a continental Association of national Internet Service Provider Associations and serves as a regional umbrella body for Africa's ISPAs to ensure coordination in priority areas as well as to provide a single voice for Africa's ISPs. Founded in 2001, it currently has ISPA (South Africa), TESPOK (Kenya), FAIR (Mauritius), GISPA (Ghana), ISPAN (Nigeria), ISPA DRC (DR Congo), TISPA (Tanzania), UISPA (Uganda) and BISPA (Botswana) as members, with other associate members. The Executive Management is made up of William Stucke (Chairman, South Africa), Brian Longwe (GM, Kenya), Eric M K Osiakwan (Executive Secretary, Ghana), Viv Padayatchy (Treasurer, Mauritius) and Didier Kasole (Francophone Director, DR Congo).

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