

AFIX Decision-makers' Workshop: Session 4

IXP Economics: An exercise in cost savings

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Overview

This session explores the cost-savings dynamics associated with participation in an IXP by an ISP, including the dynamics for the overall ISP market. Using a dynamic model, key variables can be set and a range of scenarios can be explored to interrogate and understand what the broad financial implications are likely to be for a specific ISP, other ISPs in the market, and the overall market under each scenario. The goal is to help participants understand the key drivers of cost and savings associated with participation in an IXP.

Description of the ISP-IXP Model

The model used in this session is constructed using Microsoft Excel. It is divided into six worksheets or 'tabs':

1. **Scenarios A to D:** To understand the cost and traffic routing implications associated with different numbers and sizes of ISPs participating or not participating in an IXP, a number of scenarios can be constructed and compared. These worksheets use profiles of ISPs and the values of global variables set in the 'ISP Models' worksheet (see 2 below). One of the scenarios is described in detail below as an example.
2. **ISP Models:** ISPs are modelled according to the amount of international Internet connectivity (in Mbps) they procure, to illustrate which other ISPss they will each consider as their peers. In order for the model to be flexible, it includes eleven different market segments (based on size of international connectivity), defining each by using variables such as cost, bandwidth capacity and other key criteria. These variables can be left as they are in their initial configuration or they can be adjusted globally across all eleven ISP categories (the default amounts are estimates of the African average). Alternatively, each particular variable in each market segment of ISP can be adjusted independently. This flexibility allows the model to be used quickly and simply with the initial configuration, but also enables a detailed custom configuration to more accurately reflect the real figures of a particular ISP or a particular market.
3. **Reference:** A table of common communication technologies and their associated bandwidth in Mbps is provided to assist with the customisation of the model in the 'ISP Models' worksheet.

All bandwidth numbers are standardised in Mbps. All cost numbers are standardised in US Dollars (\$). Each worksheet is explained in further detail below.

Scenario Worksheets: Scenarios A - D

Four scenarios (A – D) are provided in this worksheet, each of which can be customised as desired. The goal is to allow the user to explore, test and compare possible variations on numbers and sizes of ISPs, as well as whether those ISPs are participating or not participating in an IXP. The first scenario is described in detail as an example later in this document.

The four scenarios all have identical row and column categories; the programming logic and formulae are also identical. These are explained in detail below:

Column headings

Columns B-L cover the eleven different ISP segments as defined on the ISP Models worksheet (described in detail later in the document). They are grouped visually by colour and are coded L1-L3 (large ISPs), M1-M3 (medium ISPs) and S1-S4 (small ISPs).

Column B (heading: “My ISP”) allows the user to specifically include his or her own ISP as an independently analysed ISP. The other columns range from L1 (the segment for the largest ISP) to S4 (the segment for the smallest ISP). The programming and formulae are identical across each column.

Row headings

size (Mbps capacity)	Total bandwidth (local + international) provided by each ISP in its segment. Set in ISP Model worksheet, included here for reference only.
# of each *	How many of this segment of ISP are included in this scenario
Market segment relative local bandwidth 'strength'	Total local bandwidth of this segment. Local bandwidth is set as a proportion of total bandwidth in the ISP Models worksheet.
Per ISP in Market:	
% bandwidth	% of total local bandwidth in the market that an individual ISP provides
estimated internally routed traffic	% of local traffic handled by an individual ISP that is routed internally, i.e., among its own local customers. This figure uses the '% bandwidth' value as a proxy for market share.
% own local traffic to peer	All local traffic not internally routed (i.e., 100% - estimated internally routed traffic). This is the theoretical maximum amount of traffic that could be sent to an IX.
# peering*	Of the number of ISPs in this segment (set in '# of each') above, how many are participating in the IX in this scenario. Must not be greater than '# of each' variable.
% peering	% of ISPs in a particular segment that are part of the IX.
segment 'strength' from peering	total bandwidth of connections to IX from a particular segment.

1. * a user-defined variable

Per ISP Peering:	
% own local traffic being peered	'% own local traffic' that is routed to the IX, determined by the 'peering strength of the market' (explained below). The portion of the total local traffic routed to the IX is a proxy for how much of each ISP's local traffic can be routed to the IX.
Mbps own local traffic being peered	The above % in Mbps
% internally routed traffic	Same as 'estimated internally routed traffic' above
Mbps internally routed traffic	The above % in Mbps
subtotal, % local traffic routed locally	'% own local traffic being peered' plus '% internally routed traffic', i.e., all local traffic that is not routed internationally.
subtotal, Mbps local traffic routed locally	The above % in Mbps
% local traffic routed internationally (or otherwise)	100% - '% local traffic routed locally', i.e., all local traffic that cannot be routed internally or to the IX
Mbps local traffic routed internationally (or otherwise)	The above % in Mbps

Peering Analysis:	
peered traffic as % of total local bandwidth in market	% of total local bandwidth in the market that a given ISP routes to the IX
local traffic routed internationally, no peering, Mbps	local bandwidth of a given ISP not routed internally (i.e., if there were no IX)
local traffic routed internationally, w/ peering, Mbps	local bandwidth of a given ISP not routed internally or to the IX
Mbps converted int'l to local, per ISP	The difference between the above two numbers, i.e., how much bandwidth does a given ISP no longer route internationally if it participates in the IX under the given market scenario
as % of total bandwidth per ISP	The above number as a %
bandwidth savings due to peering, per year per ISP	the above % in dollar terms, i.e., how much international bandwidth does not need to be paid for by a given ISP if it participates in the IX under the given market scenario. The cost of the bandwidth is set on the ISP Models worksheet.
# of bandwidth increments required locally	# of standard local bandwidth increments (e.g., 64k lines) that must be provided locally to support the amount of traffic being routed to the IX. (Takes 'Mbps converted int'l to local, per ISP' rounded up to the nearest standard local bandwidth increment)
Mbps local bandwidth acquired	The Mbps of the sum of the above number of standard increments of bandwidth (e.g., the summed capacity of that number of 64k lines).

excess capacity, Mbps	The difference between the traffic being routed to the IX and the capacity of the lines that will minimally provide that amount of bandwidth (i.e., because of the need to buy bandwidth in minimum standard chunks, how much excess capacity would be in the local connection to the IX)
bandwidth costs due to peering, per year, per ISP	The cost of the bandwidth connecting locally to the IX. This is set in the ISP Models worksheet.
peering participation cost per year per ISP	An annual fee to the IX by ISP using the IX. This is set in the ISP Models worksheet.
net savings (loss) due to peering	The savings due to peering ('bandwidth savings due to peering, per year per ISP') minus the costs due to peering ('bandwidth costs due to peering, per year, per ISP' + 'peering participation cost per year per ISP').
Mbps converted int'l to local /segment	Same as 'Mbps converted int'l to local, per ISP' but for the entire ISP market segment
savings due to peering, /year, /segment	the above number in dollar terms. The cost of the bandwidth is set on the ISP Models worksheet.
bandwidth costs due to peering, /year /segment	The cost of the bandwidth connecting locally to the IX, summed for the market segment. This is set in the ISP Models worksheet.
peering participation cost /year /segment	The annual fee to the IX by ISPs using the IX, summed for the market segment. The fee amount is set in the ISP Models worksheet.
net savings (loss) due to peering	The savings due to peering ('bandwidth savings due to peering, /year /segment') minus the costs due to peering ('bandwidth costs due to peering, /year /segment' + 'peering participation cost /year /segment').
peering strength of market	The percentage of total local traffic routed to the IX. Note that this includes traffic routed internally by ISPs. This is to show how much leverage ("strength") the IX would have in the local market, and that leverage is decreased by large ISPs who essentially have their own 'peering points' for local traffic between their customers.
annual savings due to peering in this scenario	Sum across all segments of 'net savings (loss) due to peering'. Indicates how the overall ISP market is affected financially by the IX in the given scenario.

ISP Models Worksheet

Eleven market segments of ISPs are defined on this page, grouped into Large, Medium and Small, with a special column for 'My ISP' if the user wishes to focus specifically on his or her ISP in the scenarios. Below these ISP segments are a set of global variables for the model.

Initial values are provided on the worksheet. These values can be changed in two ways:

1. Change global variables: The first three global variables ('Cost of international bandwidth', 'Cost of local bandwidth', 'Average % of traffic that is local') can be changed and they will be reflected across each ISP segment.
2. Change individual values per ISP segment: Four values in each ISP segment can be altered to customise the model. These are

- a. **Bandwidth:** This is the total bandwidth managed by any ISP in a particular market segment, local + international. These values already differ across the eleven segments, so changing them should not be required, except for the 'My ISP' segment, which should be changed to match the bandwidth of the user's particular ISP.
- b. **Avg. cost per month:** How much *per month* the ISP pays *per Mbps* for the current international connection (including both transit cost and international point-to-point). This could be changed, for example, if larger ISPs are paying less for their bandwidth than smaller ISPs in a particular market. Be sure any value entered is monthly and per Mbps, not annual or the total cost for all the bandwidth.
- c. **% local traffic:** What proportion of total traffic will ultimately be routed from a local customer to another local customer.
- d. **Local point-to-point cost per month:** basically, this is 'b' above, but for the local connection to the IX. That is, what would a local connection cost *per month, per Mbps*.

Other global variables:

'standard local bandwidth increment': what is the minimum standard increment in Mbps that can be purchased in the market for a local connection. In many cases this will be a 64k line, but may vary. Note that this is in Mbps, so a 64k line is 0.064Mbps. If you want to take into account that Mbps are 1024 kbps, then enter your decimal value after having done the math yourself (i.e., instead of 0.064Mbps, it would be 0.0625Mbps).

'Fee to participate in peering, per ISP per year': how much would an ISP using an IX have to pay *per year* to contribute to the operating costs of the IX *in dollars*. Note that this does not include contributions toward capital costs.

Reference Worksheet

To help users associate the common terms for various bandwidth connections with their quantitative capacity, a table of common connections and their capacities in Mbps is provided. These can be used to customise the ISP Models worksheet, and to understand in a more common sense fashion what the Mbps capacity of a particular ISP might be (e.g., what does it mean for an ISP to have a 2,500 Mbps capacity? What does it mean for an ISP to have 15 OC-3's and 3 T-2's? This table will help).

Scenario A: Detailed Example

In this scenario, the overall market is moderate in size by African standards and significantly unbalanced. An IX is being planned for the future, but there are concerns that the largest ISP will not be interested in participating.

Understanding the Market

The top few rows (4 – 10) show us what the market looks like. The total bandwidth in the market (local + international) is 533 Mbps, but one dominant ISP has 500 Mbps of that or nearly 94% of the market. The remaining 6% of the market is divided among 6 other ISP's, 1 with 20Mbps, 1 with 5 Mbps (which is 'My ISP' in Column B) and four very small ISPs having 2 Mbps each. This is a configuration not uncommon for African markets, in which a dominant telco has had a monopoly or de facto monopoly, while a number of other ISPs are attempting to compete for customers with varied resources to do so and varying degrees of success.

This configuration was reached by adjusting the numbers appropriately across Row 4 ('# of each') for each column B-L.

Participation in the IX

Rows 12 – 49 show what the peering arrangements are, and what effect in terms of cost, savings and bandwidth that has on the various ISP's as well as on the overall market.

Row 12 indicates how many of the ISPs in the market (Row 4) are part of the IX. 'My ISP', the S2-sized ISP and 3 of the 4 S4-sized ISPs are part of the IX in this scenario. Looking down at cell B51, 'Peering Strength of Market', we can see that this market has 5.7% of the overall local traffic going through the IX. (The total local traffic is shown in Row 9, and the traffic going through the IX in Row B14.)

Analysis of the Biggest ISP in the Market

By looking at column G in detail, we can see what the facts are facing the M2-sized ISP. Cell G9 tells us that this ISP, because it is so dominant in the market, will be routing most of its local traffic internally anyway, with or without the IX in place, from its local customers to other of its local customers. With nearly 94% of the market, we estimate that nearly 94% of the local traffic this ISP handles would go to its own customers. In effect, this ISP is functioning as its own 'peering point,' and does not face the same cost pressures (or look forward to the same proportional scale of savings benefit) that the other, smaller ISPs do by having to route their local customers' traffic internationally in the absence of an IX.

Were the M2-sized ISP to join the IX (you can see this by changing cell G12 from a 0 to a 1, it would capture a meaningful financial benefit (saving \$176,538 as shown in cell G49), but it would also bring huge benefits to its competitors (Cells B49, J49 and L49 each go up dramatically, more than doubling the savings for them as a group). The financial, strategic and business reasoning behind this ISPs decision to peer (and under what terms) will be complex.

Analysis of the Smallest ISP in the Market

Looking at Column L in detail, we can see that each individual ISP benefits by \$830 per year under Scenario A – just less than \$70 per month. While this may be a sound platform for the ISP to use to support growth (i.e., if they increase their market share, the benefits of peering go up disproportionately greater than that increase), they are also vulnerable to market shocks. For example, if the second-largest ISP in this market (S2) drops out of the IX (perhaps because they sign a bi-lateral, point-to-point peering agreement with the biggest ISP), then the S4-sized ISPs lose money by being part of the IX. We can see this by changing cell J12 from a 1 to a 0 – the numbers in cells L42 and L49 go negative.

The Overall ISP Market

Looking at cell B53 ('annual savings due to peering in this scenario'), we see that the ISP market as a whole benefits from IX participation by \$29,714. This amount can be understood in different ways:

- as cost savings for each ISP

- as margin that can be used to lower prices for customers or to cushion their business against future market changes
- as cash on hand to invest in capital equipment, sales and marketing initiatives or training for employees

In such a scenario as the one described above, the unbalanced nature of the market (i.e., one dominant player) nevertheless makes a peering arrangement financially viable among the smaller players, but exposes them to some risk as the market changes. If they expect the share of the ISP market held by IX members to grow against the dominant player over coming years, then the risks are likely to shrink as well.