

# The Value of Peering



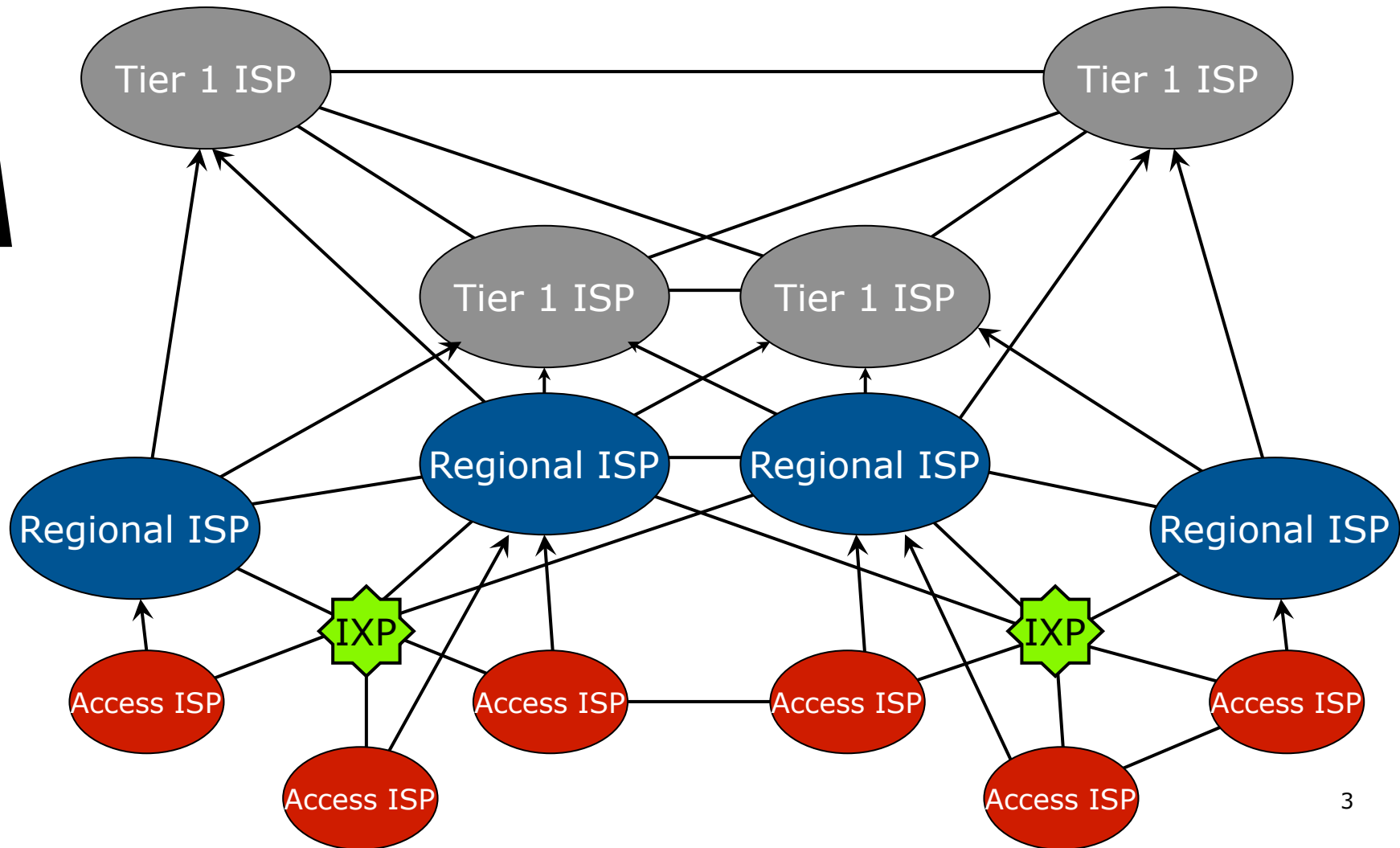
## ISP Workshops

# The Internet

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- Internet is made up of ISPs of all shapes and sizes
  - Some have local coverage (access providers)
  - Others can provide regional or per country coverage
  - And others are global in scale
- These ISPs interconnect their businesses
  - They don't interconnect with every other ISP (over 46000 distinct autonomous networks) – won't scale
  - They interconnect according to practical and business needs
- Some ISPs provide transit to others
  - They interconnect other ISP networks
  - Around 6000 autonomous networks provide transit

# Categorising ISPs



# Peering and Transit

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## □ Transit

- Carrying traffic across a network
- Usually for a fee
- Example: Access provider connects to a regional provider

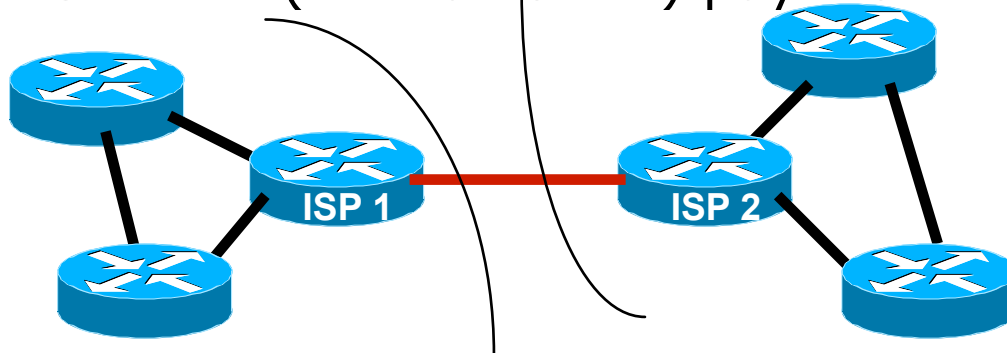
## □ Peering

- Exchanging routing information and traffic
- Usually for no fee
- Sometimes called settlement free peering
- Example: Regional provider connects to another regional provider

# Private Interconnect

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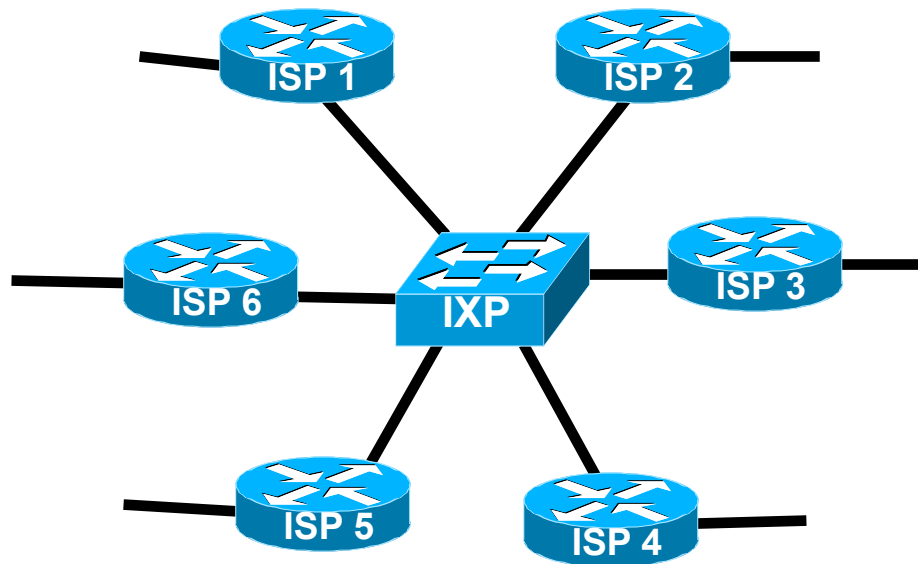
- ❑ Two ISPs connect their networks over a **private link**
  - Can be peering arrangement
    - ❑ No charge for traffic
    - ❑ Share cost of the link
  - Can be transit arrangement
    - ❑ One ISP charges the other for traffic
    - ❑ One ISP (the customer) pays for the link



# Public Interconnect

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- ❑ Several ISPs meeting in a common neutral location and interconnect their networks
  - Usually is a peering arrangement between their networks



# Types of Peering (1)

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- Private Peering
  - Where two network operators agree to interconnect their networks, and exchange their respective routes, for the purpose of ensuring their customers can reach each other directly over the peering link
- Settlement Free Peering
  - No traffic charges
  - **The most common form of peering**
- Paid Peering
  - Where two operators agree to exchange traffic charges for a peering relationship

# Types of Peering (2)

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- Bi-lateral Peering
  - Very similar to Private Peering, but may take place at a public peering point (IXP)
- Multilateral Peering
  - Takes place at Internet Exchange Points, where operators all peer with each other via a Router Server
- Mandatory Multilateral Peering
  - Where operators are forced to peer with each other as condition of IXP membership
  - **Strongly discouraged: Has no record of success**



# Types of Peering (3)

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- ❑ Open Peering
  - Where an ISP publicly states that they will peer with all parties who approach them for peering
  - Commonly found at IXPs where ISP participates via the Route Server
- ❑ Selective Peering
  - Where an ISP's peering policy depends on the nature of the operator who requests peering with them
  - At IXPs, operator will not peer with RS but will only peer bilaterally
- ❑ Closed Peering
  - Where an ISP decides who its peering partners are, and is generally not approachable to creating peering opportunities

# Types of Peering (4)

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- The Peering Database documents ISPs peering policies
  - <http://peeringdb.com>
- All operators of ASNs should register in the peeringdb
  - All operators who are considering peering or are peering must be in the peeringdb to enhance their peering opportunities
- Participation in peering fora is encouraged too
  - Global Peering Forum (GPF)
  - Regional Peering Fora (European, Middle Eastern, Asian, Caribbean, Latin American)

# ISP Goals

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- ❑ **Minimise** the **cost** of operating the business
- ❑ Transit
  - ISP has to pay for circuit (international or domestic)
  - ISP has to pay for data (usually per Mbps)
  - Repeat for each transit provider
  - Significant cost of being a service provider
- ❑ Peering
  - ISP shares circuit cost with peer (private) or runs circuit to public peering point (one off cost)
  - No need to pay for data
  - Reduces transit data volume, therefore reducing cost

# Transit – How it works

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- Small access provider provides Internet access for a city's population
  - Mixture of dial up, wireless and fixed broadband
  - Possibly some business customers
  - Possibly also some Internet cafes
- How do their customers get access to the rest of the Internet?
- ISP buys access from one, two or more larger ISPs who already have visibility of the rest of the Internet
  - This is transit – they pay for the physical connection to the upstream and for the traffic volume on the link

# Peering – How it works

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- If two ISPs are of equivalent sizes, they have:
  - Equivalent network infrastructure coverage
  - Equivalent customer size
  - Similar content volumes to be shared with the Internet
  - Potentially similar traffic flows to each other's networks
- This makes them good peering partners
- If they don't peer
  - They both have to pay an upstream provider for access to each other's network/customers/content
  - Upstream benefits from this arrangement, the two ISPs both have to fund the transit costs

# The IXP's role

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- ❑ Private peering makes sense when there are very few equivalent players
  - Connecting to one other ISP costs  $X$
  - Connecting to two other ISPs costs 2 times  $X$
  - Connecting to three other ISPs costs 3 times  $X$
  - Etc... (where  $X$  is half the circuit cost plus a port cost)
- ❑ The more private peers, the greater the cost
- ❑ IXP is a more scalable solution to this problem

# The IXP's role

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- Connecting to an IXP
  - ISP costs: one router port, one circuit, and one router to locate at the IXP
- Some IXPs charge annual “maintenance fees”
  - The maintenance fee has potential to significantly influence the cost balance for an ISP
- Generally connecting to an IXP and peering there becomes cost effective when there are at least three other peers
  - The real \$ amount varies from region to region, IXP to IXP

# Who peers at an IXP?

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## □ Access Providers

- Don't have to pay their regional provider transit fees for local traffic
- Keeps latency and costs for local traffic low
- 'Unlimited' bandwidth through the IXP (compared with costly and limited bandwidth through transit provider)

## □ Regional Providers

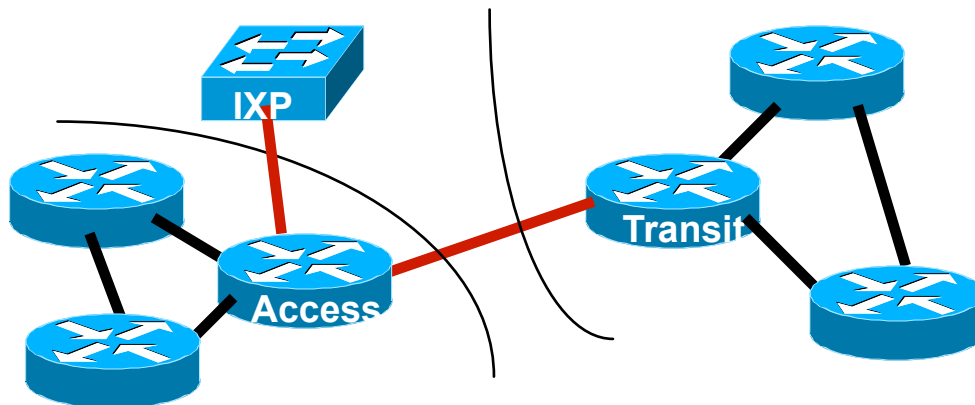
- Don't have to pay their global provider transit for local and regional traffic
- Keeps latency and costs for local and regional traffic low
- 'Unlimited' bandwidth through the IXP (compared with costly and limited bandwidth through global provider)



# The IXP's role

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- ❑ Global Providers can be located close to IXPs
  - Attracted by the potential transit business available
- ❑ Advantageous for access & regional providers
  - They can peer with other similar providers at the IXP
  - And in the same facility pay for transit to their regional or global provider
  - (Not across the IXP fabric, but a separate connection)



# Connectivity Decisions

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## □ Transit

- Almost every ISP needs transit to reach rest of Internet
- One provider = no redundancy
- Two providers: ideal for traffic engineering as well as redundancy
- Three providers = better redundancy, traffic engineering gets harder
- More than three = diminishing returns, rapidly escalating costs and complexity

## □ Peering

- Means low (or zero) cost access to another network
- Private or Public Peering (or both)

# Transit Goals

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1. **Minimise number of transit providers**
  - But maintain redundancy
  - 2 is ideal, 4 or more is hard
2. **Aggregate capacity to transit providers**
  - More aggregated capacity means better value
    - Lower cost per Mbps
  - 4x 45Mbps circuits to 4 different ISPs will almost always cost more than 2x 155Mbps circuits to 2 different ISPs
    - Yet bandwidth of latter (310Mbps) is greater than that of former (180Mbps) and is much easier to operate

# Peering or Transit?

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- How to choose?
- Or do both?
- It comes down to cost of going to an IXP
  - Free peering
  - Paying for transit from an ISP co-located in same facility, or perhaps close by
- Or not going to an IXP and paying for the cost of transit directly to an upstream provider
  - There is no right or wrong answer, someone has to do the arithmetic

# Private or Public Peering

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- Private peering
  - Scaling issue, with costs, number of providers, and infrastructure provisioning
- Public peering
  - Makes sense the more potential peers there are (more is usually greater than “two”)
- Which public peering point?
  - Local Internet Exchange Point: great for local traffic and local peers
  - Regional Internet Exchange Point: great for meeting peers outside the locality, might be cheaper than paying transit to reach the same consumer base

# Local Internet Exchange Point

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- ❑ Defined as a public peering point serving the local Internet industry
- ❑ Local means where it becomes cheaper to interconnect with other ISPs at a common location than it is to pay transit to another ISP to reach the same consumer base
  - Local can mean different things in different regions!

# Regional Internet Exchange Point

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- These are also “local” Internet Exchange Points
- But also attract regional ISPs and ISPs from outside the locality
  - Regional ISPs peer with each other
  - And show up at several of these Regional IXPs
- Local ISPs peer with ISPs from outside the locality
  - They don’t compete in each other’s markets
  - Local ISPs don’t have to pay transit costs
  - ISPs from outside the locality don’t have to pay transit costs
  - Quite often ISPs of disparate sizes and influences will happily peer – to defray transit costs

# Which IXP?

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- How many routes are available?
  - What is traffic to & from these destinations, and by how much will it reduce cost of transit?
- What is the cost of co-lo space?
  - If prohibitive or space not available, pointless choosing this IXP
- What is the cost of running a circuit to the location?
  - If prohibitive or competitive with transit costs, pointless choosing this IXP
- What is the cost of remote hands/assistance?
  - If no remote hands, doing maintenance is challenging and potentially costly with a serious outage



# Example: South Asian ISP @ LINX

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- Time: May 2013
- Data:
  - Route Server plus bilateral peering offers 70k prefixes
  - IXP traffic averages 247Mbps/45Mbps
  - Transit traffic averages 44Mbps/4Mbps
- Analysis:
  - 85% of inbound traffic comes from 70k prefixes available by peering
  - 15% of inbound traffic comes from remaining 380k prefixes from transit provider

# Example: South Asian ISP @ HKIX

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- Time: May 2013
- Data:
  - Route Server plus bilateral peering offers 67k prefixes
  - IXP traffic is 159Mbps/20Mbps
  - Transit traffic is 108Mbps/50Mbps
- Analysis:
  - 60% of inbound traffic comes from 67k prefixes available by peering
  - 40% of inbound traffic comes from remaining 383k prefixes from transit provider

# Example: South Asian ISP

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## □ Summary:

- Traffic by Peering: 406Mbps/65Mbps
- Traffic by Transit: 152Mbps/54Mbps
  
- 73% of incoming traffic is by peering
- 55% of outbound traffic is by peering

# Example: South Asian ISP

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- Router at remote co-lo
  - Benefits: can select peers, easy to swap transit providers
  - Costs: co-lo space and remote hands
- Servers at remote co-lo
  - Benefits: mail filtering, content caching, etc
  - Costs: co-lo space and remote hands
- Overall advantage:
  - Can control what goes on the expensive connectivity “back to home”

# Value propositions

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- Peering at a local IXP
  - Reduces latency & transit costs for local traffic
  - Improves Internet quality perception
- Participating at a Regional IXP
  - A means of offsetting transit costs
- Managing connection back to home network
- Improving Internet Quality perception for customers

# Summary

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- Benefits of peering
  - Private
  - Internet Exchange Points
- Local versus Regional IXPs
  - Local services local traffic
  - Regional helps defray transit costs

# Worked Example



Single International Transit  
Versus  
Local IXP + Regional IXP + Transit

# Worked Example

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- ISP A is local access provider
  - Some business customers (around 200 fixed links)
  - Some co-located content provision (datacentre with 100 servers)
  - Some consumers on broadband (5000 DSL/Cable/Wireless)
  - Some consumers on dial (1000 on V.34 type speeds)
- They have a single transit provider
  - Connect with a 16Mbps international leased link to their transit's PoP
  - Transit link is highly congested



## Worked Example (2)

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- There are two other ISPs serving the same locality
  - There is no interconnection between any of the three ISPs
  - Local traffic (between all 3 ISPs) is traversing International connections
- Course of action for our ISP:
  - Work to establish local IXP
  - Establish presence at overseas co-location
- First Step
  - Assess local versus international traffic ratio
  - Use NetFlow on border router connecting to transit provider

# Worked Example (3)

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- Local/Non-local traffic ratio
  - Local = traffic going to other two ISPs
  - Non-local = traffic going elsewhere
- Example: balance is 30:70
  - Of 16Mbps, that means 5Mbps could stay in country and not congest International circuit
  - 16Mbps transit costs \$50 per Mbps per month traffic charges = \$250 per month, or \$3000 per year for local traffic
  - Circuit costs \$100k per year: \$30k is spent on local traffic
- Total is \$33k per year for local traffic

# Worked Example (4)

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## □ IXP cost:

- Simple 8 port 10/100 managed switch plus co-lo space over 3 years could be around US\$30k total; or \$3k per year per ISP
- One router to handle 5Mbps (e.g. 2801) would be around \$3k (good for 3 years)
- One local 10Mbps circuit from ISP location to IXP location would be around \$5k per year, no traffic charges
- Per ISP total: \$9k
- Somewhat cheaper than \$33k
- Business case for local peering is straightforward - \$24k saving per annum

# Worked Example (5)

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- After IXP establishment
  - 5Mbps removed from International link
  - Leaving 5Mbps for more International traffic – and that fills the link within weeks of the local traffic being removed
- Next step is to assess transit charges and optimise costs
  - ISPs visits several major regional IXPs
  - Assess routes available
  - Compares routes available with traffic generated by those routes from its Netflow data
  - Discovers that 30% of traffic would transfer to one IXP via peering

# Worked Example (6)

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## □ Costs:

- Router for Regional IXP (e.g. 2801) at \$3k over three years
- Co-lo space at Regional IXP venue at \$3k per year
- Best price for transit at the Regional IXP venue by competitive tender is \$30 per Mbps per month, plus \$1k port charge
- 30% of traffic offloads to IXP, leaving 70% of 16Mbps to transit provider = \$330 per month, or \$5k per annum
- Total with this model is \$9k per year, plus the cost of the circuit (still \$100k)
- Compare this with paying \$50 per Mbps per month to the transit provider = \$10k per annum (plus cost of the circuit)

# Worked Example (7)

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## □ Result:

- ISP co-locates at Regional IXP
- Pays reduced transit charges to transit provider (competitive tender)
- Pays no charges for traffic across Regional IXP

## □ Bonuses:

- Rate limits on router at Regional IXP Co-lo
  - Can prioritise congestion dependent on customer demands
- Install servers at Regional IXP co-lo facility
  - Filters e-mail (spam and viruses) – relieves some capacity on link
  - Caches content – relieves a little more capacity on link

# Conclusion

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- Within the original costs of having one international transit provider:
  - ISP has turned up at the local IXP and offloaded local traffic for free
  - ISP has turned up at a major regional IXP and offloaded traffic, avoiding paying transit charges to transit provider
  - ISP has reduced remaining transit charges by competitive tender at the regional IXP co-location facility
- Caveat
  - These numbers are typical of the Internet today
  - As ever, your mileage may vary – but do the financial calculations first and in the context of potential technical advantages too

# The Value of Peering



ISP Workshops