



# Internet Exchange Point Design

**ISP/IXP Workshops**

# IXP Design

- **Why set up an IXP?**
- **Layer 2 Exchange Point**
- **Layer 3 Exchange Point**
- **Design Considerations**

# Internet Exchange Points

- **Layer 2 exchange point**

**Ethernet (1000/100Mbps)**

**Older technologies include ATM, Frame Relay, SRP, FDDI and SMDS**

- **Layer 3 exchange point**

**router based**

**central or distributed**



# Why an Internet Exchange Point?

**Saving money, improving QoS,  
Generating a local Internet economy**

# Internet Exchange Point

## Why peer?

- **Consider a region with one ISP**
  - They provide internet connectivity to their customers**
  - They have one or two international connections**
- **Internet grows, another ISP sets up in competition**
  - They provide internet connectivity to their customers**
  - They have one or two international connections**
- **How does traffic from customer of one ISP get to customer of the other ISP?**
  - Via the international connections**

# Internet Exchange Point

## Why peer?

- **Yes, International Connections...**

**If satellite, RTT is around 550ms per hop**

**So local traffic takes over 1s round trip**

- **International bandwidth**

**Costs significantly more than domestic bandwidth**

**Congested with local traffic**

**Wastes money, harms performance**

# Internet Exchange Point

## Why peer?

- **Solution:**

**Two competing ISPs peer with each other**

- **Result:**

**Both save money**

**Local traffic stays local**

**Better network performance, better QoS,...**

**More international bandwidth for expensive international traffic**

**Everyone is happy**

# Internet Exchange Point

## Why peer?

- **A third ISP enters the equation**

**Becomes a significant player in the region**

**Local and international traffic goes over their international connections**

- **They agree to peer with the two other ISPs**

**To save money**

**To keep local traffic local**

**To improve network performance, QoS,...**

# Internet Exchange Point

## Why peer?

- **Peering means that the three ISPs have to buy circuits between each other**

**Works for three ISPs, but adding a fourth or a fifth means this does not scale**

- **Solution:**

**Internet Exchange Point**

# Internet Exchange Point

- **Every participant has to buy just one whole circuit**  
From their premises to the IXP
- **Rather than N-1 half circuits to connect to the N-1 other ISPs**  
5 ISPs have to buy 4 half circuits = 2 whole circuits → already twice the cost of the IXP connection

# Internet Exchange Point

- **Solution**

**Every ISP participates in the IXP**

**Cost is minimal – one local circuit covers all domestic traffic**

**International circuits are used for just international traffic – and backing up domestic links in case the IXP fails**

- **Result:**

**Local traffic stays local**

**QoS considerations for local traffic is not an issue**

**RTTs are typically sub 10ms**

**Customers enjoy the Internet experience**

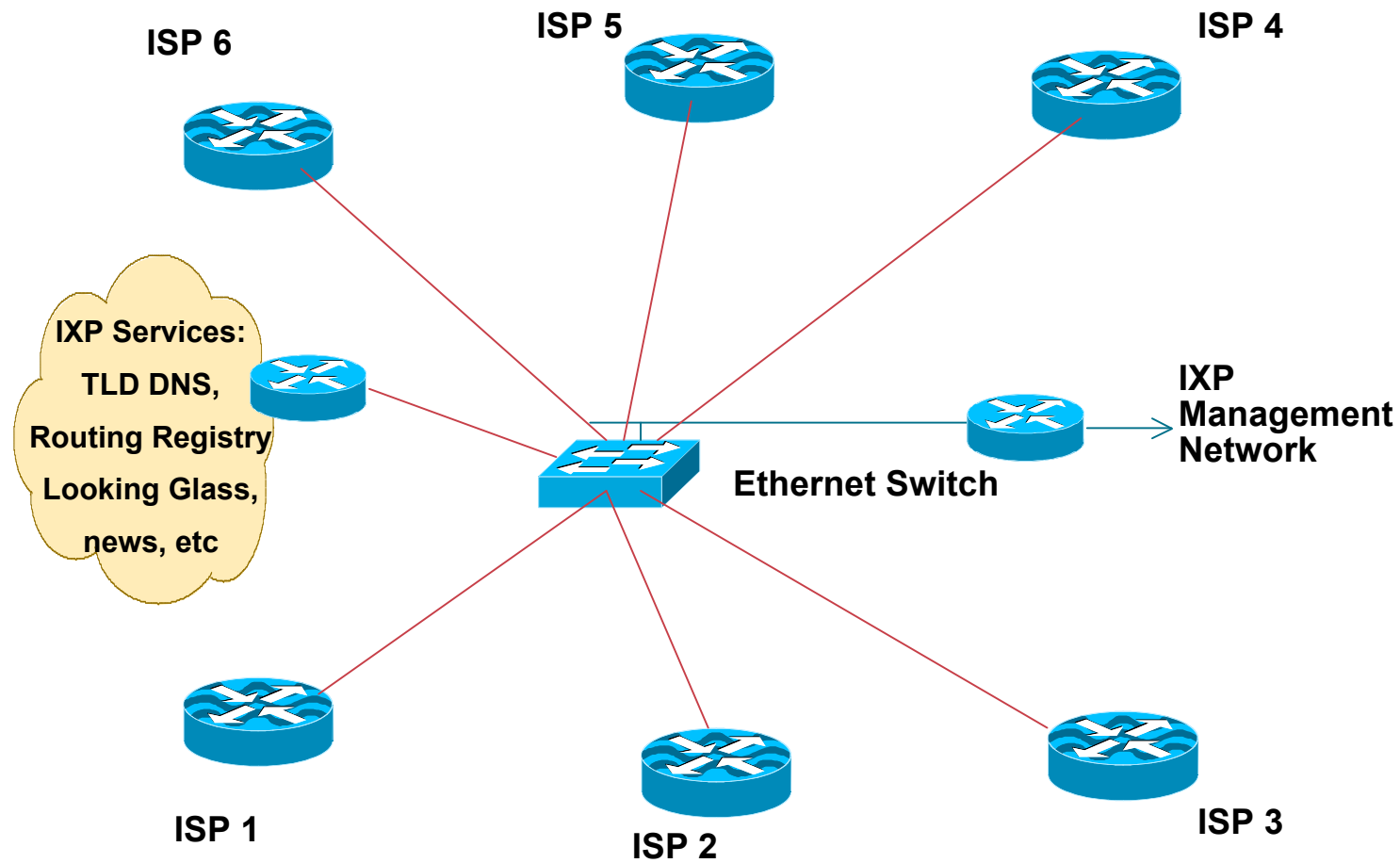
**Local Internet economy grows rapidly**



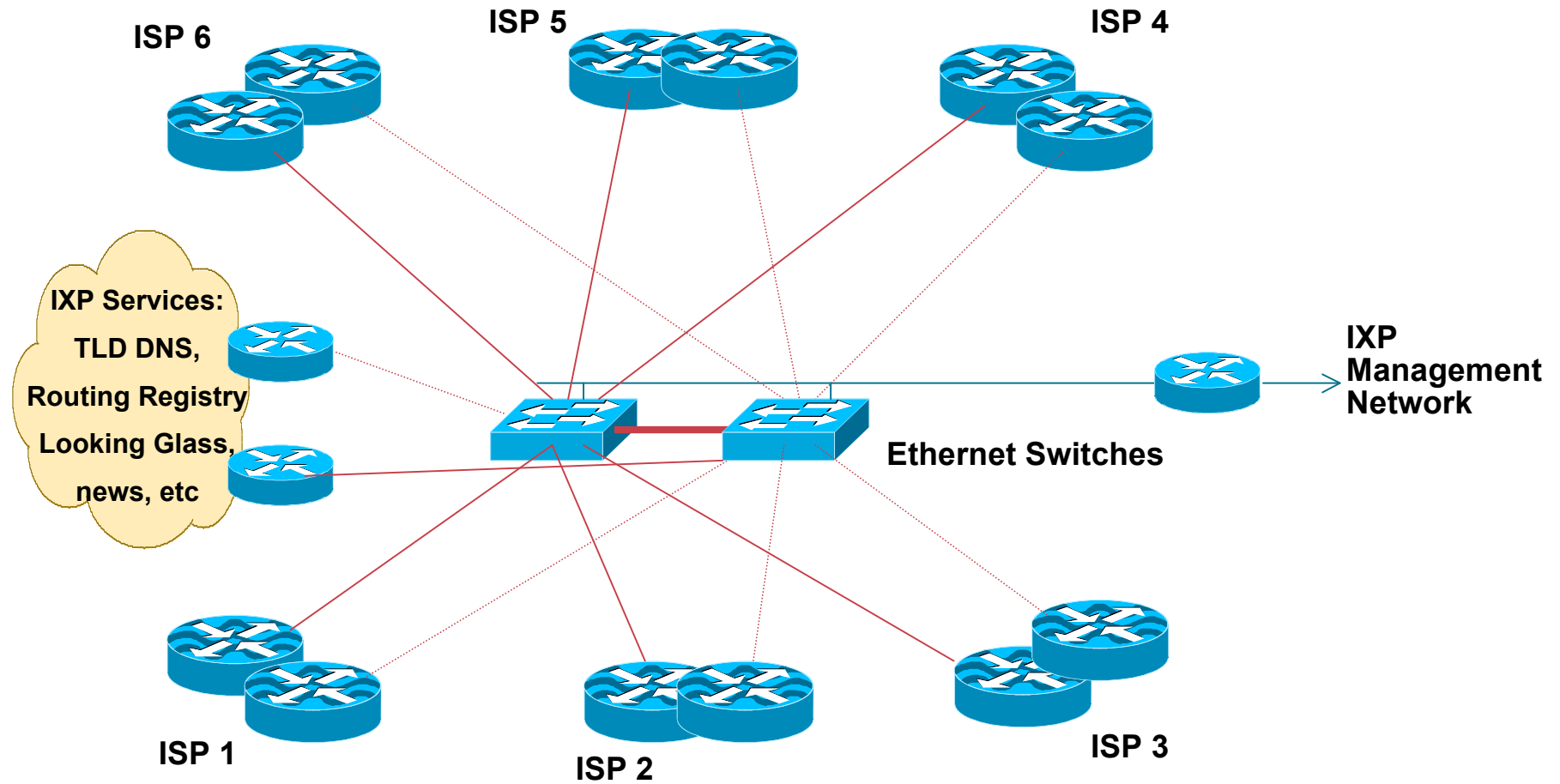
# Layer 2 Exchange

**The traditional IXP**

# Layer 2 Exchange



# Layer 2 Exchange



# Layer 2 Exchange

- **Two switches for redundancy**
- **ISPs use dual routers for redundancy or loadsharing**
- **Offer services for the “common good”**

**Internet portals and search engines**

**DNS TLD, News, NTP servers**

**Routing Registry and Looking Glass**

# Layer 2 Exchange

- **Requires neutral IXP management**
  - usually funded equally by IXP participants
  - 24x7 cover, support, value add services
- **Secure and neutral location**
- **Configuration**
  - private address space if non-transit and no value add services
  - ISPs require AS, basic IXP does not

# Layer 2 Exchange

- **Network Security Considerations**

**LAN switch needs to be securely configured**

**Management routers require TACACS+ authentication, vty security**

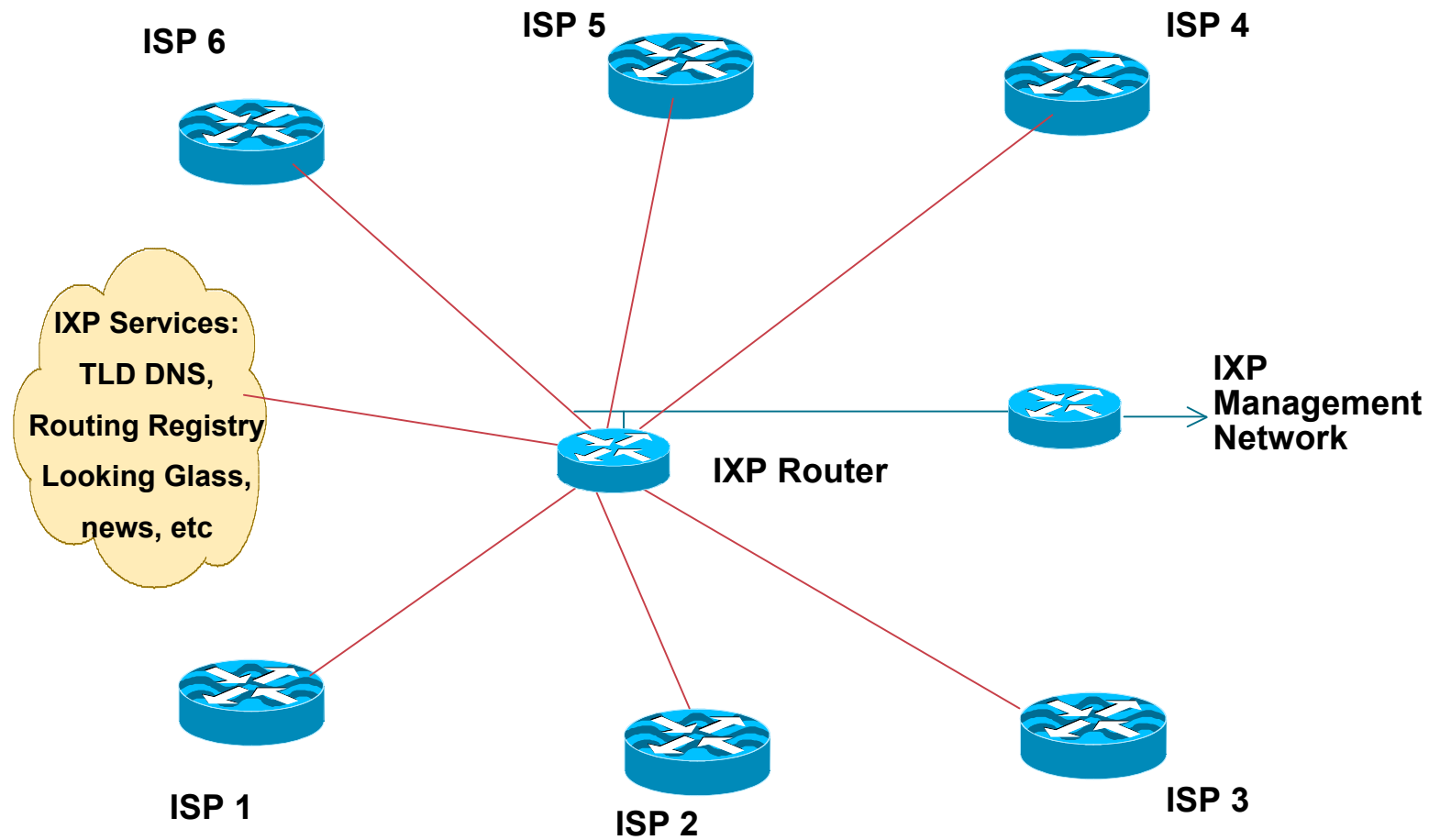
**IXP services must be behind router(s) with strong filters**



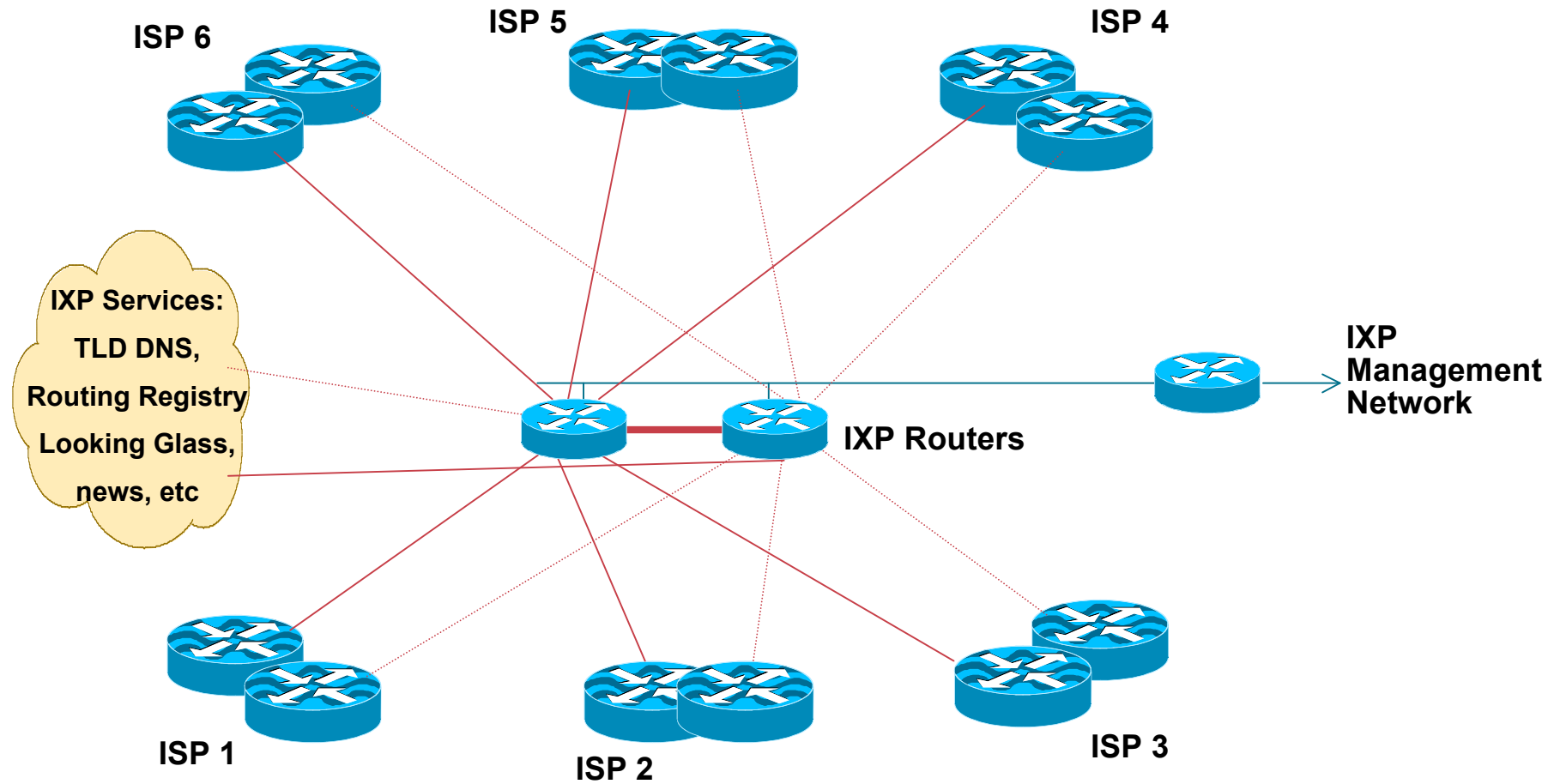
# Layer 3 Exchange

**The wholesale transit ISP**

# Layer 3 Exchange



# Layer 3 Exchange



# Layer 3 Exchange

- **Two routers for redundancy**
- **ISPs use dual routers for redundancy or loadsharing**
- **Offer services for the “common good”**

**Internet portals and search engines**

**DNS TLD, News, NTP servers**

**Routing Registry and Looking Glass**

# Layer 3 Exchange

- **Requires neutral IXP management**
  - usually funded equally by IXP participants
  - 24x7 cover, support, value add services
  - BGP configuration skills essential
- **Secure and neutral location**
- **Configuration**
  - private address space if non-transit and no value add services
  - ISPs and IXP require AS

# Layer 3 Exchange

- **Network Security Considerations**

**Core IXP router(s) require strong security, preferably with BGP neighbour authentication**

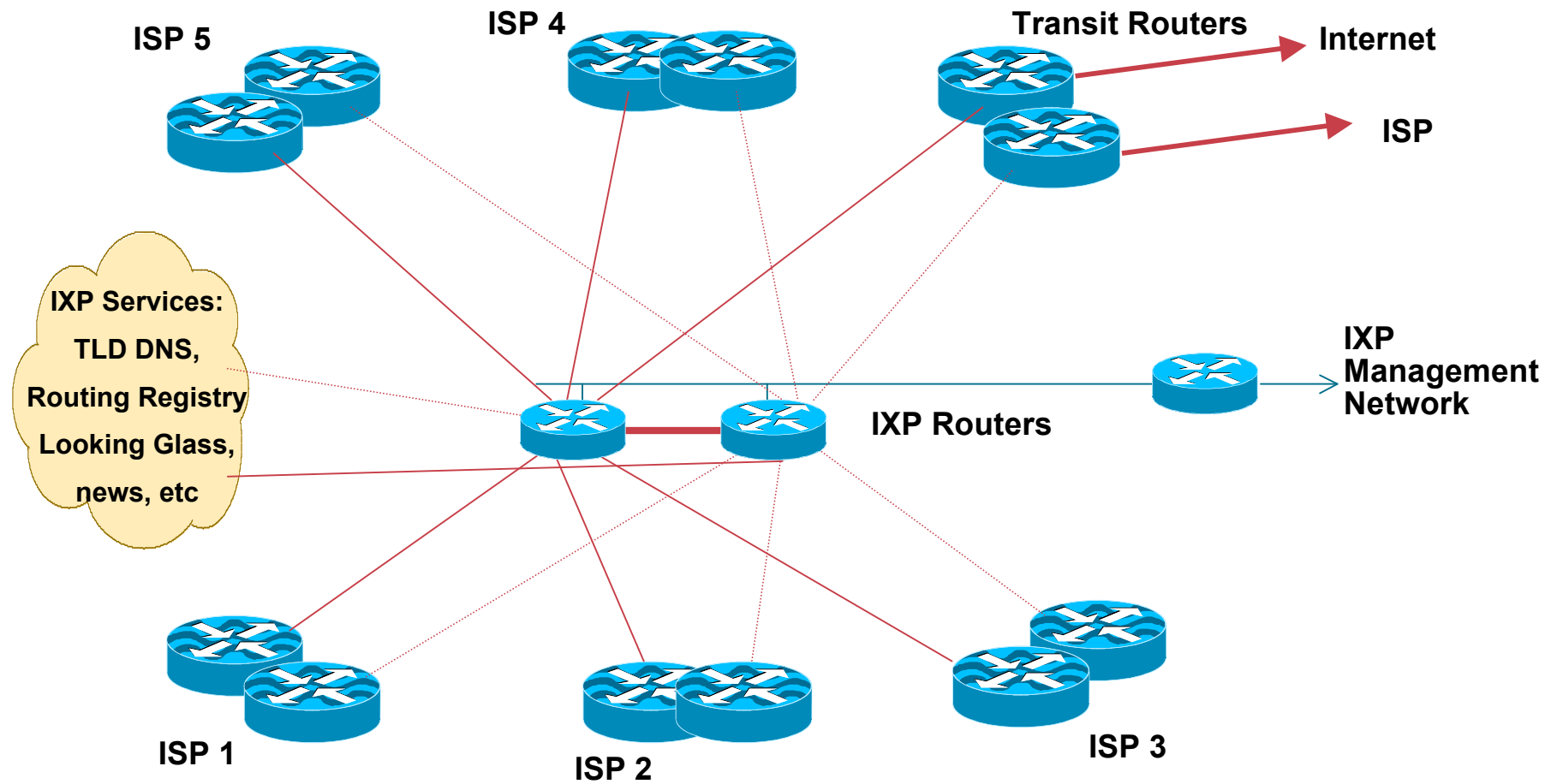
**Management routers require TACACS+ authentication, vty security**

**IXP services must be behind router(s) with strong filters**

# Transit IXPs

- **Provides local Internet exchange facility to members**
- **Also provides transit to Internet or upstream ISP**
- **Usually operated as a commercial service**
- **Usually layer 3 design**

# Layer 3 Transit Exchange



# Layer 2 versus Layer 3

- **Layer 3**

**IXP team requires good BGP knowledge**

**Rely on 3rd party for BGP configuration**

**Less freedom on who peers with whom**

**Could potentially compete with IXP membership**

**Easier to distribute over wide area**

# Layer 2 versus Layer 3

- **Layer 2**

**IXP team does not need routing knowledge**

**Easy to get started**

**More complicated to distribute over wide area**

**ISPs free to set up peering agreements with each other as they wish**

# Layer 2 versus Layer 3 Summary

- **Layer 2 is a REAL internet exchange point**
- **Layer 3 is marketing concept used by Transit ISPs**



# IXP Design Considerations

# Routing

- **ISP border routers at the IXP generally should NOT be configured with default route or carry full Internet routing table**

**Carrying default or full table means that this router and the ISP network is open to abuse by non-peering IXP members**

**Correct configuration is only to carry routes offered to IXP peers on the IXP peering router**

- **Note: Some ISPs offer transit across IX fabrics**

**They do so at their own risk – see above**

# Routing (more)

- **ISP border routers at the IXP should not be configured to carry the IXP LAN network within the IGP or iBGP**

**Use next-hop-self BGP concept**

- **Don't generate ISP prefix aggregates on IXP peering router**

**If connection from backbone to IXP router goes down, normal BGP failover will then be successful**

# Address Space

- **Some IXPs use private addresses for the IX LAN**

**Public address space means IXP network could be leaked to Internet which may be undesirable**

**Because most ISPs filter RFC1918 address space, this avoids the problem**

- **Some IXPs use public addresses for the IX LAN**

**Address space available from the RIRs**

**IXP terms of participation often forbid the IX LAN to be carried in the ISP member backbone**

# Hardware

- **Don't mix port speeds**

**if 10Mbps and 100Mbps connections available, terminate on different switches (L2 IXP)**

- **Don't mix transports**

**if terminating ATM PVCs and G/F/Ethernet, terminate on different devices**

- **Insist that IXP participants bring their own router**

**moves buffering problem off the IXP**

**security is responsibility of the ISP, not the IXP**

# Services Offered

- **Services offered should not compete with member ISPs (basic IXP)**

e.g. web hosting at an IXP is a bad idea unless all members agree to it

- **IXP operations should make performance and throughput statistics available to members**

Use tools such as MRTG to produce IX throughput graphs for member (or public) information

# Services to Offer

- **TLD DNS**

**the country IXP could host the country's top level DNS**

**e.g. "SE." TLD is hosted at Netnod IXes in Sweden**

**Offer back up of other country TLD DNS**

- **Root server**

**Anycast instances of I.root-servers.net, F.root-servers.net etc are present at many IXes**

- **Usenet News**

**Usenet News is high volume**

**could save bandwidth to all IXP members**

# Services to Offer

- **Route Collector**

**All IXP members peer with the route collector**

**Route collector shows the reachability information available at the exchange**

**Requires a simple router with large memory**

- **Looking Glass**

**one way of making the Route Collector routes available for global view**

**public or members only access**

# Services to Offer Route Server

- **Reduces admin burden on IXP member routers**
  - only BGP session is with Route Server**
  - Route Server supplies all paths it knows to the IXP member routers – no best path selection**
- **Can use private AS**
  - Route Server software does not prepend its AS to the AS path**
- **RSd (from Merit Network) has been used**

# Services to Offer

- **Network Time Protocol**

**Locate a stratum 1 time source (GPS receiver, atomic clock, etc) at IXP**

- **Multicast**

**Provide MBONE and other multicast services for the common good**

# Services to Offer Routing Registry

- **Routing Registry is used to register the routing policy of the IXP membership**
  - documenting peering relationships**
  - auto-configuring of peer routers**
- **Alternative is to use the public Internet Routing Registry (IRR)**



# IXP Design

## Summary

# Summary

- **L2 IXP – most commonly deployed**  
Based around ethernet switches  
ATM and other old technologies are obsolete
- **L3 IXP – nowadays generally a marketing concept used by wholesale ISPs**  
Does not offer the same flexibility as L2  
Not recommended unless there are overriding regulatory or political reasons to do so



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