

Afrinic 10

May 2009

Economics of IXP



Internet Exchange Point (IXP)

Mouhamet Diop

<http://www.kheweul.com>

<http://www.next.sn>



Agenda

Definitions

Peering & Transit -

Architecture of IXP

Economy of IXP

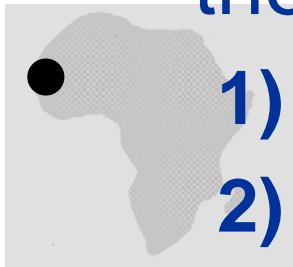
IXP enabler for Voice and Data Peering

African Strategy and Policy for Peering ?



Objectives

- **How Internet is interconnected**
(Specifically, understand and how to apply the following terms:)
 - 1) **Internet Transit**
 - 2) **Internet Peering**
 - 3) **Internet Peering Ecosystem, Tier 1 ISPs, Tier 2 ISPs; their position and motivations, and the role of Internet Exchange Points**
 - 4) **Economic Impact of IXP**



Thanks to Source NANOG & AFIX Meeting - William Norton

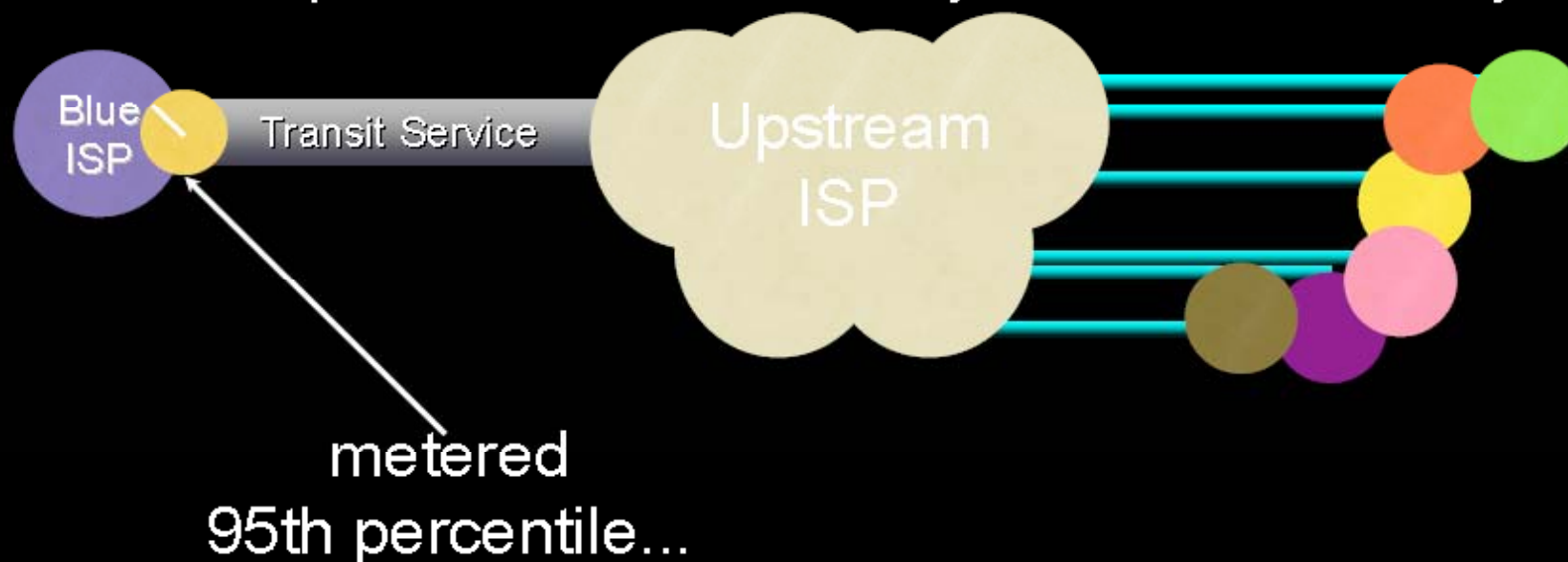
Def: The Internet is a network of networks.

Def: ISP sells access to the Internet, so...

An ISP must itself get attached to an ISP
already attached to the Internet.

Def: 'Transit' is service whereby one ISP sells access to the
Internet.

"A port in the wall that says 'Internet this way'"



Q?Transit
Billing...

Minimum Commits: Tiered Transit Pricing

\$/Mbps

12

11

10

9

8

7

6

5

4

3

Business Knobs:

ISP(s) selection

Minimum Commits

Negotiated Price

So, Transit is Easy, Cheap

Why do we need this Peering thing?

$100\text{Gbps} * \$4/\text{Mbps} = \$400\text{K}/\text{mo}$

1 2 3 4 5 6 7 8 9 10 11 12 13

Gbps commits

Source: 2008 NANOG

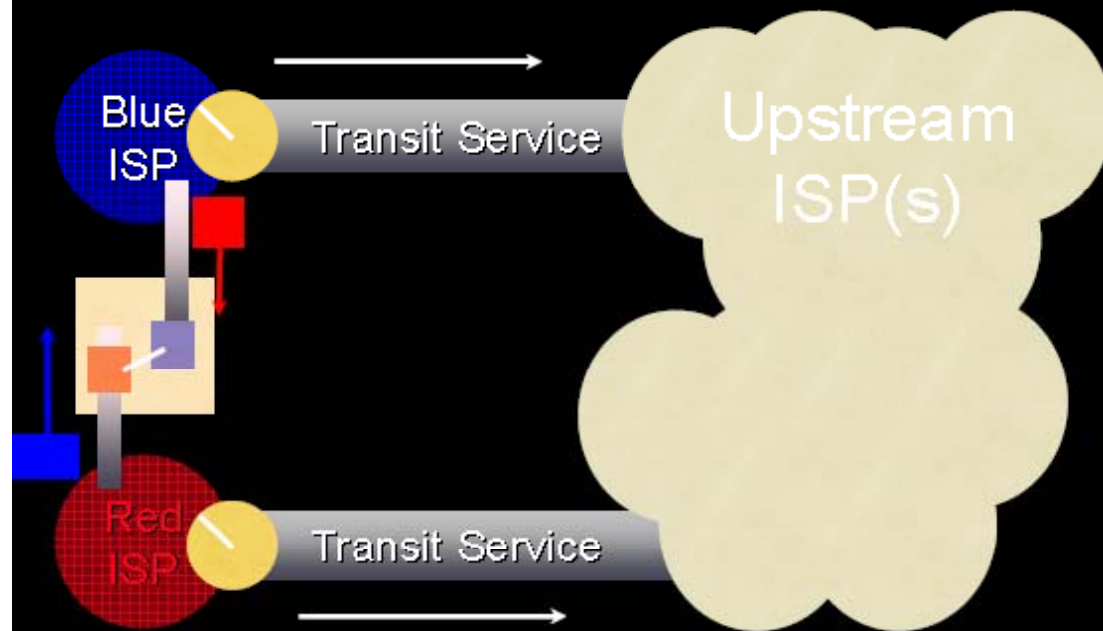
Discussions: \$4/Mbps!

Def: 'Peering' is a reciprocal exchange of access to each others customers.

Motivations to peer

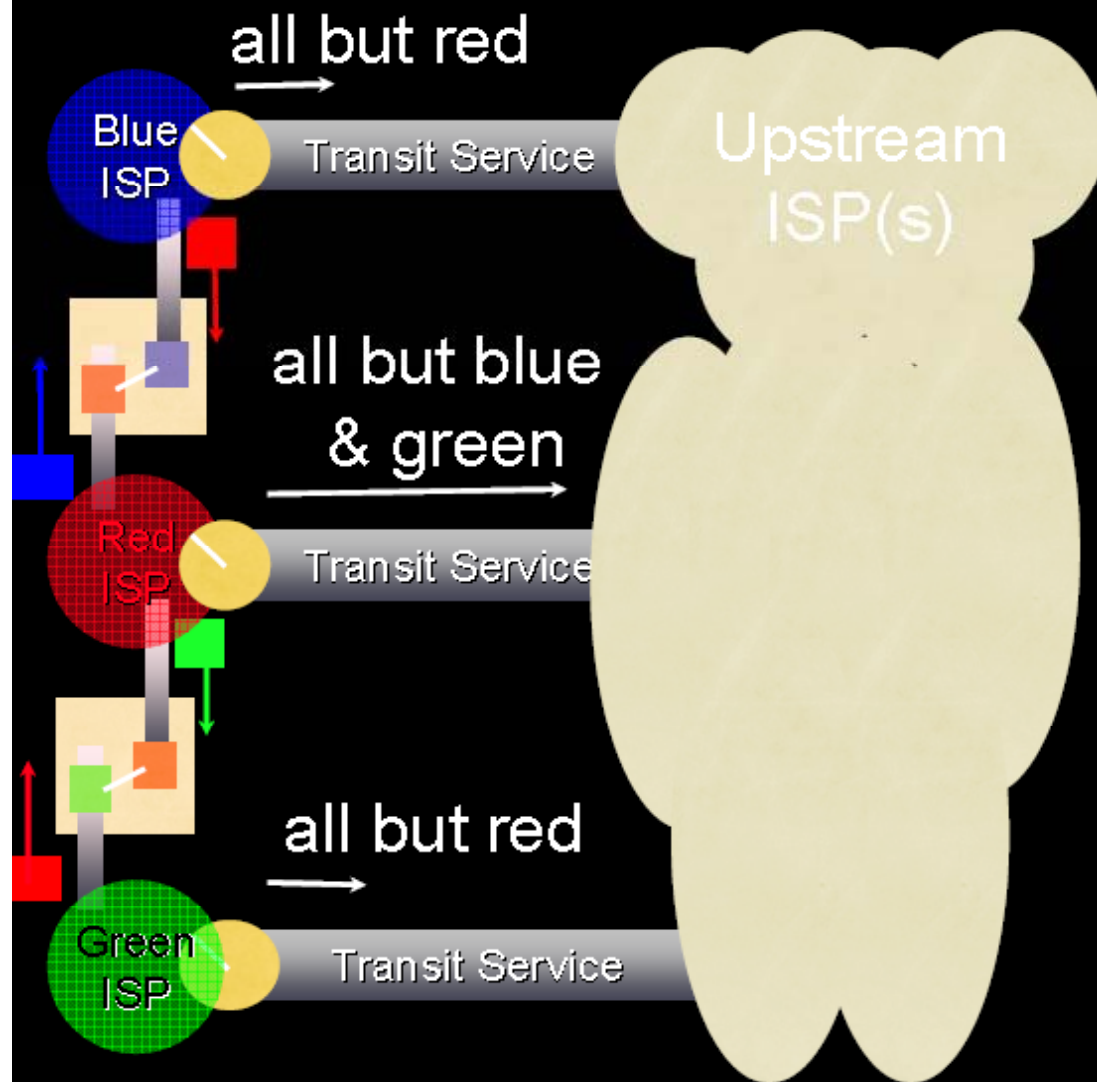
- 1) Cost Savings
- 2) Performance Benefits
- 3) Additional revenue
 - 3a) ABOV
 - 3b) AMZN

All traffic except red traffic goes this way



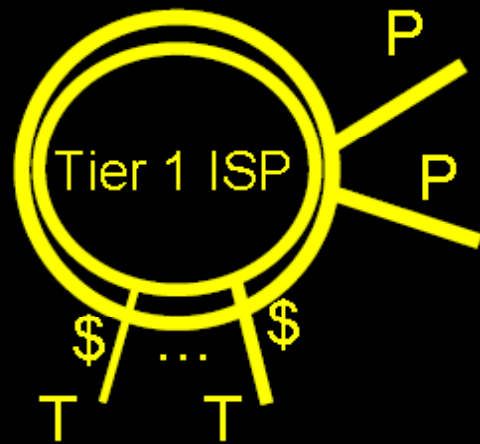
All traffic except blue traffic goes this way

Two key points about peering



- 1) Peering is not Transitive
- 2) Peering is not a perfect substitute for Transit

Ecosystem Member: Tier 1 ISP



Def: A Tier 1 ISP is an ISP that has access to the **ENTIRE Internet Region Routing Table** Solely via Peering Relationships

(Doesn't buy transit from anyone to reach any destination in the Internet Region.)

Motivation: Is NOT motivated to Peer in region to reduce transit fees,
Is NOT motivated to peer with anybody else.

Behavior: "Restrictive" Peering
*def: Policy

Definitions (WTO, EU, ITU)

The Concept Of Interconnection **According to the World Trade Organization (WTO)**, **interconnection** refers to: *"linking with suppliers providing public telecommunications transport networks or services in order to allow the users of one supplier to communicate with users of another supplier and to access services provided by another supplier, where specific commitments are undertaken »*

Under the provisions of the **European directive** of 30 June 1997, **interconnection** means: *"the physical and logical linking of telecommunications networks used by the same or a different organization in order to allow the users of one organization to communicate with users of the same or another organization, or to access services provided by another organization. Services may be provided by the parties involved or other parties who have access to the network"*

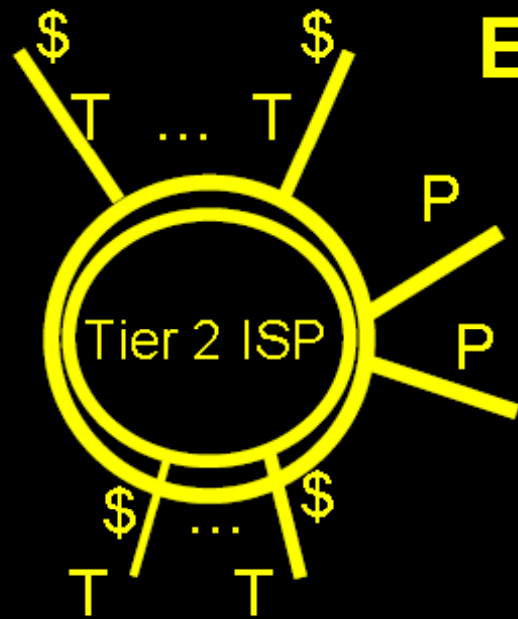
For the **International Telecommunication Union**: *"Interconnection is comprised of those commercial and technical arrangements by which service providers connect their equipment, networks and services so that their customers can have access to the customers, services and networks of other service providers"*

The Default-Free Zone (DFZ)

- The **Default-Free Zone (DFZ)** is the set of Ases without a transit provider
- To ensure *global connectivity*, each AS in the DFZ must peer with all other ASes in the DFZ, i.e., form a clique
- We look at the DFZ not from a routing, but from a business perspective
- We distinguish between **paid or unpaid peering**

AS174	Cogent
AS209	Qwest
AS293*	Energy Sciences
AS701	Verizon
AS1239	Sprint
AS1299	Telia
AS2828	XO
AS2914	NTT
AS3356	Level 3
AS3549	Global Crossing
AS6453	Teleglobe
AS6461	Abovenet
AS7018	AT&T

Ecosystem Member: Tier 2 ISP



Def: A Tier 2 ISP is an ISP that has to purchase Transit to access some part of the Internet Region.

Motivation: Is motivated to Peer in region to reduce transit fees.

Behavior: "Open" Peering or "Selective" Peering Policy
Active in Peering Forums



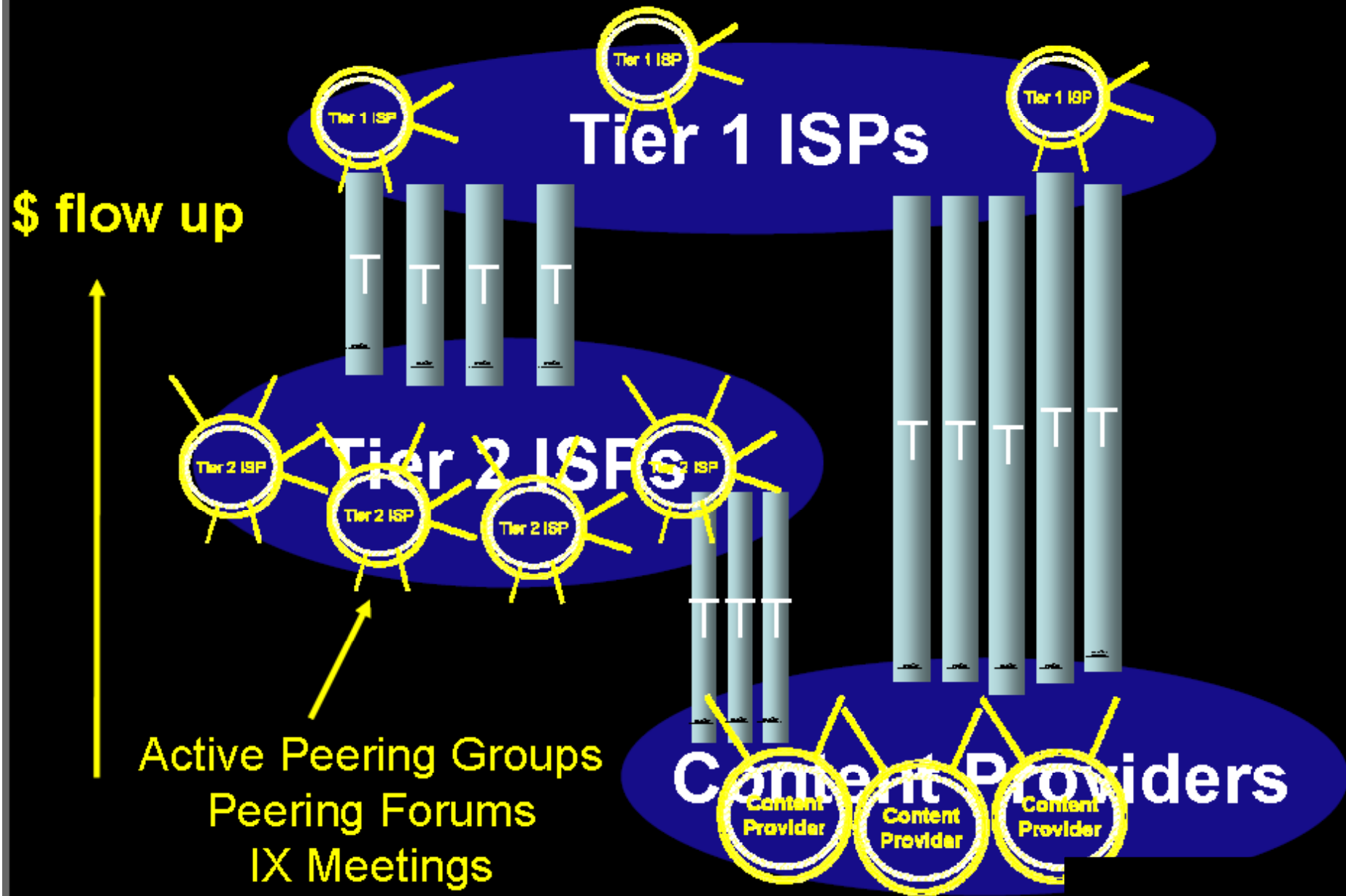
Content Providers

Def: A Content Provider focuses on content development and does not Sell access to the Internet.

Motivation: SLAs w/well known ISP

Behavior: "No Peering" Policy

Generic Peering Ecosystem

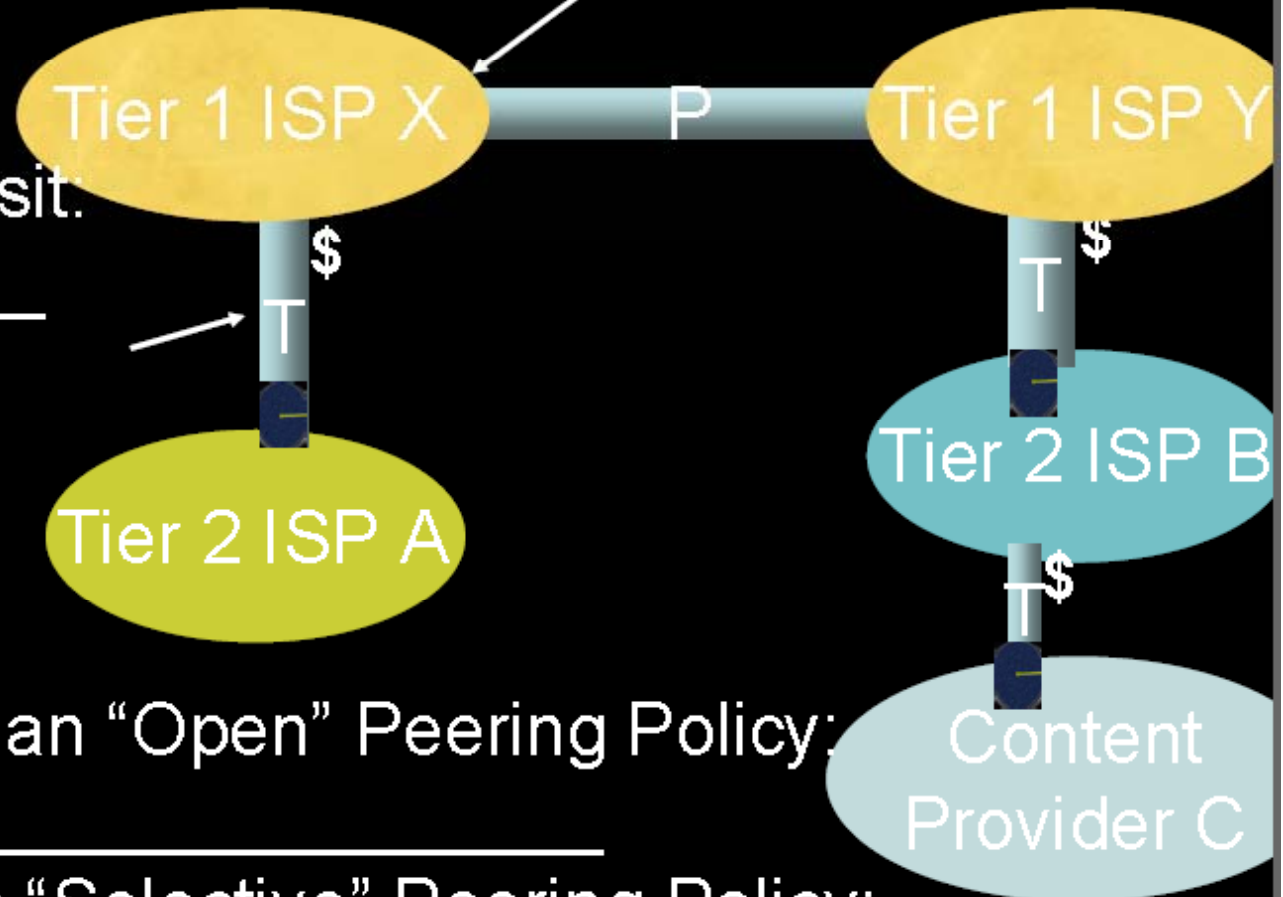


And What
About Africa ?

2) Definition of Peering:

Quiz

1) Definition of Transit:



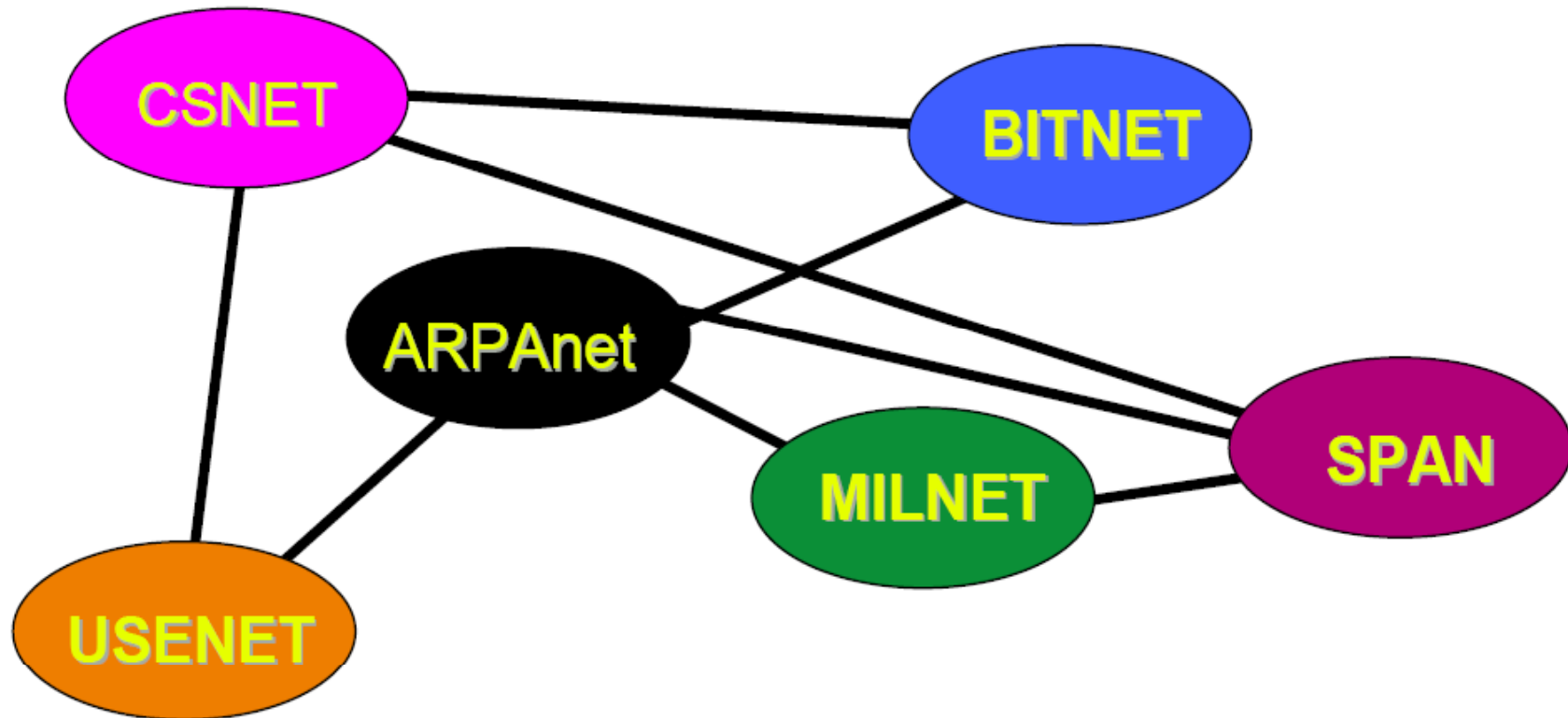
3) Definition of an "Open" Peering Policy:

4) Definition of a "Selective" Peering Policy:

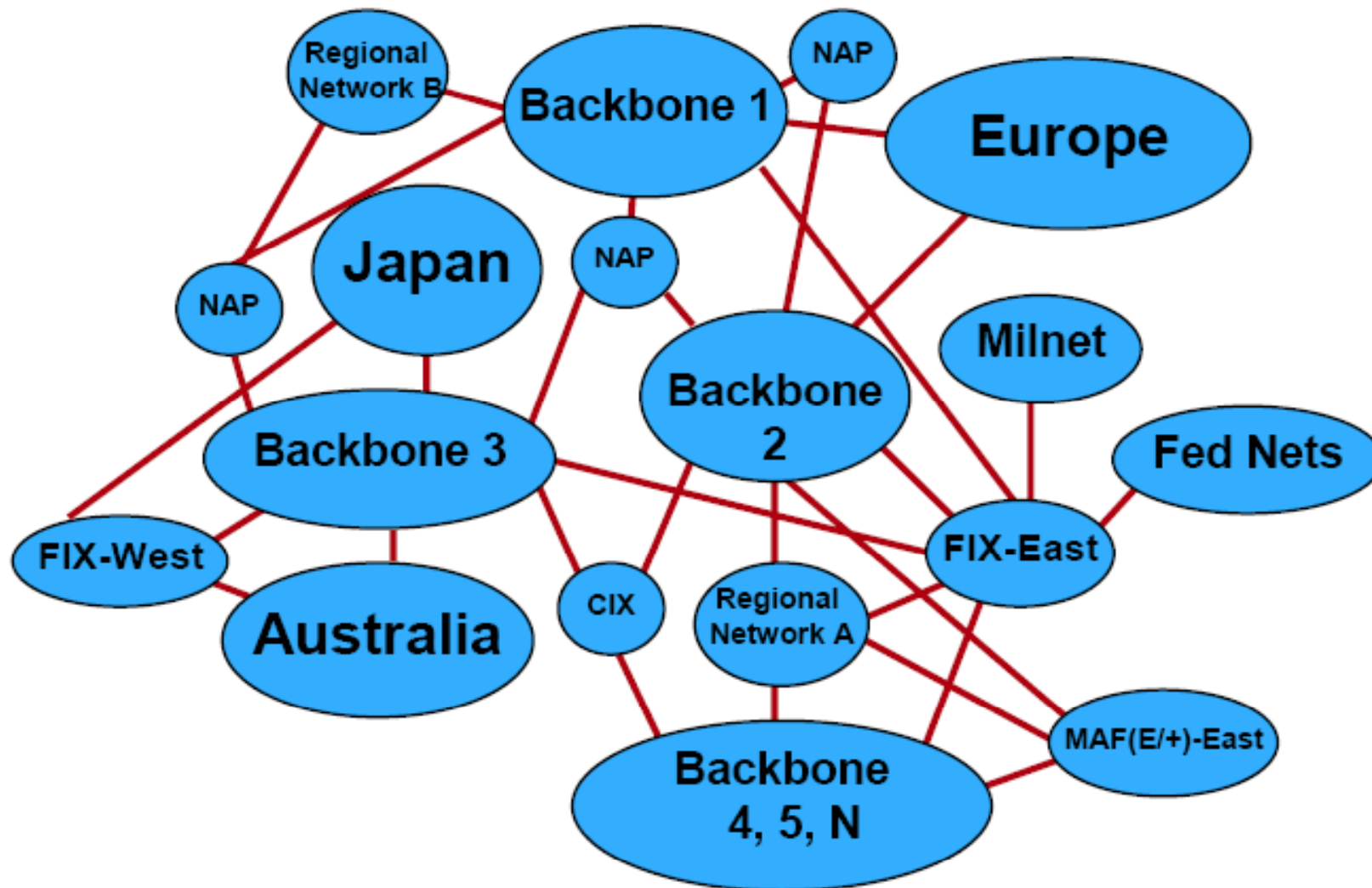
5) Definition of a "Restrictive" Peering Policy:

History

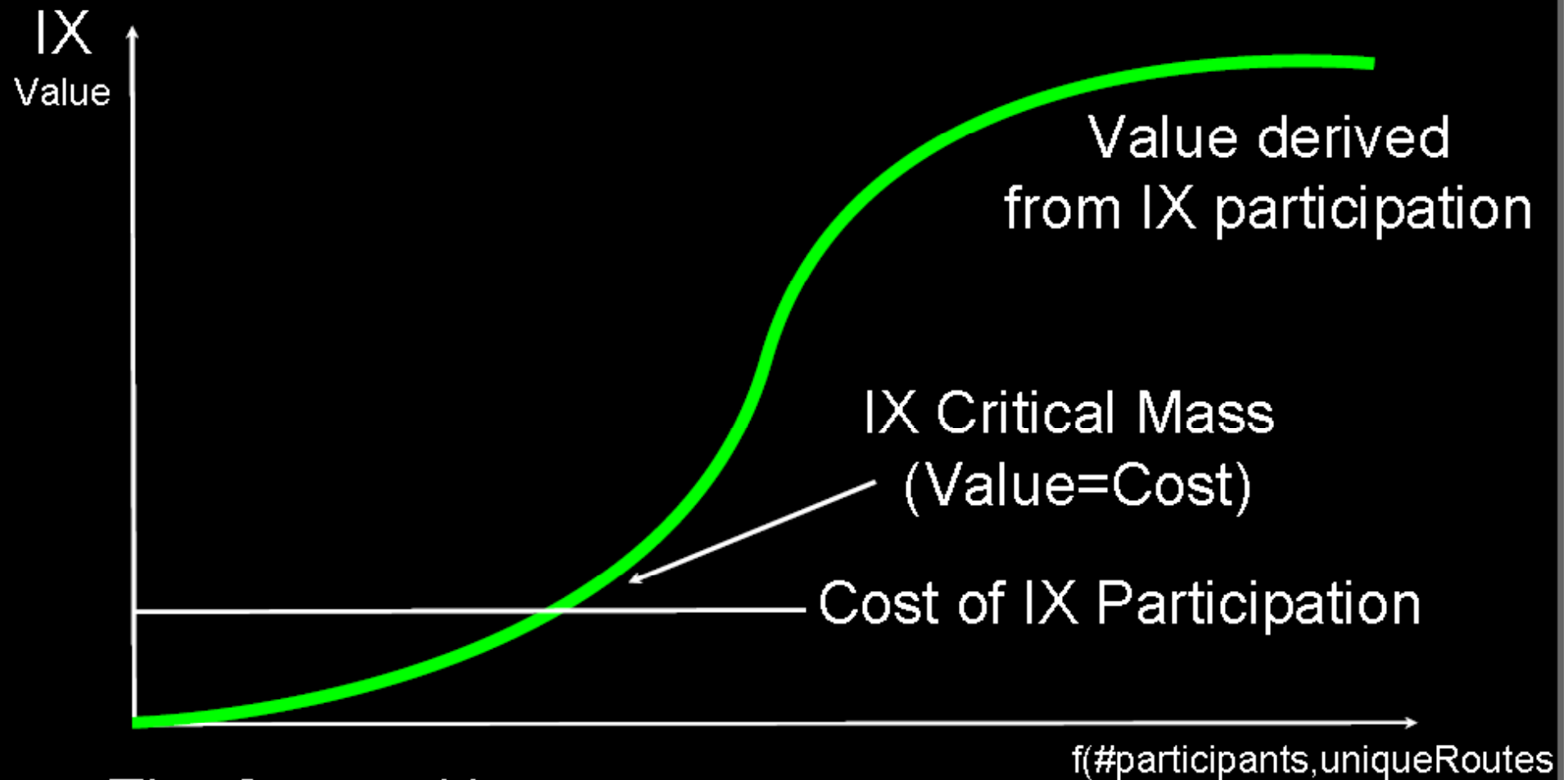
- In the beginning, there was no *Internet Backbone*...people just *interconnected*..



First Evolution



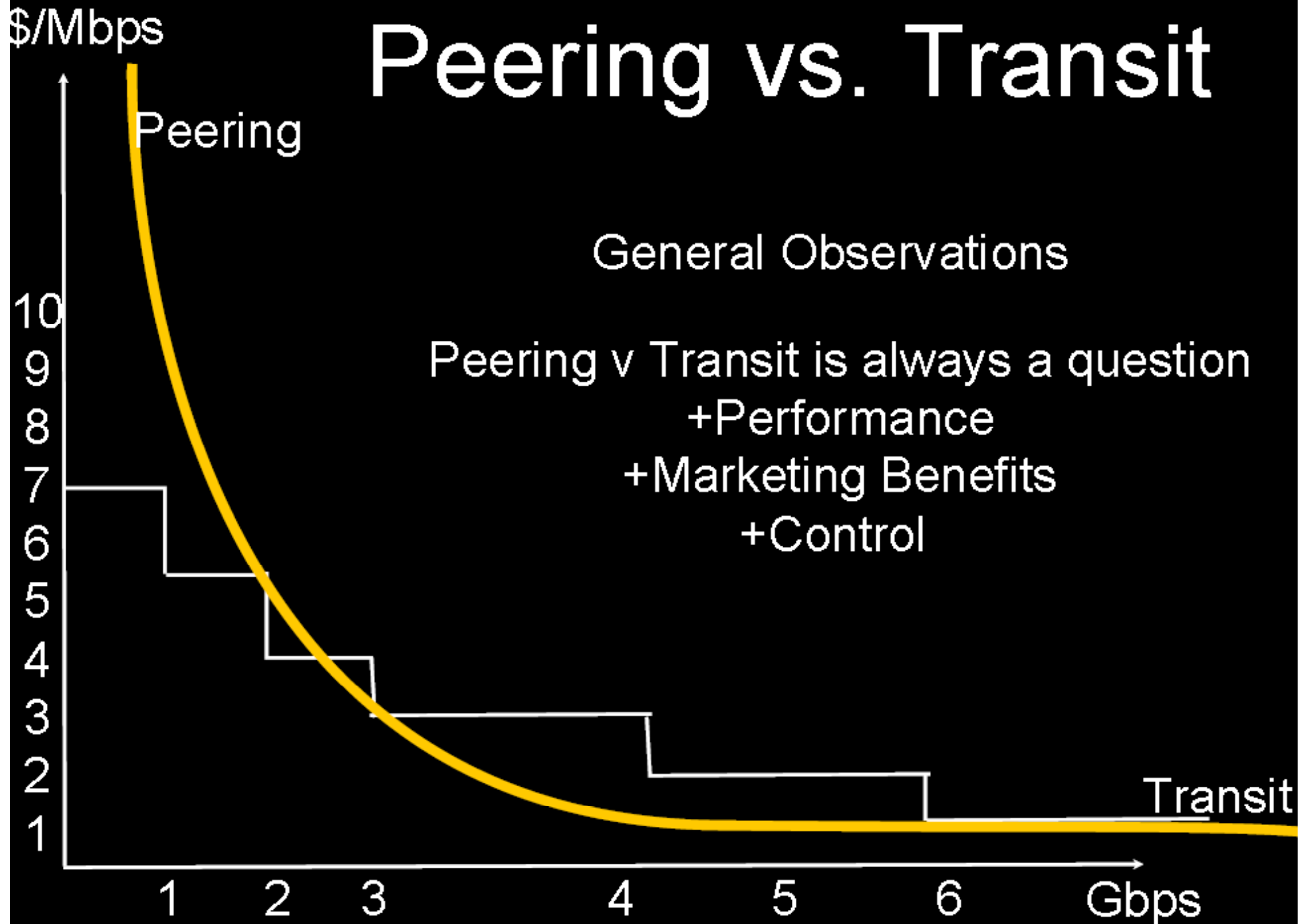
IX Network Externality



The Startup Hump

Discussion Here

Peering vs. Transit



... ITU recommendation D.50 ...

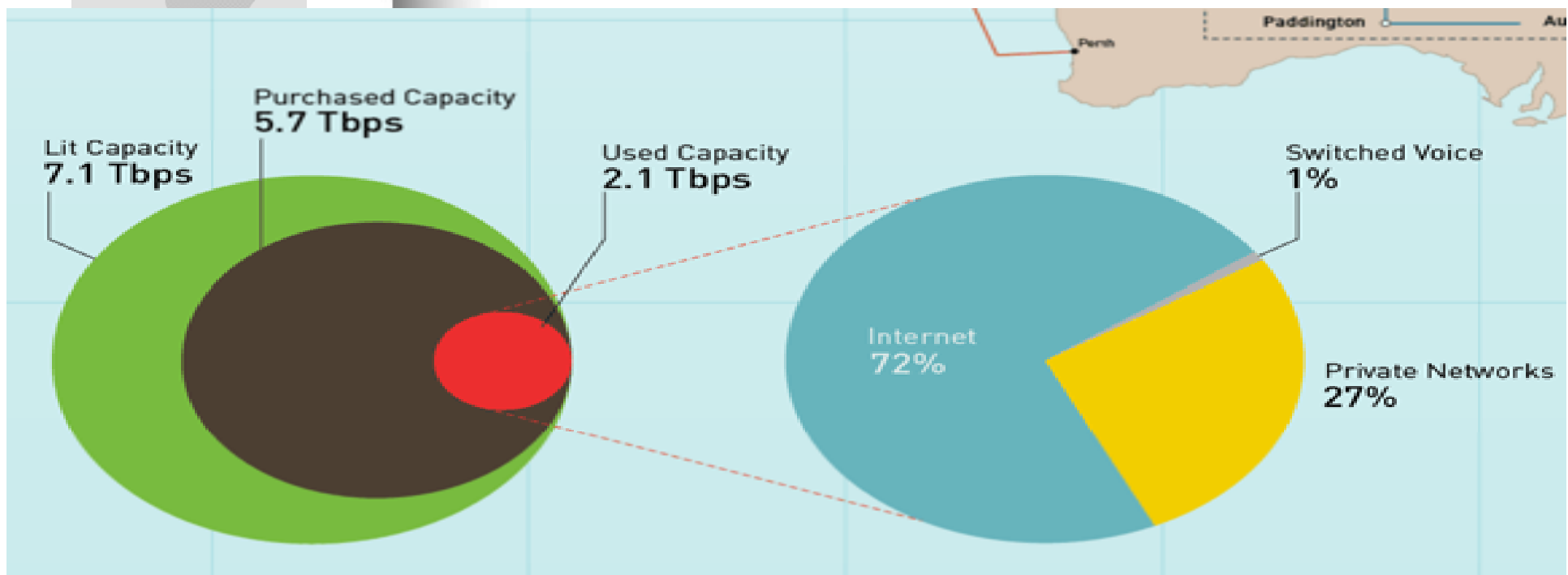
- “Administrations..[should].. **negotiate and agree to bilateral commercial arrangements** enabling direct international Internet connections that take into account the **possible need for compensation between them**
 - for the value of elements such as traffic flow, number of routes, geographical coverage and cost of international transmission...”
- This has no force, as it simply describes what is happening anyway.

Interconnection Challenges

- Internet Connectivity
- Mobile operators Backhaul
- Telecom Operator Backhaul
- Telco Interconnection Traffic

New Driven Area

- Content Providers
- Multimedia Broadcasters
- U-Telco
- Local Collectivities
- User Content Creation



Historical Investment in African Long-Haul African Submarine Infrastructure

	Cumulative Total ¹	% of Worldwide	In-Service Total ²	% of Worldwide
Transatlantic	\$10,803	23%	\$8,563	21%
Transpacific	\$6,975	15%	\$5,377	13%
East Asian Pan-Regional	\$5,672	12%	\$5,115	13%
Europe-Asia and South Asian Intercontinental	\$4,959	11%	\$4,179	10%
European and North African Regional	\$4,955	11%	\$4,831	12%
North America-South America Intercontinental	\$4,218	9%	\$4,148	10%
East Asian Regional	\$3,276	7%	\$2,996	7%
Australian Intercontinental	\$2,167	5%	\$1,892	5%
Latin American/ Caribbean Regional	\$1,460	3%	\$1,400	3%
Sub-Saharan African Intercontinental	\$874	2%	\$874	2%
North American Regional	\$635	1%	\$635	2%
South Pacific Islands	\$405	1%	\$230	1%
Australian Regional	\$233	0%	\$233	1%
Middle Eastern and South Asian Regional	\$226	0%	\$226	1%
Sub-Saharan African Regional	\$60	0%	\$60	0%
Trans-Polar	\$0	0%	\$0	0%

¹ Includes both active and retired systems: \$46.9 billion to date.

² Active systems as of YE 2007: \$40.8 billion

Source: *The Undersea Cable Report*, © 2008 Terabit Consulting



Some Numbers from Financial Crisis

- IMF 1 100 billions dollars
- USA 787 billions dollars
-  Europa 200 billions euro
- ODA (International help) 50 billions
(announce more but in fact)
- African Connect Plan **only** USD **55 billions**
 - The Connect Africa objectives : 5 objectives
(cf. Connect Africa Summit, Kigali, Rwanda 2007)



The Connect Africa objectives : 5 objectives

(cf. Connect Africa Summit, Kigali, Rwanda 2007)

- **Interconnect** the African major cities to broadband ICT networks within **2012**
- **Connect African villages** to broadband ICT networks and services within **2015**
- Adopt basic regulatory measures to promote affordable broadband networks and services development, fair competition among operators, the **creation of IXPs**
- Support capacity building, the **creation of centers of excellence**, and cooperation between African universities and training centers
- Adopt a national cyberstrategy, including a **cybersecurity framework**, to develop and promote e-Services: e-governance, e-health, e-commerce, etc.

Global commitments for more than USD **55 billions**



Business Model

- What technical realities drive cost changes?
- How to create a critical mass of users ?
- ISP Model and scenarios
 - – Exercise: Modelling tool to explore possible scenarios and their cost-savings implications
- Global variables
 - Cost of international bandwidth (\$/Mbps/month)
 - Cost of local bandwidth (\$/Mbps/month)
 - Average % of traffic that is local
 - Standard local bandwidth increment (Mbps)
 - Fee to participate in peering, per ISP per year

Scenarios – Keys to Interpretation

- **ISPs who dominate** already keep much of their local traffic local (% internally routed traffic).

• **This traffic will not go through an IXP** in any case.

- **Savings** come from converting (old) international Mbps to (new) local Mbps.
- **Costs** come from the new local lines and sharing operating costs for the IXP.

Business Model : key questions !

- What makes a successful IXP?
- Setting up an IXP: Key business decisions
 - *Co-op or independent?*
 - *What kind of business entity?*
 - – *Should the IXP offer additional services?*
 - *Who owns the assets?*
 - *Ensuring financial sustainability*
- Managing relationships: 90% of the work!
- What kind of IXP would work best in your country?
- What is the legal and regulatory position?
- Are there any stakeholders likely to oppose an IXP? On what grounds?

What makes a successful IXP?

- **Neutrality**

- With respect to carriers, ISPs and co-location providers



- Should never be perceived to serve interests of one stakeholder at the expense of others
 - IXP operated by ISP association or non-profit is ideal – but not always achievable

- **Robust and secure**

- **Can scale in size**

- **Financially sound and stable**

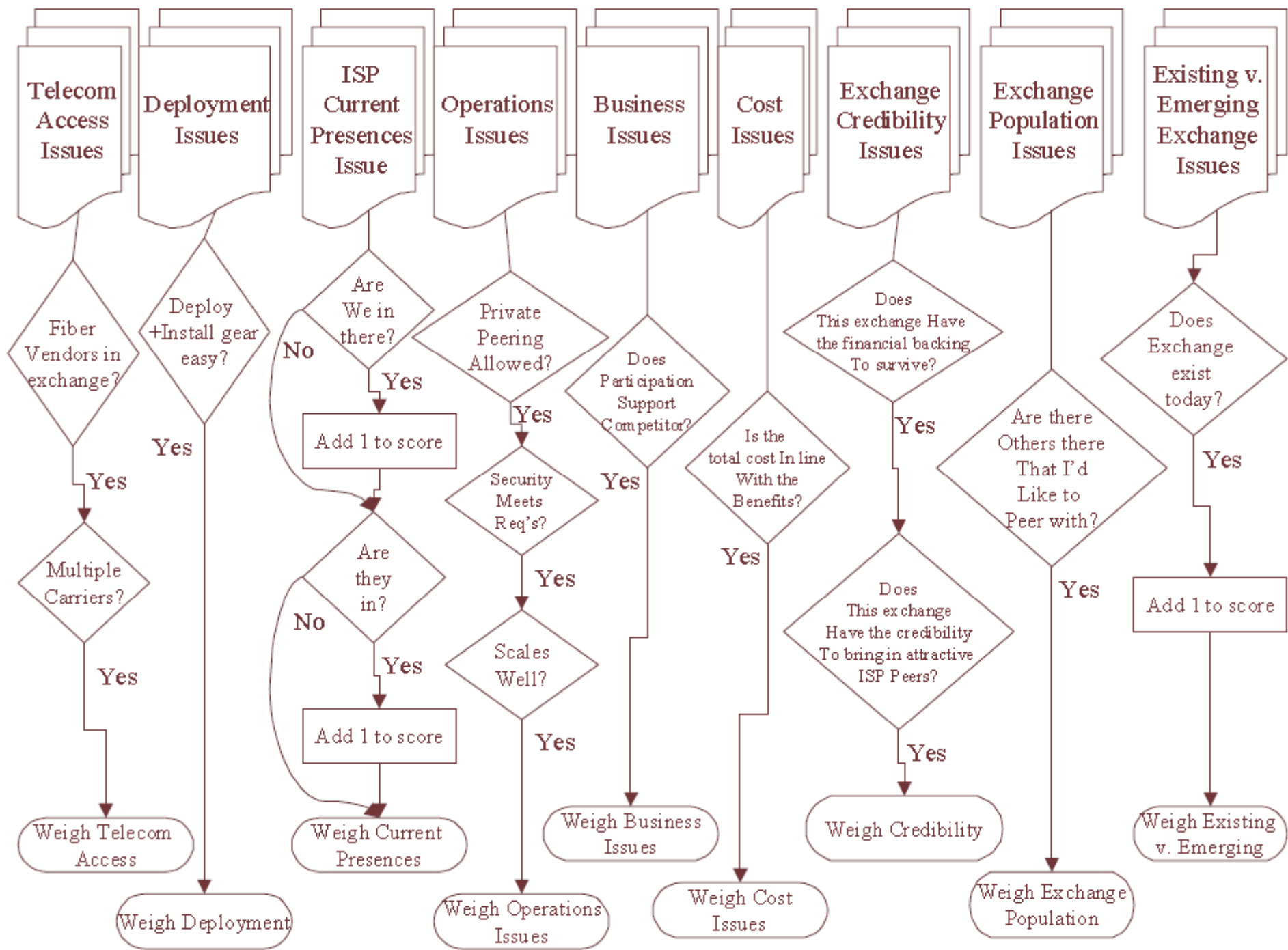
Video Industry impact on the Internet !

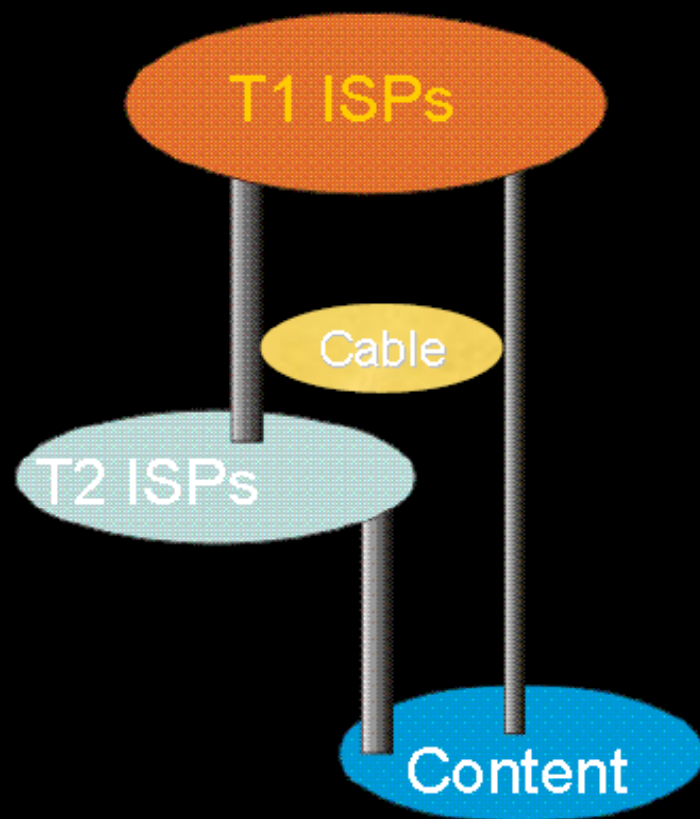
- “...video traffic will represent at least **80 percent** of all Internet traffic... ”.

David Filo (Co-founder of Yahoo!)



- **Video Service Provider Distribution Networks**
 - Model 1: Simple Commodity Transit
 - Model 2: Content Delivery Network (CDN)
 - Model 3: Hybrid Transit/Peering/DIY CDN
 - Model 4: Peer-to-Peer Networking

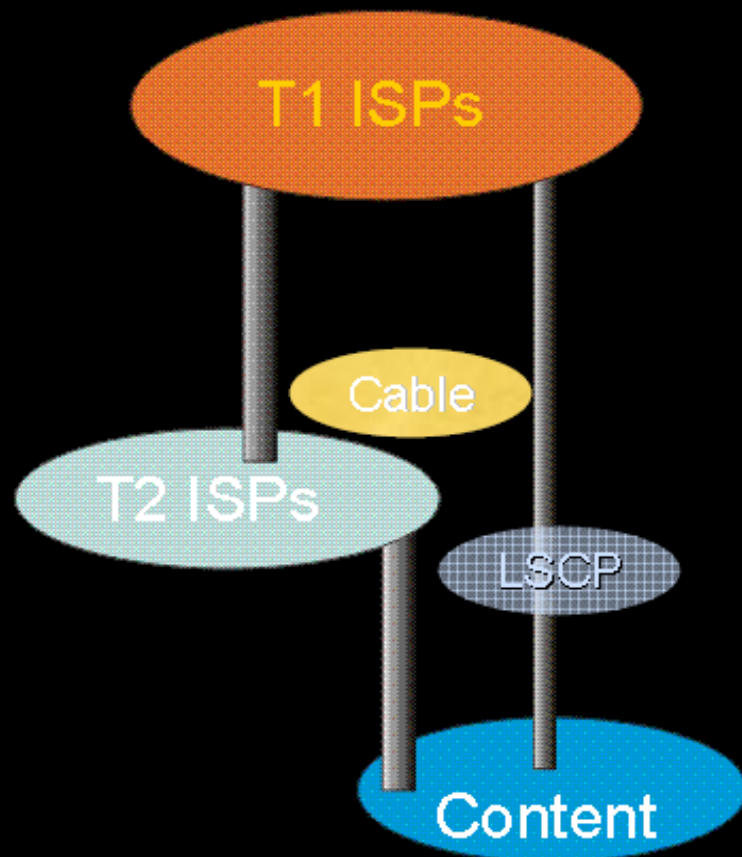




U.S. Evolution #1 Cable Companies Peer

Significant Evolution...

- 1) Volume of traffic is huge
- 2) Cable Cos Open Peering
- 3) "Kazaa Effect" amplifies peering benefits

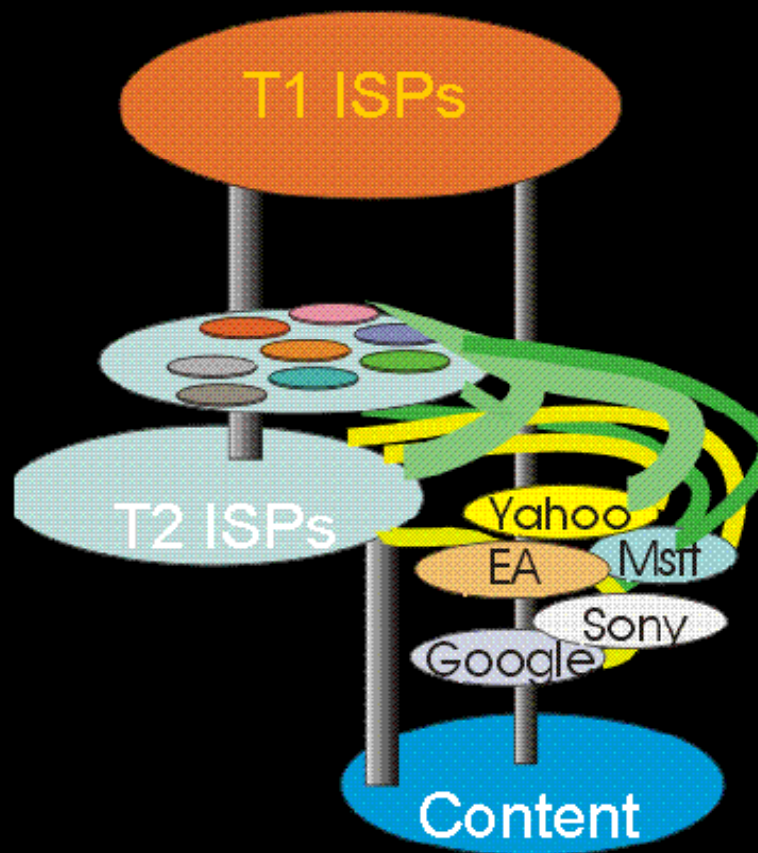


U.S. Evolution #2 Large Scale Content Players Peer

Significant Evolution...

- 1) Volume of traffic is huge
- 2) Content is Open Peering
- 3) Improves End-User Experience
- 4) Leading Players are paving the way

...need to move out of
Bankrupt colo anyway...



U.S. Evolution #3 Cable Cos Peer w/ Large Scale Content Players

Significant Evolution...

- 1) Volume of traffic pulled away from T1s is huge
 - 2) Reduces perceived need for T1s (for local delivery anyway)
 - 3) T1s still needed for distance
- Content Literally right on the

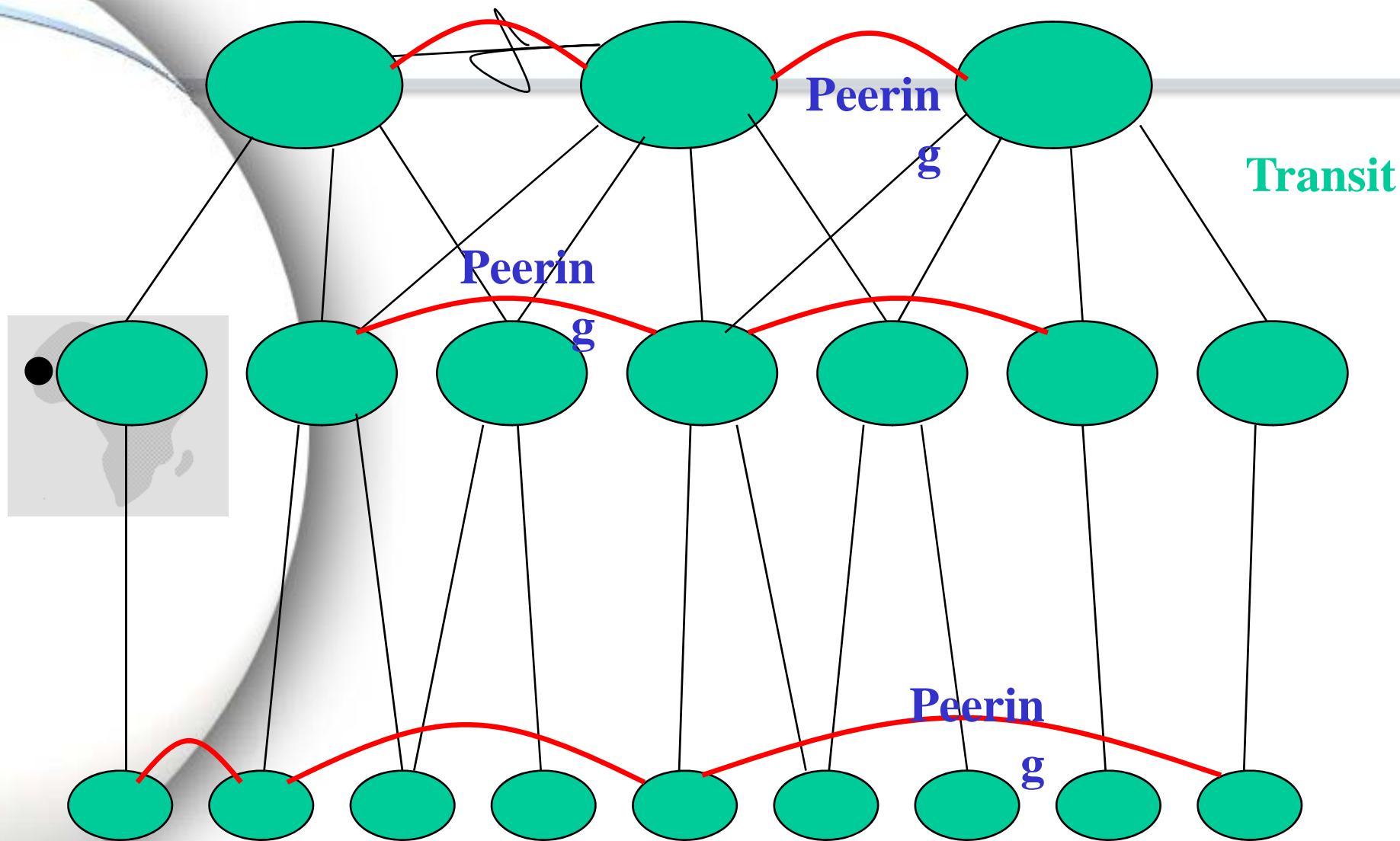
Recap of key terms

- Transit: One ISP provides (usually sells) access to all destinations in its routing table
- Peering: ISPs reciprocally provide access to each other's customer

- **Internet Exchange Points**

- Three or more peering partners \Rightarrow IXP should be considered
- Platforms: Layer 2 or Layer 3
- Ownership
 - Commercial
 - Non Profit
 - Governmental

Peering vs Transit



Policy influences on IXPs

- IXPs are affected by two kinds of policy:
 - Government policy
 - Business and technical policies: IXP and member ISPs
- Government policy is simple: none is best!
- In the real world, two extremes of intervention:
 - – Governments have shut down IXPs
 - Government have forced peering
- Both approaches are failures.
- Government's ideal role is to encourage, provide information, support, facilitate.
- IXP business & technical policy
- Key areas to be negotiated between members
- Must be agreed BEFORE IXP is set up to ensure buy-in
- Business and technical decisions frequently overlap – technical choices are made for business reasons.

Key business decisions

- Location
- Ownership
- Operator: who runs it?
- Do you provide additional services eg co-location?
- Form of business (for profit or not?)
- Funding and pricing: Flat fee, traffic fee, some other?
- **Commercial Option**
- IXP built and operated by a telco or co-location provider
- Profit comes from the services that support the IXP:
 - Co-location space
 - Telecommunications services, etc.
- MAE, PacBell NAP, Equinix, AboveNet

IXP Organisational & legal

Non-Profit Option

- A collective effort by several ISPs
- Incorporate as a non-profit in order to operate the IXP
- Referred as the “club” IXP model
- – LINX, JINX, KIXP, APE (NZ)

Government Option

- To enhance the connectivity of government and educational institutions
- Federal Internet eXchanges (FIXs): interconnected US govt networks
- Internet2’s GigaPOPs: Universities
- StarTap: the R&D Networks
- Private sector benefit is incidental, if at all



Alternative forms

- Network Service Providers:
 - Backbone carriers mainly selling transit service
 - Use the term IX as a marketing tool
 - Example: SAIX, EIX, ..etc
- National Gateways:
 - Mainly in regulated markets
 - Local and international traffic are separated domestically

Best Practices

- IXP operated by a neutral party who is not an ISP (to ensure fairness and neutrality)
- Robust and secure fashion
- • Located in areas of high density of Internet market space
 - Able to scale in size
 - Fiscally sound and stable

Economic Dynamics

Economic Impact

- *Value Chain*
- *New Opportunities*
- *Emerging market & Emerging actors*

Job creation

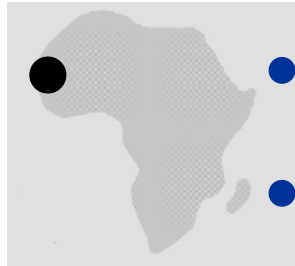
- *National GIS solutions (Ex Google in Kenya)*
- *Video*
- *CDN Providers*
- *Multimédia*

Actors

- *State and Gov Network*
- *Telco Operators*
- *U Telco*
- *Regulators (Strategic)*
- *ISP*
- *Serach Engines (Google, Microsoft, yahoo, etc.)*
- *Academic Networks*
- *Hosting Companies*
- *Content Provider*
- *etc.*

Summary of policy issues

- Location
- Ownership and form
- Governance
- Additional services
- Pricing
- Interconnection policy
- Acceptable use



Africa Agenda

- Policy Forum at the AU level to put the Exchange Point as key priority at a regional and national level
- Enforce the regulatory framework to have IXP
- Use Universal Service Fund to set up IXP
- Create innovative fundings for the regional optical fiber connectivity to have the bandwidth needed !!
- 40 Gb or 100 Gb in Africa before 2015
between all cities and countries !!

Standards Trends for connectivity

- Defined architectures and nomenclature (100GBASE-ER4, etc)
- Adopted baseline proposals for all objectives
- Finished Draft 1.0
- On schedule: the 40 GbE and 100 GbE standards will be delivered together in June 2010
- Crystal ball says there is already demand for other PMDs outside the scope of 802.3ba (100 GbE serial, etc)
 - Standard defines a flexible architecture that enables many implementations as technology changes
 - Expect MSAs

Summary of Reach Objectives and Physical Layer Specifications

Reach	40 GbE	100 GbE	Solution
1m Backplane	40GBASE-KR4	x	4 x 10 Gb/s (reuse 10GBASE-KR)
10m Copper Cable	40GBASE-CR4	100GBASE-CR10	n x 10 Gb/s (reuse 10GBASE-KR)
100m OM3 MMF	40GBASE-SR4	100GBASE-SR10	n x 10 Gb/s
10km SMF	40GBASE-LR4	100GBASE-LR4	4 x 10 Gb/s and 4 x 25 Gb/s
40km SMF	x	100GBASE-ER4	4 x 25 Gb/s

803.3ba Nomenclature Suffix Summary

Speed	Medium		Coding Scheme	Lanes	
	Copper	Optical		Copper	Optical
40G = 40Gb/s	K = Backplane	S = Short Reach (100m)	R = 64B/66B Block Coding	n = 4 or 10	n = Number of Lanes or Wavelengths
100G = 100Gb/s	C = Cable Assembly	L = Long Reach (10km)			
		E = Extended Long Reach (40km)		n=1 is not required as serial is implied	

Example: 100GBASE-ER4

धन्यवाद

Hindi

多謝

Traditional Chinese

תודה רבה

Hebrew

Спасибо

Russian

Gracias

Spanish

Thank You

English

شكراً

Ar4abic

Obrigado

Brazilian Portuguese

Diareudieuf

Grazie

Italian

多谢

Simplified Chinese

Danke

German

Merci

French

ขอบคุณ

Thai

நன்றி

Tamil

ありがとうございました

Japanese

감사합니다

Korean

