



Inter connection Strategies for ISPs

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Agenda

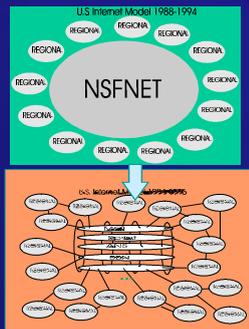
- Background
- Internet Interconnection Strategies
 - Research
 - Findings
- Financial Models: White Paper Available

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NSFNET to Post-NSFNET Era Internet

- NSFNET (1987-1994) [Regional Techs Meetings](#)
 - Performance & Operations
 - Reporting & Coordination
 - Routing & Network Planning
- Privatization (1994-Now) [North American Network Operators Group](#)
 - ([NANOG](#)) [Meetings](#)



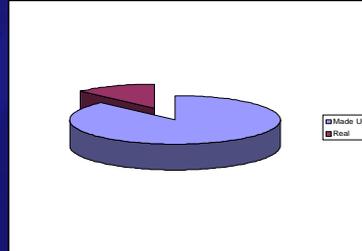
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No Internet presentation complete without...



Internet Statistics

- 87.5% of all Internet statistics are made up.



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Source: I made it up



Research Focus

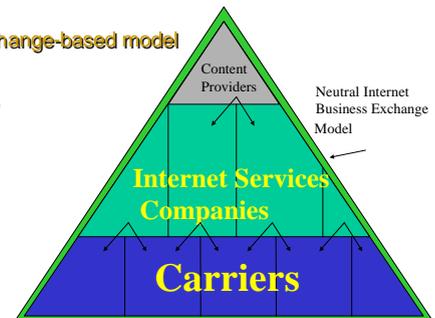
- Interconnection Strategies :
 - [Direct Circuit](#) Interconnect Model vs. [Exchange-based](#) Interconnection Model
 - When do each of these make sense?
 - Based on current practices, existing or soon to exist technology
 - White Paper & Financial Model

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Neutral Internet Business Exchange Model

- Basis for Exchange-based model comparison
- Infrastructure
- Neutrality
- Facilitation
- Players



Direct Circuit Interconnection Strategy

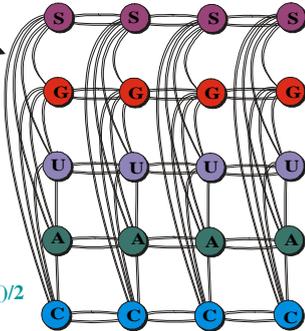
Point-to-point circuits for ISP interconnection for regional presence

Cost drivers:

- Circuit sizes (c)
- Circuit miles (m,loc)
- CircuitCost=fn(c,m,loc)
- # of participants (n)
- (1/2 cost paid by each party)

Direct Circuit Cost Function:

$$ISPXC\text{Cost}=(n-1)*\text{CircuitCost}()/2$$



Exchange-Based Interconnection Model

Direct circuits replaced with:

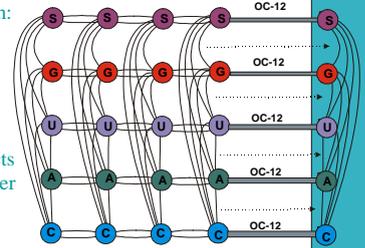
- OC-12 into Exchange
- Fiber cross connects

Cost Drivers:

- Big OC-12 Direct Circuit
- Cheap Fiber Cross Connects
- Aggregation Efficiency over OC-12 (2:1,3:1)
- RackXC Fees

Cost Formula:

$$\text{ExchangeModelCost}=\text{BigDirectCircuit}()+ (n-1)*x/2+\text{RackXC}\text{Fees}()$$



Cost Comparison at n=5

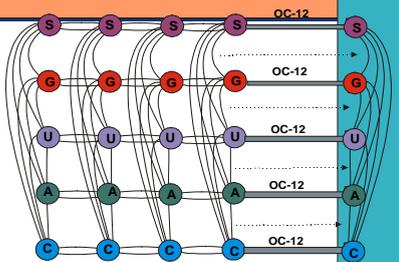
$$\text{costDCfn}()=(n-1)*C/2$$

$$C=\text{OC-3 @ } \$11,400$$

$$n=5$$

$$\text{costDC}=(4)*\$11,400/2$$

$$\text{costDC}=\$22,800/\text{mo}$$



$$\text{costExchfn}()=\text{BDC}+(n-1)*x/2+\text{Racks}$$

$$\text{BDC}=\text{OC-12 @ } \$23,000$$

$$n=5, 1 \text{ Rack @ } \$1500$$

$$\text{costExch}=\$23,000+(4)(200/2)+\$1500$$

$$\text{costExch}=\$24,900/\text{mo}$$

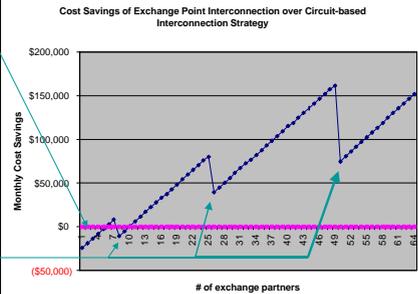
More expensive to use Exchange-Based Interconnection Strategy at n=5. N>5?

Cost Savings: Exchange-based vs. Direct Circuit Cost Model

At low n, cost of big circuit is greater than half-circuit costs.

Steps represent incremental circuit growth required for interconnection.

Aggregation kicks in... efficiency @ 2:1 (to 3:1)



Dynamics accelerate as BW requirements grow... Today's quotes->Monthly savings can get huge

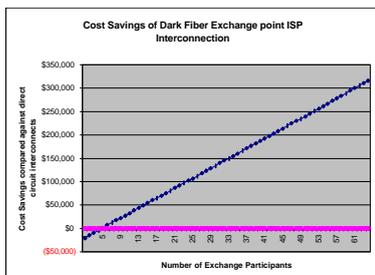
Exchange-based applying DWDM over dark fiber

Facilities-based providers win big!

Seamlessly scale BW into exchange

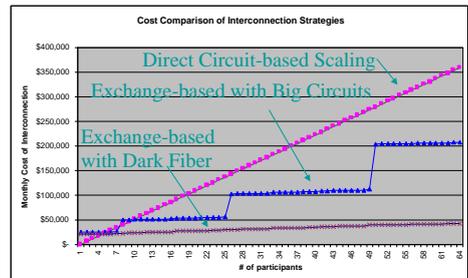
Seamlessly scale BW within exchange to other ISPs/CPs

Aggregation back to net

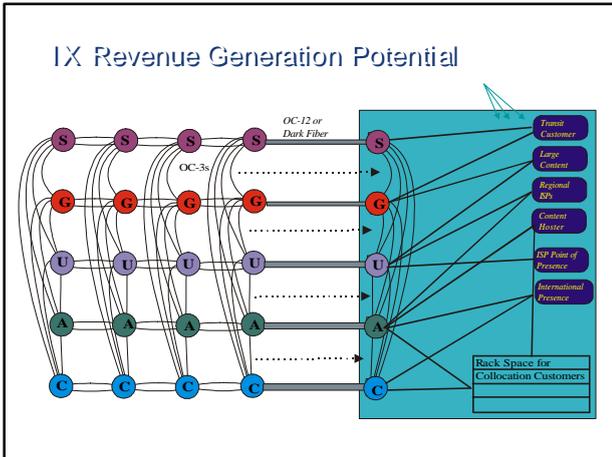


Direct Circuit vs. Exchange-based Interconnection Strategies

BW Scaling:
DC: Linear
BC: Stepped Linear
DF: Linear Efficient



But this ignores a key aspect of the exchange model...



Transit Revenue Projections

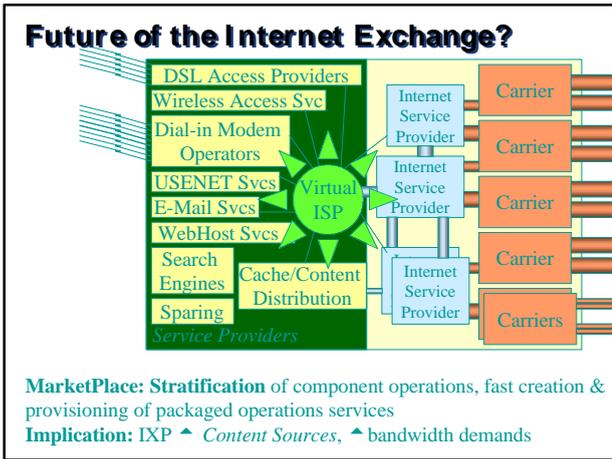
# Transit Sales	Attachment Speed for New Transit Customer	Revenue to ISP per New Customer per Month	Monthly Revenue from Participation	Total Annual Revenue from Participation
6	DS-3	\$65,000	\$390,000	\$4,680,000
1	OC-3	\$120,000	\$120,000	\$1,440,000
			Annual Incremental Revenue:	\$6,120,000

Financial Model Assumptions

- 65 participants (5 carriers, 10 Autonomous Content Providers, 50 ISPs)
- Revenue & Projections figures based on interviews and participation modeled from PAIX
- Assuming zero growth in bandwidth demand through period
- Sufficient bandwidth into exchange to accommodate load

The Point: Incremental Revenue Generation not possible with Direct Circuit Model

Source: Dave Rand Interview
(DS3:UUNet=\$65,000/GTE=\$70,000/mo), UUNet Src: OC-3=\$120K/mo



Conclusions

- Direct Circuit Interconnection Strategy makes sense for interconnection among ~5 or fewer parties
- Aggregation and Optical efficiencies lead to tremendous cost efficiencies by using big circuits into exchange
- Facilities-based providers win big applying DWDM into exchange
- Large bandwidth (OC-12) for interconnections and/or large # of participants exhibit good scaling properties for exchange-based model
- Incremental transit sales possible in exchange-based model
- White paper available -- comments welcome Business Cards or e-mail to: wbn@equinix.com

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- ### Special Thanks To:
- | | |
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