

**The Evolution of Internet Interconnection from Hierarchy
to “Mesh”:
Implications for Government Regulation**

Stanley M. Besen and Mark A. Israel
June 15, 2012

The View of the Department of State

- “Interconnection is, of course, the single greatest imperative for a network of networks. And here the absence of governmental or intergovernmental controls is particularly striking. The...economic arrangements necessary for...interconnection have been worked out through commercial negotiation. National governments, let alone international institutions...have not prescribed the economic transfers that take place between and among the participating networks.” Ambassador Philip L. Verveer, “Internet Must Stay Free of Government Control,” The European Institute (January 2011)

Some Views from the Academy

- “...we are not convinced by the evidence we have seen to date that more activist policies (e.g., direct regulation of Internet interconnection) is warranted; and equally important, even if we were to see a need for such regulation, we are concerned any such regulation might cause more harm than good.” D. Clark, W. Lehr, and S. Bauer, “Interconnection in the Internet: the policy challenge,” August 9, 2011.
- “...analysis of the relevant cost data and network flows would likely vary from network to network. Indeed, one might well expect different networks to pursue different pricing strategies. In addition, the data would need to be updated constantly in response to technological changes.” See Christopher S. Yoo, *Network Neutrality and the Economics of Congestion*, 94 Georgetown Law Journal 1847, at 1876 (2006).

We Agree That

- There is no clear need for regulation of Internet interconnection.
- Regulation would be difficult.
- Regulation would likely do more harm than good.

Our Paper Analyzes

- The effects of regulation on the incentives to minimize total costs
- The effects of regulating interconnection rates on access prices to end users
- Constraints on the exercise of market power by ISPs
- The difficulties that would be faced by regulators

Reduced Incentives to Minimize Total Cost

- Price regulation may be highly inefficient, particularly when different costs are subject to the control of different parties.
- Example:
 - A CDN bears a cost of \$3 million for transporting its content to an ISP, which then bears a cost of \$8 million to transport this content to end users.
 - There is a new a method for delivering the traffic that would increase the ISP's costs by \$1 million but would reduce the CDN's costs by \$2 million.
 - The method will be adopted if the CDN were to pay the ISP an amount between \$1 million and \$2 million but it will **not** be adopted if regulation limits the payment to less than \$1 million.

Limiting Interconnection Rates Increases Rates to End Users

- This is a “two sided market” that is subject to the “seesaw principle”
- According to the seesaw principle, if regulation were to mandate lower revenues from interconnecting CDNs, this would be associated with higher prices charged to subscribers.
- “preventing network providers from exercising pricing flexibility . . . would simply increase the proportion of the network costs that providers must recover directly from end users. This simultaneously raises the prices paid by consumers and decreases the likelihood that the capital improvements [necessary to accommodate ever-greater traffic volumes] will ever be built.” [Yoo]

Constraints on the exercise of market power

- Any CDN or other IP network normally has a choice of several alternative paths into an ISP's network, and it is capable of rerouting traffic among these paths in real time.
- ...the complex mesh of interconnections, with diverse pricing models, constrains the range of negotiating positions that can be sustained by [an access network]....the limit on the payment that [an access network] can extract from [a content delivery network] will be related in some way to the customary price for transit, which is a commodity product...." [Clark, Lehr, and Bauer]
- Indeed, in negotiations with an ISP, a CDN can threaten to exploit transit alternatives that would leave the ISP worse off than if it had entered into a reasonably priced paid peering relationship with the CDN.

Regulation Would be Difficult

- Regulators would have to determine:
 - which IP networks would be required to peer with which others and on what terms (i.e. paid peering, settlement free peering, or transit).
 - where, and on what technical terms, networks would have to interconnect
 - the obligations of an ISP to maintain capacity in anticipation of changes in the amount and nature of traffic
- These complexities leave two possibilities:
 - Regulator leaves aspects of rules as “TBD.” Likely to create investment deterring uncertainty about implementation of regulations.
 - Regulator attempts to impose precise rules on all terms. Likely to prevent beneficial experimentation during a time when rapid changes in Internet flows heightens benefits from experimentation.