Internet Connectivity in LDCs

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I. Connectivity
Definition: what is it?
Measurement: how is it distributed?
Diagnosis: is that a problem?
Analysis: is there a big picture?

II. Transit
Connectivity: Definition

- capacity, connectivity, applications
- Internet connectivity:
  - unique *ICANN-overseen* IP number for duration of connection;
  - ability to exchange *general Internet traffic* (POP, http) with other ICANN-overseen IP addresses
- excludes:
  - private networks
  - closed networks
- implies:
  - end-to-end interoperability
Connectivity: Measurement

- building blocks: for each provider, every international route (City A, City B, Capacity)
- methodology: network tools, public data, private data
- automatable: much can be routinized; some private-sector firms are building this capability (Quova, IXIA)

- mid-2001: LDCs had 0.1X percent of Internet users, 0.02 percent of international Internet bandwidth.
- Africa connected 0.15 percent of international Internet bandwidth, down from 0.22 percent—but South Africa’s growth was slowest.
- toolkits and international benchmarking: do connectivity market regulators {need|want} year-on-year results?
- is this a useable metric?
Connectivity: Diagnosis

To diagnose market failure:
- supply must be insufficient to meet demand; and
- market distortions must prevent the additional supply from being provisioned.

Traditional approaches to demand-supply matching:
- **top-down**: start with historical bandwidth usage data; extrapolate future usage; compare to forecasted supply. *But we know little about bandwidth usage.*
- **bottom-up**: start with assumptions about applications usage and bandwidth used per application; multiply out. *But we know little about applications usage, and nothing about how available bandwidth affects it.*
Connectivity: Diagnosis
Alternative Approaches

• bandwidth per person, but:
  – non-users unlikely to produce bandwidth demand, so can’t claim market failure

• bandwidth per user, but:
  – demand for international traffic varies by language, etc.
  – some countries produce more non-user (hosting) traffic than others

• bandwidth per host, but:
  – does not address international traffic mix
  – hosts are hard to count; for LDCs, impossible.
Connectivity: Diagnosis  
Bit-Minute Index

OECD: 10.79  
U.S. & Canada: 6.10  
Europe: 6.09  
LatAm & Caribbean: 0.87  
Asia: 0.79  
LDCs: 0.18  
Africa: 0.17

- calculated as (inbound and outbound international minutes) / (international Internet bandwidth)
- assumes international telephone traffic is relevant to demand for international communications, including users, hubbing, hosting
- further work needed: international audiovisual traffic?
Connectivity: Analysis
U.S.-centric Internet (1/3)

Largest Interregional Routes, mid-2001

Source: TeleGeography, Inc., *Packet Geography 2002*
Connectivity: Analysis
Hub-and-Spoke (2/3)
Interregional Internet Capacity, mid-2001

Source: TeleGeography, Inc., Packet Geography 2002
Connectivity: Analysis
Hub-and-Spoke (2/3)

International Internet Providers vs International Internet Capacity, by City

Source: TeleGeography, Inc., Packet Geography 2002
Connectivity: Analysis
Regionalisation (3/3)

• “regionalisation” as new narrative
  – in every region except Africa, intraregional growth has been the fastest-growing set of connectivity routes

• two extremes in intraregional connectivity
  – Europe: 75 percent of international Internet bandwidth
  – Africa: < 1 percent of international Internet bandwidth

• is higher intraregional connectivity desirable?
  – Latin America: 3%, mid-2000; 12%, 2001
  – Asia: 7%, mid-1999; 13%, mid-2000; 18%, 2001
I. Connectivity

II. Transit
   Definition
   Competitive Markets
   Developing Markets
Internet Transit: Definition

• buying transit is similar to buying Internet access, but requires bundling of inter-AS BGP routing with connectivity
  – engaged in only by ISPs with >1 connection to the Internet

• related to peering
  – peering is settlement-free, unlike transit;
  – peering allows access only to on-net destinations, not the whole Internet
Internet Transit: Competitive Markets

*Commodity (n.):* tangible good or service resulting from the process of production. Differences between commodities, real or imagined, will determine whether or not they are close substitutes for one another.

- for purchasers, commodity competition leads to lower prices
- for vendors, commoditisation is to be staved off: product differentiation strategies (bundling, features, etc.) take on greater importance
Internet Transit: Competitive Markets

Who has the most routes?

- 1 route (393 providers) 58%
- 2 routes (122 providers) 18%
- 3 routes (51 providers) 8%
- 4 routes (26 providers) 4%
- 5-9 routes (36 providers) 5%
- Over 10 routes (49 providers) 7%

Who is the best connected?

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Internet Transit:
Developing Markets

Lessons from competitive markets:
• information transparency drives down prices
• price or product unbundling helps build commodity-like markets
• innovation should be encouraged at each layer

Ways to implement:
• separate pricing for capacity (terrestrial/satellite leased-line equivalents), connectivity (Internet transit)
• information-gathering and analysis: price-performance
Internet Transit: Developing Markets

Internet Exchange Growth

Source: TeleGeography, Inc., *Packet Geography 2002*
Internet Transit: Developing Markets
Scattered Pricing for Internet Exchanges

Source: TeleGeography, Inc., Packet Geography 2002
Internet Transit: Developing Markets

Transit Aggregation

- A model exists for discounted transit pricing for research markets.
  - Backbone providers find it advantageous to participate, partly as a way of developing new markets.
- “ITU Transit POP”: several transit vendors collocate at a single location and provide very competitive transit pricing restricted to a well-defined set of providers (“all LDC-based transit ISPs”, etc.).
  - subsidise the Transit POP’s maintenance, engineering staff, etc.
  - should competitive or subsidised leased-line pricing to get to POP be provided?
  - should several POPs of this type be located in developing regions? would subsidy be necessary to establish them?
Internet Transit: Developing Markets

Content Peering

Content peering:

• began as non-market innovation (Squid)
• content peering initiative lived briefly; died when swallowed up by Digital Island (now Cable & Wireless)
• what model could be designed for high cost-of-bandwidth areas, bundled with measurement tools, standardised, and made available as an Internet exchange enhancement?
Internet Transit: Developing Markets
Beyond Connectivity

Why did the Internet grow?
• active transmission of authoring and design know-how...
  – the Web was once thought of as a two-way medium!
• ... and focus on end-to-end connectivity as efficient two-way distribution plant

What will stimulate bandwidth demand in LDCs?
• active transmission of authoring and design know-how...
  – enable LDC citizenries to design their own applications, content
  – move beyond point-to-mass paradigm
• ... and focus on end-to-end connectivity as efficient two-way distribution plant
Thanks!

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