Network design
What (not) to expect from the future Internet

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Very crude outline:

DON'T EXPECT ANYTHING DRAMATICALLY NEW

Outline:

- The hard-to-predict non-techie user is king

- Inertia more important than technology and economics

- Precise prediction impossible

- Flexibility, the main source of Internet's success, key (for even if you find the optimal solution, you won't convince decision makers in time)

4 dimensions of communications technology:

- Volume: How much data can it transmit?

- Transaction latency: How long does it take to do something?

- Reach: Where can the service be provided?

- Price: How much does it cost?

Network technologies and architectures:

- Irrelevant to users

- Cannot compensate completely for weaknesses of applications

Technology:

- Many choices

- Drive for uniformity (converged network)

- Drive for diversity (walled gardens, security, redundancy, customer-owned networks, outsourcing, ...)

$\Rightarrow$ Likely outcome a multimodal telecom scene, unified by IP layer (in analogy with transportation sector, unified by container)

Inertia:

- Standards that are still diffusing rapidly (e.g., IP) hard to undermine

- Comparison to standard gauge on railroads

Conclusion: You can tweak it, but it will be called IP, and will be very much like IP, however poor IP is

Long-haul is not where the action is:

▸ 360networks transatlantic cable

Construction cost	**$850 M**
Sale price	**$18 M**
Annual operating cost	**$10 M**
Lit capacity	**192 Gb/s**
Fully lit capacity	**1,920 Gb/s**
Ave. transatlantic Internet traffic	**400 Gb/s**
(mid-2007)	

Central technology trends:

- Rapid growth in processing power

- Rapid growth in storage

- Rapid growth in transmission

- Slow growth in resolution of display devices

- Imbalance, with far more storage than transmission

MINTS (Minnesota Internet Traffic Studies):

http://www.dtc.umn.edu/mints

- monitor of Internet traffic growth

- worldwide growth rate decelerating to about 50% per year (contrary to claims of exafloods clogging the networks)

Future: uncertain

- huge potential sources of traffic
(far more storage, processing power, and broadcast video than Internet transmission capacity)
- user, service provider, and policy level inertia

- need to monitor networks to plan

- at current growth rates, no case for big architectural changes

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Further data, discussions, and speculations in papers and presentation decks at:

http://www.dtc.umn.edu/~odlyzko