

Some observations on Internet traffic growth & scaling

Bill St Arnaud, CANARIE

Bill.st.arnaud@canarie.ca

Growth of Internet traffic

- What is driving growth of Internet traffic, particularly in backbone networks?
- Will Internet traffic eventually reach steady state growth like the telephone system today?
 - 5% to 8% annual growth
- Is Internet traffic growth sustainable doubling every year?
- Why haven't universities seen maturity in growth of Internet traffic
 - Most computers are connected and student population has not increased substantially

When a new town is built

- From backbone perspective what drives demand for bandwidth?
 - New subscribers or more usage by each subscriber?
- But new subscriber growth for telephone is ultimately limited by number of humans
- Internet growth is ultimately limited by:
 - Not by number of humans
 - Not solely by number of connected computers
 - But by number of simultaneous TCP sessions (assuming no last mile bottleneck and CPU limitation)
- Number of simultaneous TCP sessions is directly related to Moore's Law
 - **Internet growth (at a minimum) will be no less than Moore's law**

A simple test of hypothesis

- Who is receiving less e-mail than 2 years ago?
- Is growth in e-mail because of increased correspondence with same people 2 years ago, or because you receive e-mail from many more people
 - List servers, cc avalanches, etc

Humans are a bottleneck to traffic growth

- Humans can only do so much web surfing in a day
- P2P applications such as Napster, Grids and eScience allow computers to generate and receive traffic all the time
- These applications have much different traffic characteristics than human traffic
 - Many simultaneous connections to different destinations
 - Each of which can burst to full capacity

Impact on Internet Backbone

- Will Internet backbone need to scale linear with growth or even faster?
- If Internet traffic is fractal (bursty) in temporal domain (Still being debated)
- Is Internet traffic also fractal in spatial domain (slosh)?
- By looking at a single Internet connection it is impossible to distinguish between spatial and temporal fractal traffic
 - In fact one may mask another e.g separating amplitude and phase
- Require 2D Fourier analysis of large network?

Spatial challenges

- In telephone calls humans can generally only talk to one human at a time
 - Network trunks between COs are designed on certain interconnection ratios
 - Moving from one armed limb to multi-connected branch
- With computer multiple connections can be maintained at same time
- Even with fixed access speed and fixed number of computers backbone demand may increase because of increased slosh due to larger number of processes communicating to a larger number of other processes
- Early warning signs:
 - Multi-homed customers and explosion of BGP tables
 - Collapse of peering to carrier neutral IX