

INTERNET TRAFFIC AND QoS

Simplest of all: constant bit rate (CBR)

- flat is good
- because predictable
- e.g., telephone call, real-time MP3 audio
- approximately “flattish”

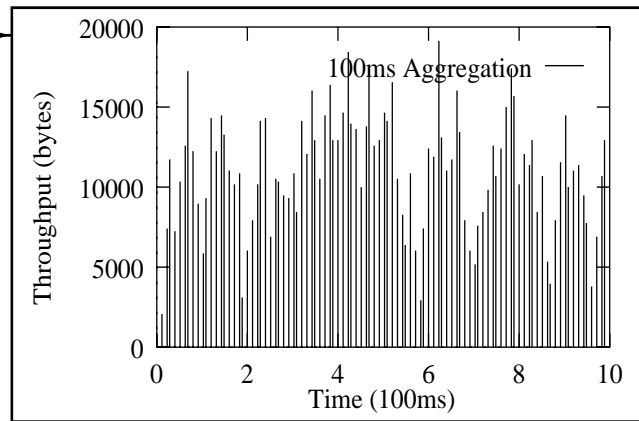
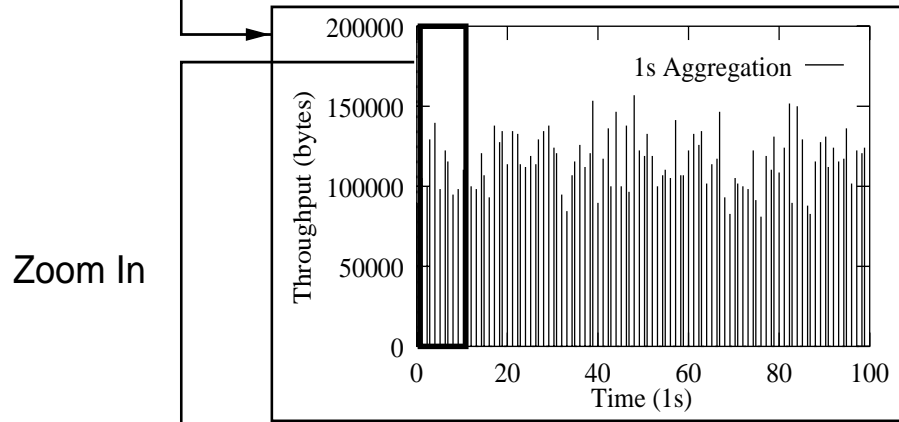
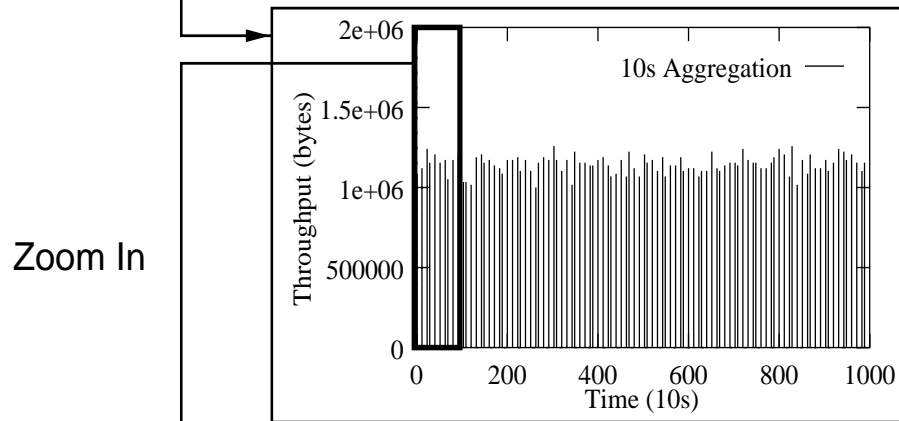
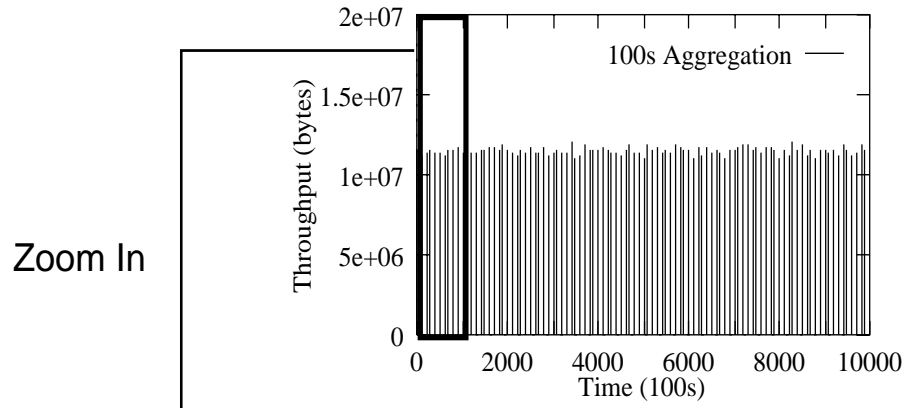
Internet data traffic: variable bit rate (VBR)

- primary: skewed file sizes
- many mice and a few elephants
- secondary: compressed real-time/streaming video

What does network traffic look like?

—→ first traditional telephone traffic

—→ includes voice data carried in IP packets



Deaggregation

Aggregation

Note: when aggregated over time, traffic becomes flat

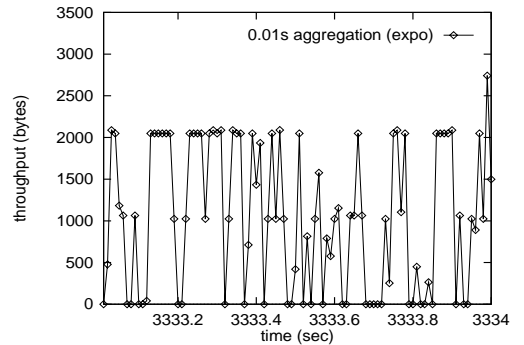
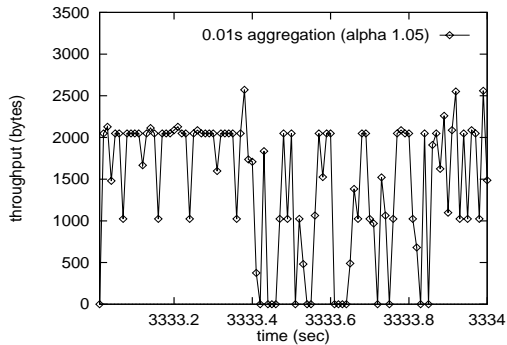
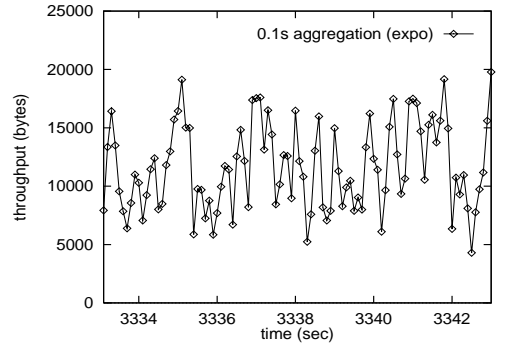
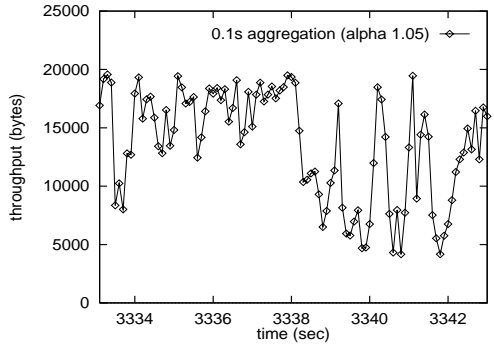
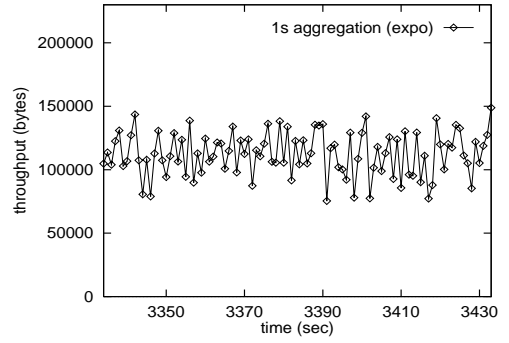
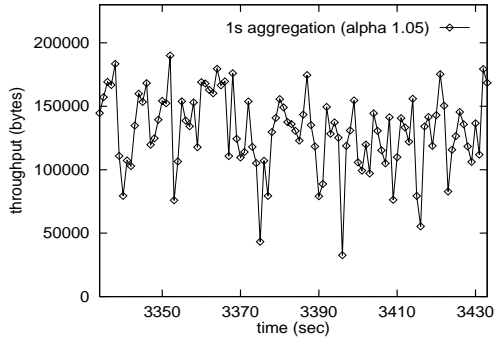
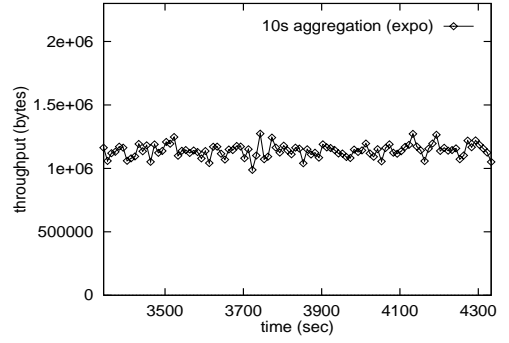
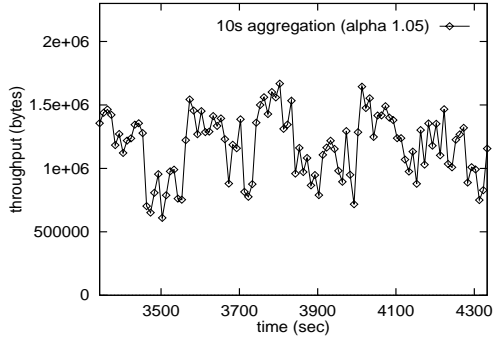
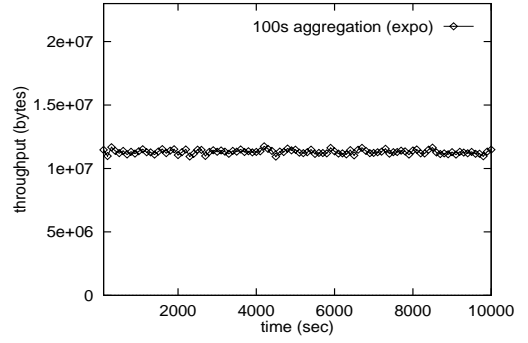
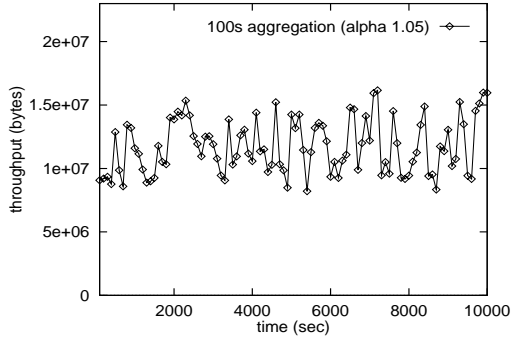
→ “flat is good” rule for QoS provisioning

→ simple bandwidth dimensioning

→ both happy customers (QoS) and providers (efficient resource usage)

What about Internet data traffic?

- around 90% is TCP file transfer traffic
- VoIP and other traffic remains a small minority
- note: video streaming is VBR
- video file download is TCP file transfer



Right column: previous telephone traffic

Left column: Internet data traffic

- key difference: doesn't become flat even at large time scales
- traffic stay bursty no matter what the time scale
- self-similar
- also called fractal

Not good for network management and engineering

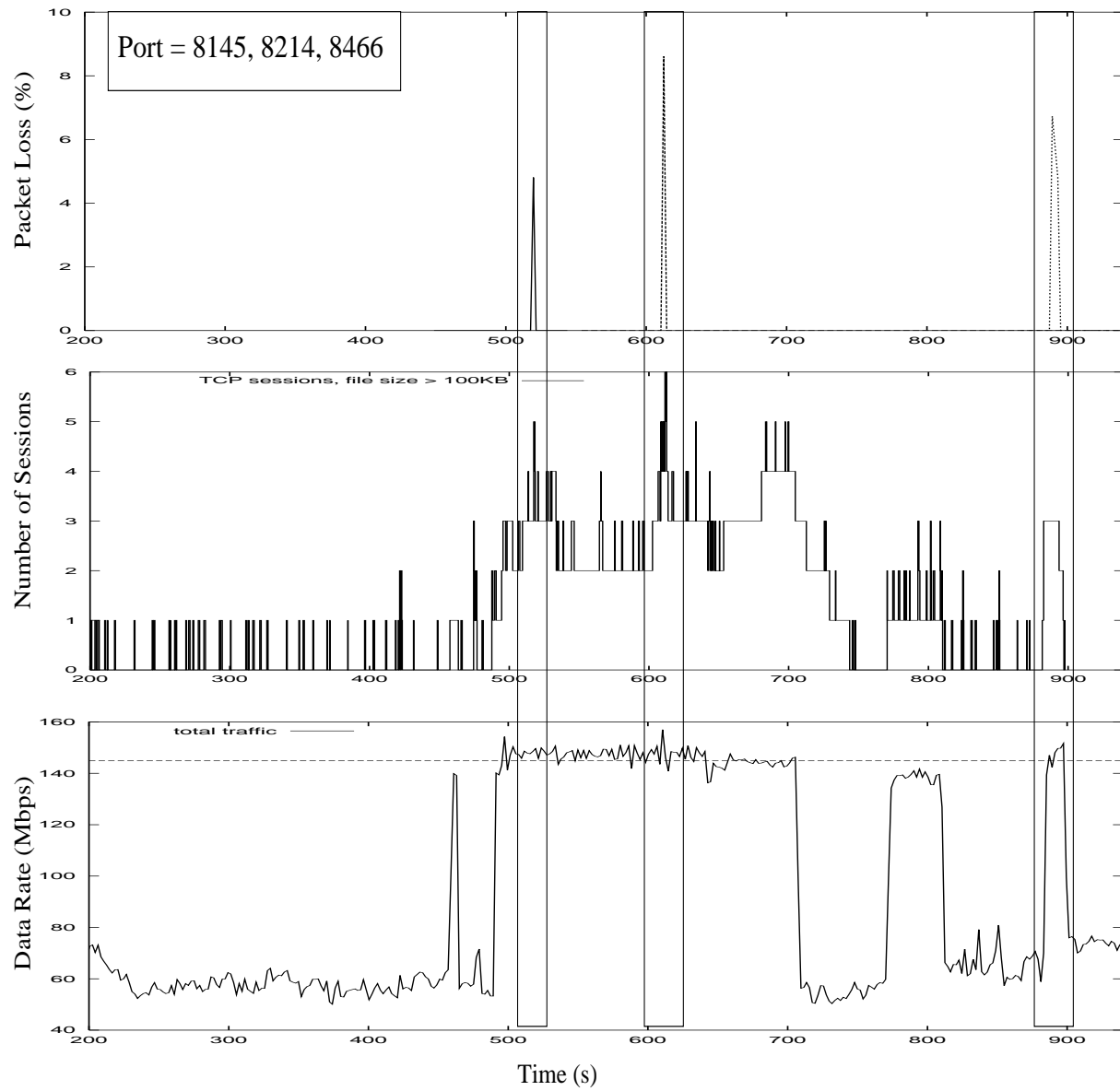
- cannot make customer and provider both happy
- intrinsic trade-off relationship between QoS and efficiency

Why is traffic so bursty?

- because of elephants
- most files are small but a few are very large
- also 90/10 rule
- see UNIX file system data

Elephants in action:

→ OC-3 (155 Mbps) interface of Cisco router



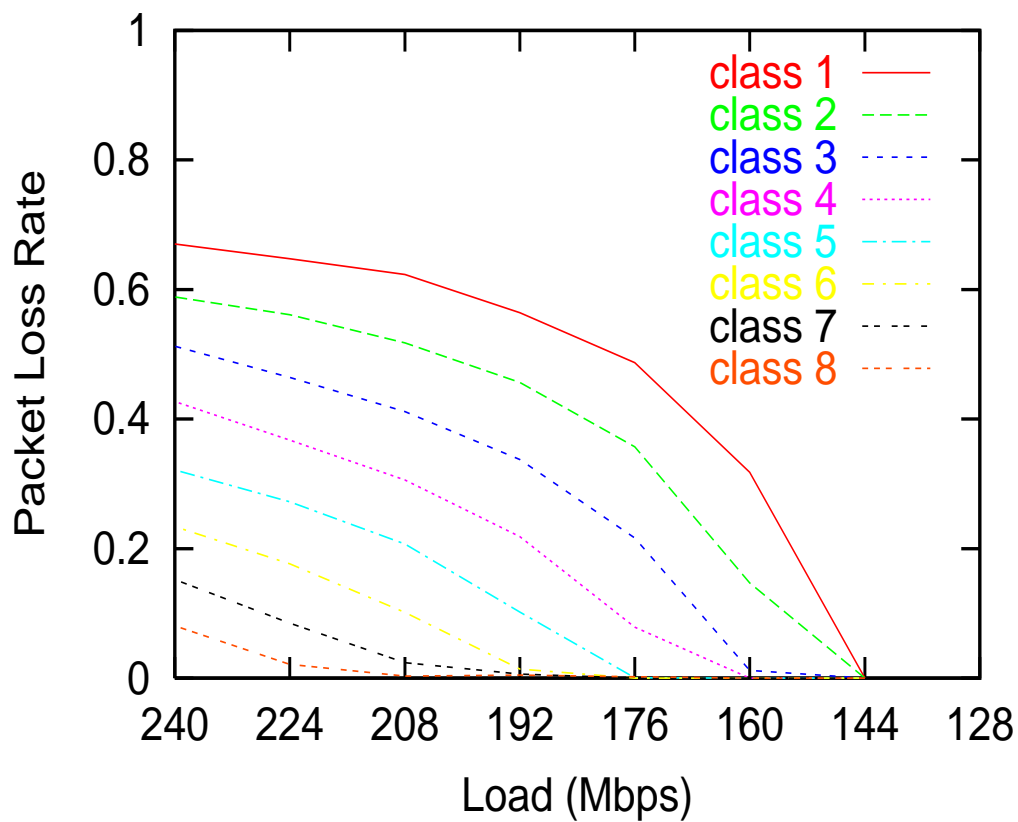
Internet QoS mechanisms:

- use per-flow (or user) reservation for high-quality service
 - guaranteed service
- use shared service classes (platinum, gold, silver, bronze) for prioritized service
 - differentiated service

Internet standards:

- IETF IntServ
 - RSVP protocol
 - analogous to leasing a line
- IETF DiffServ
 - different types of router behavior
 - AF, EF, Cisco's LLQ for VoIP

Cisco IP router: packet loss rate



- 8 classes
- OC-3 (155 Mbps) link
- varying offered load

Internet QoS:

As with many other traffic protocol/engineering features

→ router/switch supported

→ not utilized in practice