Internet2 QoS: Is Less More?

Columbia University
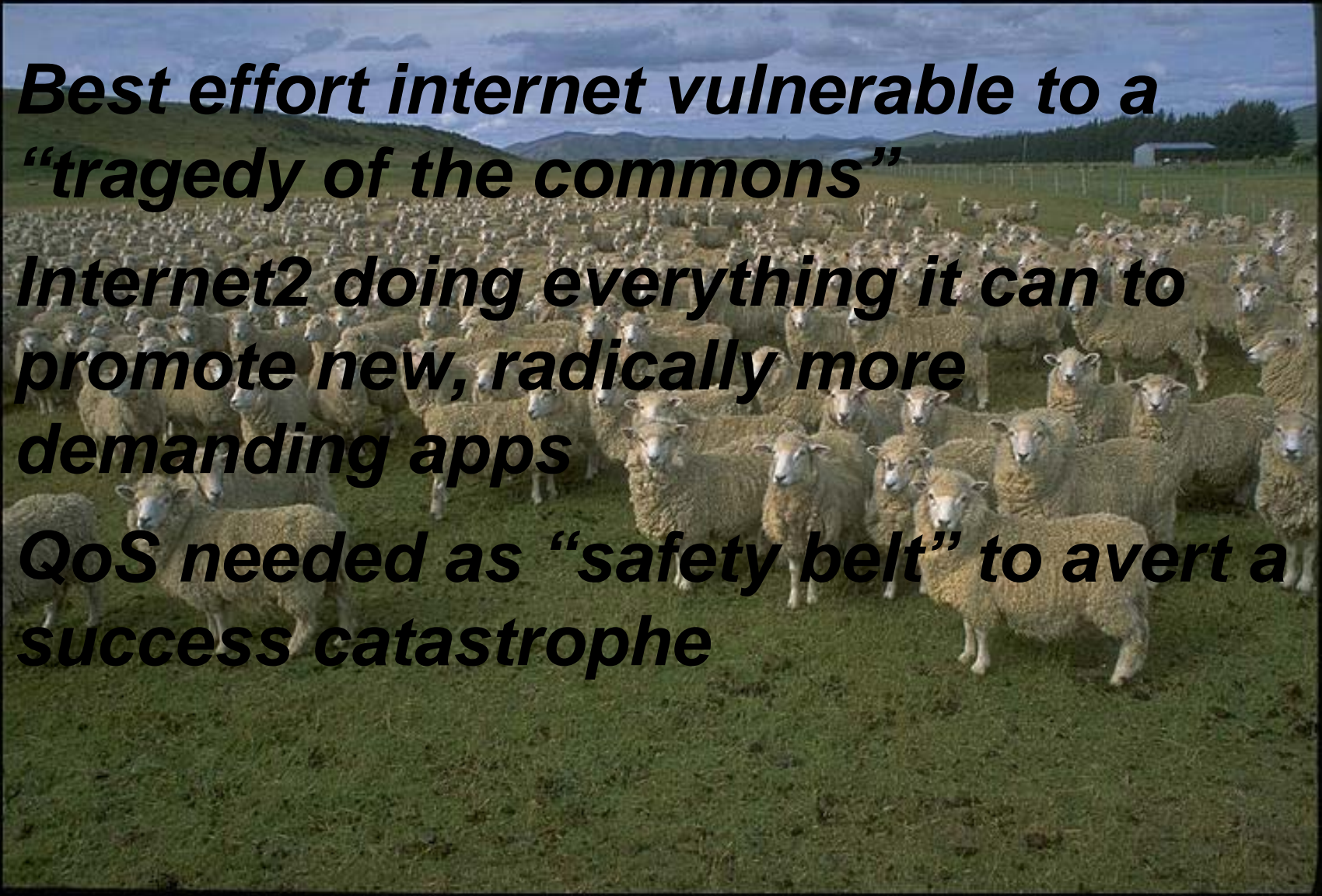
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October 29th, 2001

Why QoS?

Best effort internet vulnerable to a "tragedy of the commons"

Internet2 doing everything it can to promote new, radically more demanding apps

QoS needed as "safety belt" to avert a success catastrophe

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QBone Architecture

A Service: QBone Premium Service

- IP circuit–emulation (a.k.a. "virtual leased line")
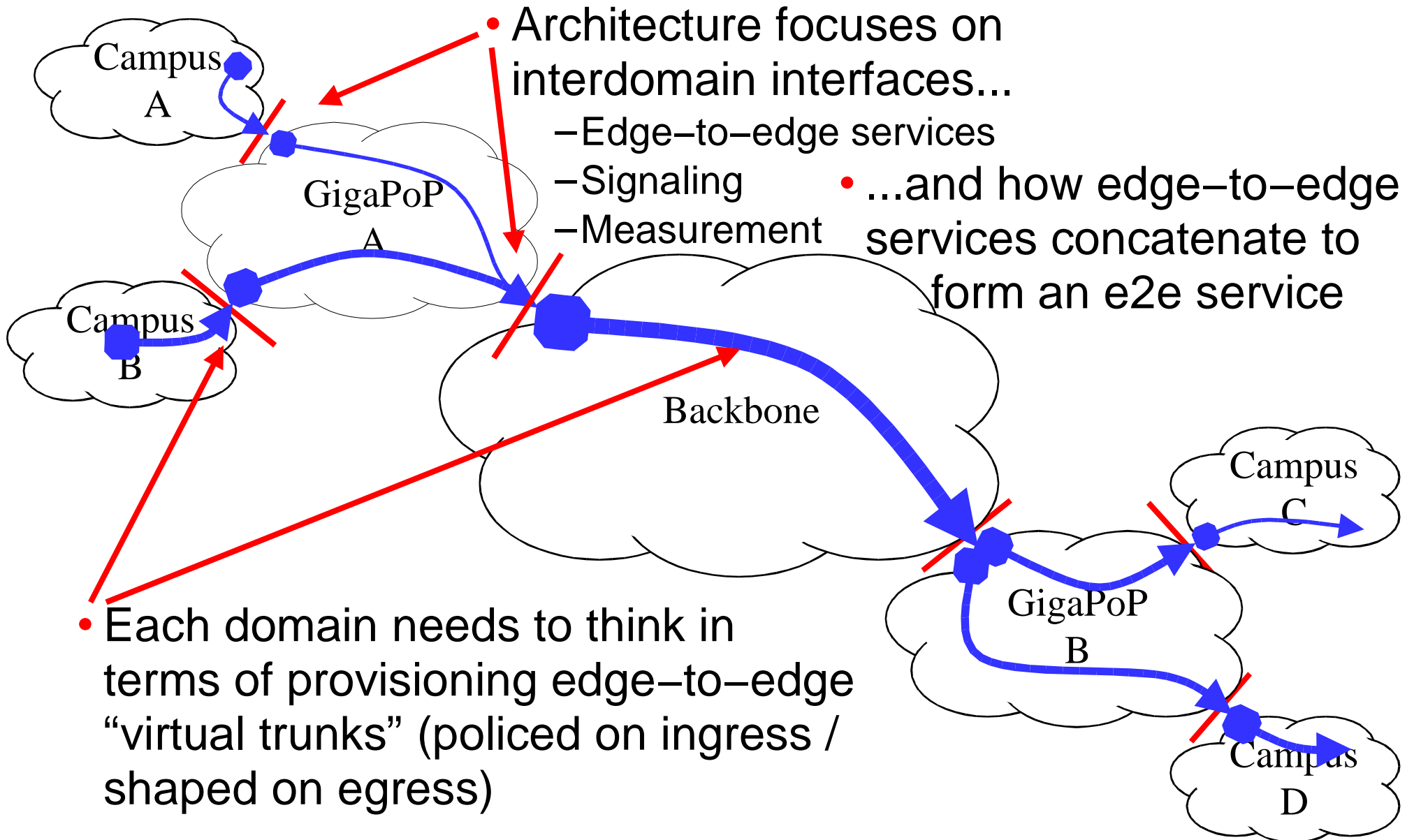- Built on Expedited Forwarding (EF) (RFC 2598)

Reservation Setup Protocol

- **Now**: long–lived, manual setup
- **Proposed**: SIBBS protocol between QBone domains; RSVP end–to–end between hosts

QBone Measurement Architecture

- Uniform collection of QoS metrics
- Uniform dissemination interface

QBone Architecture (30 kilofoot view)

Campus A

GigaPoP A

Campus B

Backbone

Campus C

GigaPoP B

Campus D

- Architecture focuses on interdomain interfaces...
  - Edge−to−edge services
  - Signaling
  - Measurement

- ...and how edge−to−edge services concatenate to form an e2e service

- Each domain needs to think in terms of provisioning edge−to−edge "virtual trunks" (policed on ingress / shaped on egress)

Obstacles to Premium Deployment 1/2

Low demand

Router support for DiffServ is spotty; e.g...

- No PQ
- DiffServ comes with a performance cost
- Limitations on token bucket depths
- Inflexible classification rules

Dramatic changes to network operations, peering arrangements, and business models

Requires all–or–nothing network upgrades (e.g. all access interfaces must police)

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Utilization Paradox

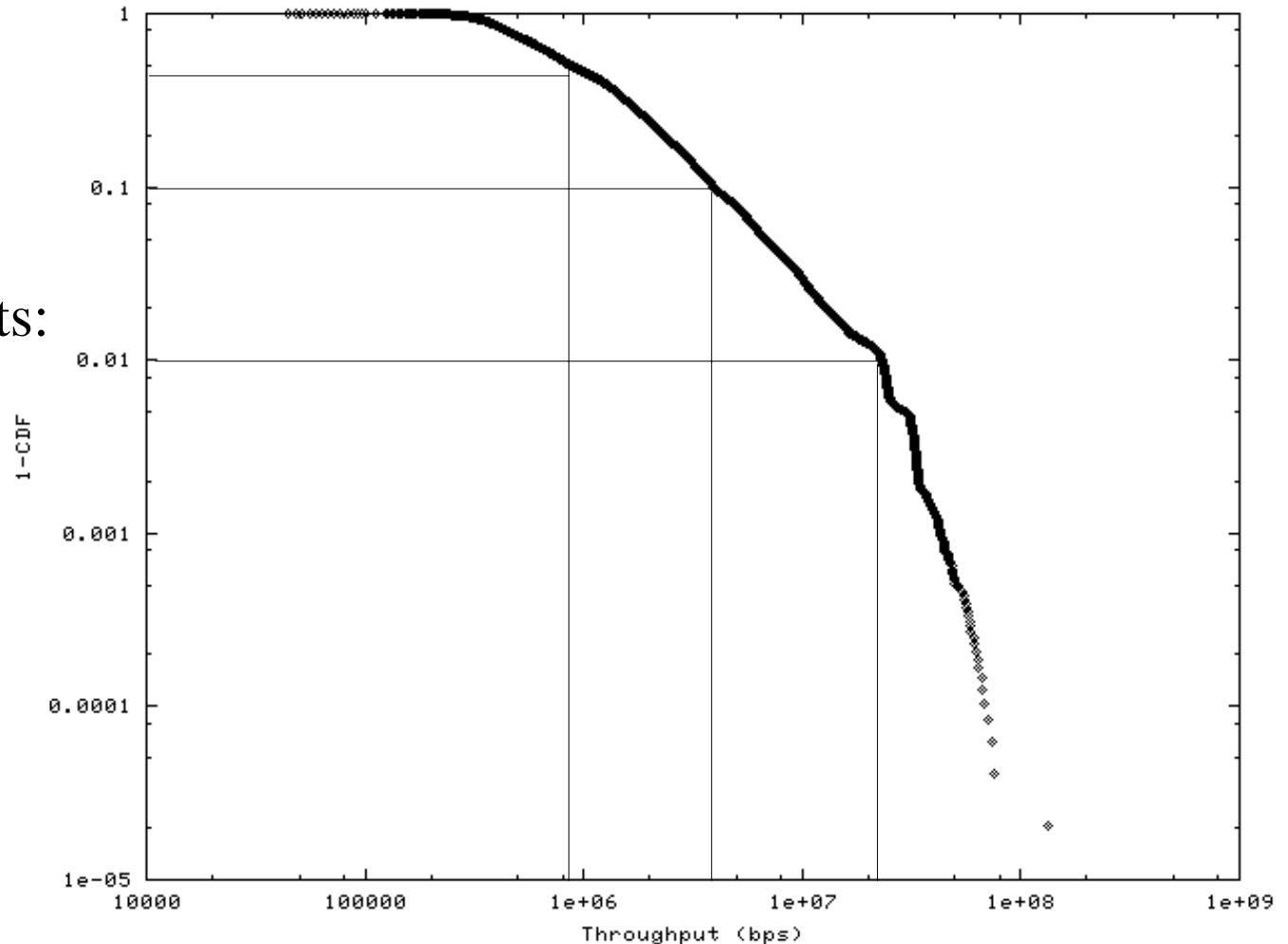Order ~10^4 hosts with nothing slower than switched 100Mbps Ethernet between them

Theoretically, ~25 of these could congest the 2.4 Gbps backbone

Yet... the backbone is lightly loaded!

Paradox: Abilene is both under–provisioned and under–utilized

Why is this?!

"Typical" E2E Internet2 Performance[1]

- 50,000 bulk TCPs observed on 6/19/01
- Sampled NetFlow at core router
- Observed throughputs:
  - Median: 880 Kbps
  - 10% ≥ 3.9 Mbps
  - 1% ≥ 23 Mbps

1. Draft paper at: http://www.internet2.edu/abilene/tcp/

Performance Faults Obviate QoS

Evidence suggests that most problems are in hosts and LANs

Common performance faults

- Broken TCP stacks (*e.g.* inadequate socket buffering, no window scaling)
- Ethernet duplex mismatch
- Crummy cabling (*e.g.* CAT3, shared, or damaged)

Internet2 End–to–End Performance Initiative

- Major initiative to work on this problem
- http://www.internet2.edu/e2epi/

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"Non–Elevated" Services

"Worse"

- QBone Scavenger Service (QBSS)
- Bulk Handling PDB (B. Carpenter, K. Nichols)

"Different–but–equal"

- Alternative Best Effort (ABE)

Why do we like these wacky services?!

- Require no policing, admissions, settlement, etc.
- Deploy incrementally at the granularity of single interfaces
- Consistent with end–to–end principle

QBone Scavenger Service

Basic idea

- **Voluntary** marking hints to network that degraded service is OK (like Un*x `nice` for the network)
- Scavenger traffic **may** be degraded at congestion points
- **Think**: thin, bottom–feeding best–effort network that can expand to full capacity in absence of congestion
- Formal service definition:
  `http://qbone.internet2.edu/qbss/qbss-definition.txt`

Goals

- A tool to preserve/extend uncongested BE experience for interactive applications

All traffic is not equal

- Mix of critical/non–critical traffic
- Since you may be competing with yourself for downstream resources, it's in your interest to identify non–critical traffic to protect your critical traffic

Most routers support multiple queues

- Let's get some value and experience out of them!

Internet2 utilization very low

- **Pro**: interactive apps work fine; **Con**: what a waste!
- What new applications could be built if we weren't shy about filling the pipes?

Motivations_{2/2}

INTERNET2

Fine−grained Netiquette

- Self−policing users exist
  - HEP community runs bulk−transfers "at night"
  - Network backups
  - CDN pre−fetching
- QBSS allows these apps to run continuously

Pricing

- Additional control over upstream commodity usage
- Potential point of negotiation for metered connectors

Policy

- Users/institutions could mark non−mission traffic

Current State of QBSS

Testing underway to support bulk transfer needs of HEP and astrophysics users

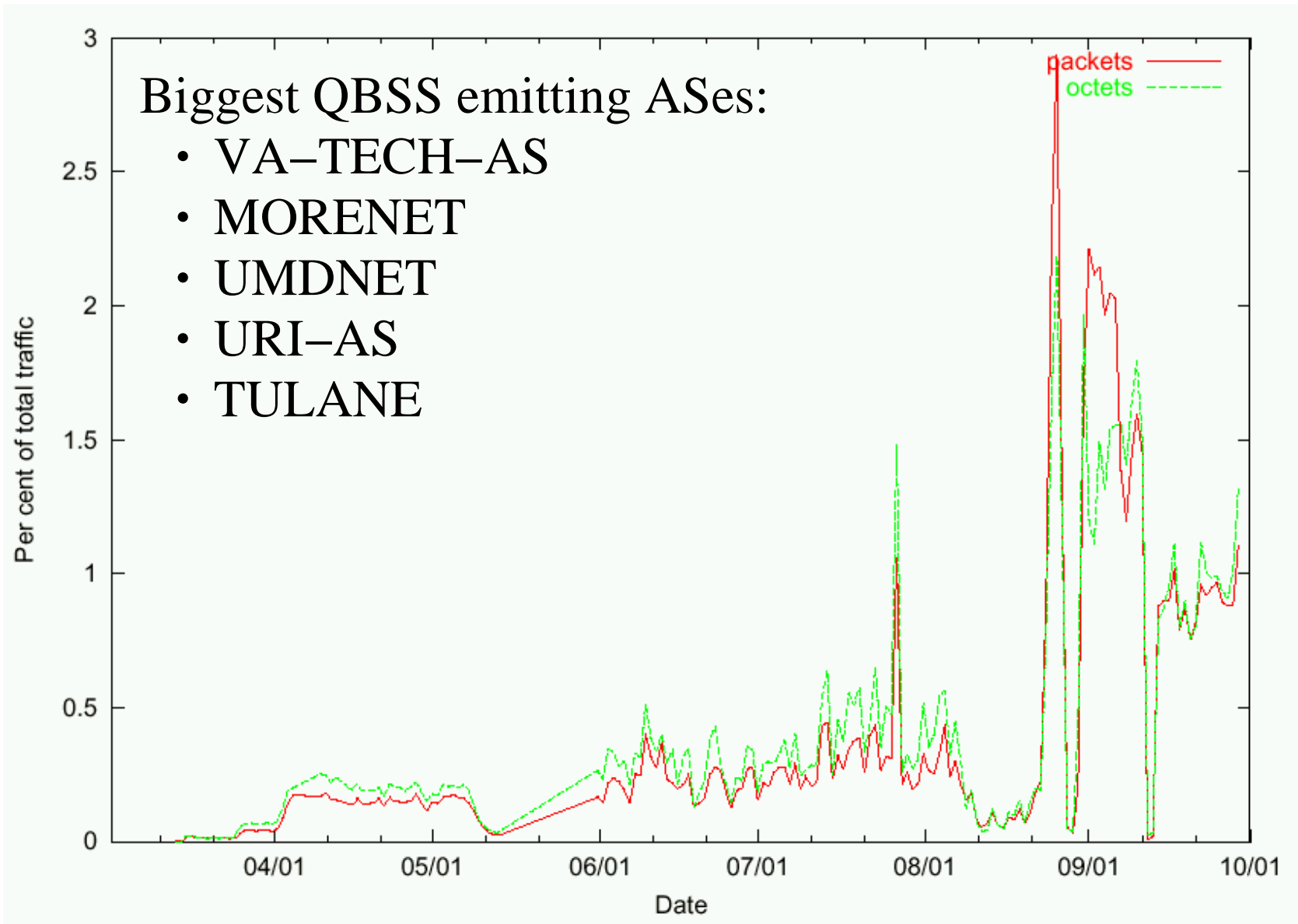- SLAC, TransPAC (GRAPE), CERN, UKERNA

Gear tested and configs available for:

- Cisco 7200, 7500, GSR
- Juniper

Some operational traction

>1% QBSS on Abilene

QBSS Usage at Abilene CLEV

Biggest QBSS emitting ASes:
- VA–TECH–AS
- MORENET
- UMDNET
- URI–AS
- TULANE

Alternative Best Effort (ABS)

Monolithic best–effort service class split into:

- **Blue** –lower loss / higher delay
- **Green** – higher loss / lower delay

Fairness relationship between classes

Each app knows its utility function and trades off loss for delay accordingly

See: http://www.abeservice.com/

Too much mythology and confusion about what apps really need

Goals:

- Build bridges between networkers and developers
- Promote best practices for developing and deploying adaptive multimedia applications

Activities in this area

- Survey paper of application QoS needs
- Measurement and analysis to understand application performance and use of new services
- Investigating the value of a service–specific service initiative (*e.g.* a VoIP network service)

For more information...

Internet2 QoS WG Home:

- http://www.internet2.edu/qos/wg/
- Links to all WG design teams may be found here

QBone Scavenger Service

- http://qbone.internet2.edu/qbss/

QBone Home:

- http://qbone.internet2.edu/

"Future Priorities for Internet2 QoS" paper:

- http://www.internet2.edu/qos/wg/papers/qosFuture01.pdf

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