



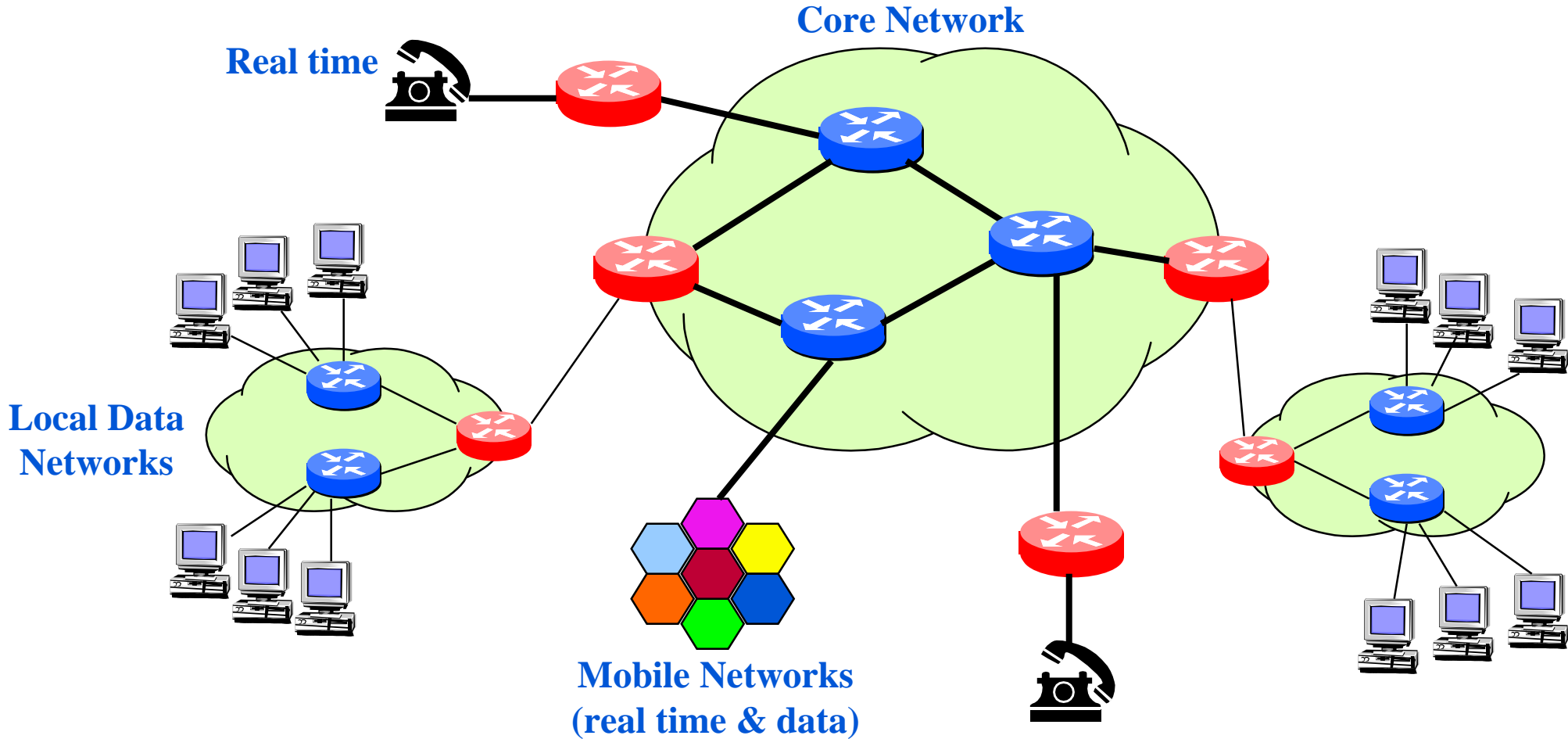
QoS Architectures for Connectionless Networks

Stewart Fallis [stewart@mirror.bt.co.uk]
BT Advanced Communications Research

Outline

- Future network model
- A generic network model
- Current architectures
 - ATM QoS
 - Integrated Services
 - Differentiated Services
- Evolving Differentiated Services
 - ‘Soft’ QoS
 - ‘Hard’ QoS
 - Bounded Delay service
 - Dynamic QoS
- Grade of service
- Generic QoS node
- Concluding comments

Generic Network Model



Need a Globally Accepted QoS Architecture

Current QoS Architectures

- **ATM QoS**

- Delay by design

- **Integrated Services**

- Connection Oriented QoS
- Negotiable guaranteed end-to-end delay service
- Dynamic Delay Guarantees
- Zero packet loss

- **Differentiated Services**

- Connectionless QoS
- Small set of aggregate classes: no per-flow information
- ‘Dumb’ core routers

- Classes: signalled via control

- Heavy weight signalling protocol
- Hard QoS
- Requires per-flow state in routers
- Pessimistic delay bound

- QoS maybe too soft e.g. Premium service
- No-per flow separation
- Static: Subscription based
- No feedback from network when failure occurs

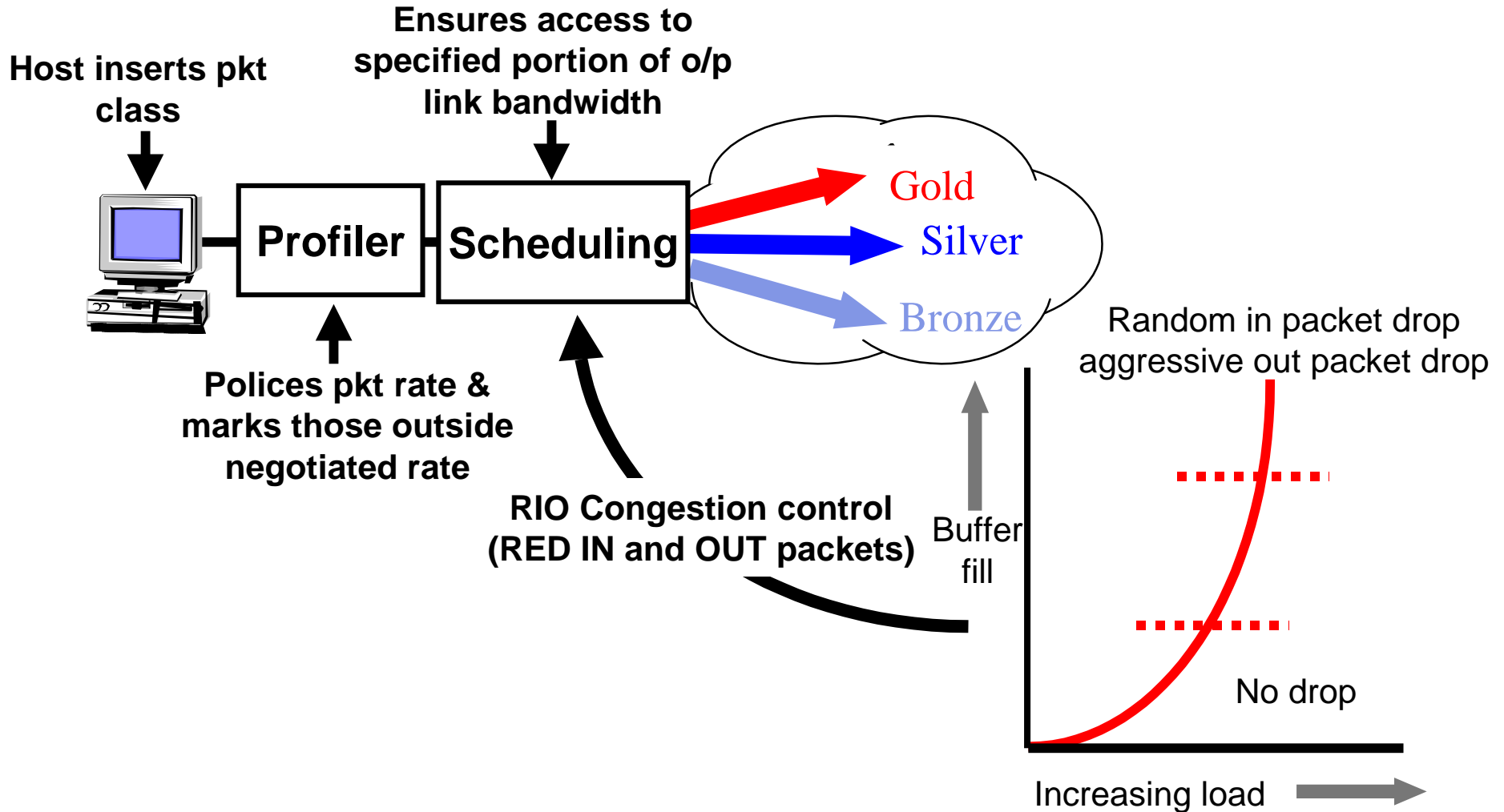
Evolving Differentiated Services

What we really need is:

- Dynamic Bandwidth Allocation
- Per-flow state only at edge
- Signalling for hard QoS
- Low delay by design not negotiation
- Aggregate in core
- Not soft-state

**Network would support both ‘Hard’
and ‘Soft’ QoS**

Soft QoS: Olympic Service



Hard QoS: Bounded Delay

- Evolve Diffserv EF class
- Peak rate host shaping
- Limit Max Packet size
- Dimensioned buffer & bandwidth



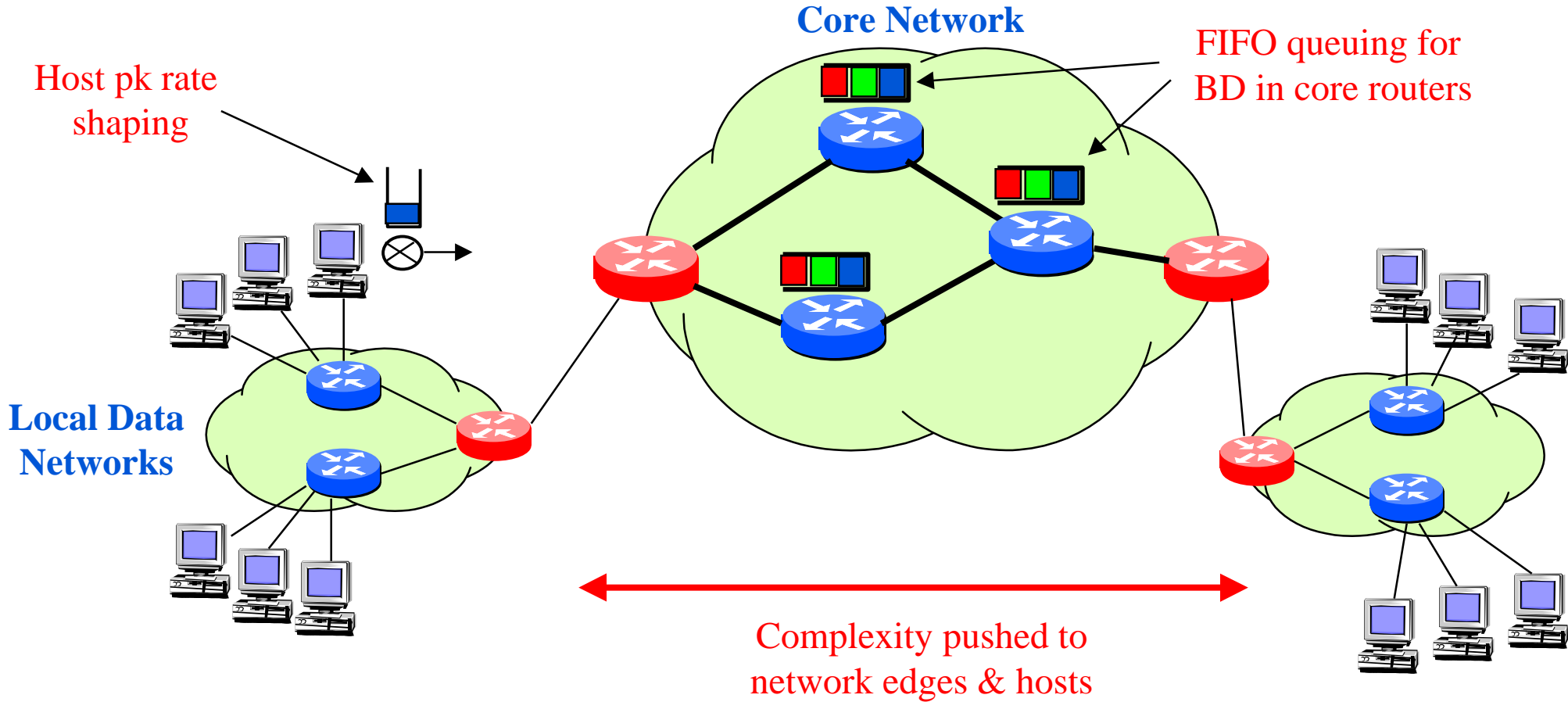
Guaranteed Delay bound

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Simple FIFO queuing

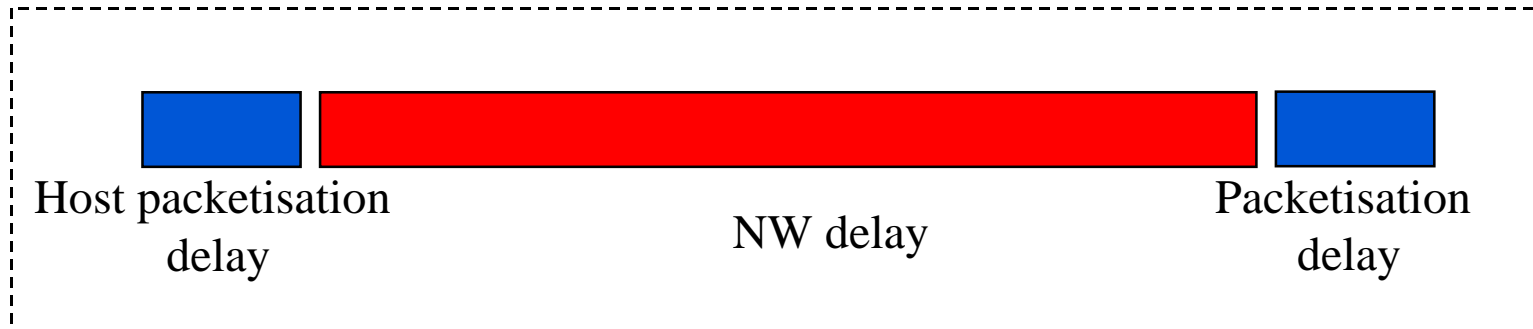
Overcomes Need For Per-Flow State

Hard QoS: Bounded Delay



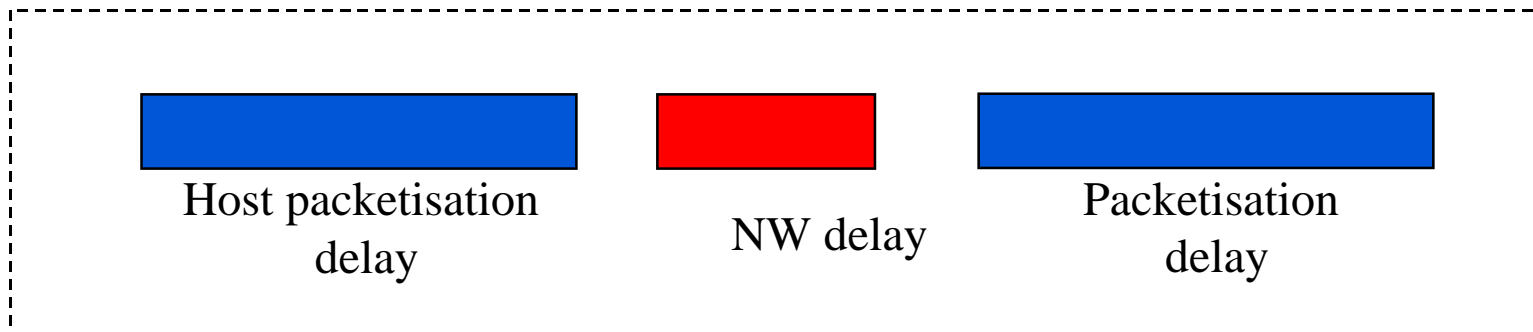
$$T_{wc} \approx \frac{N \cdot L_{BD}}{R}$$

Bounded Delay: Delay Bound



- Network delays dominant

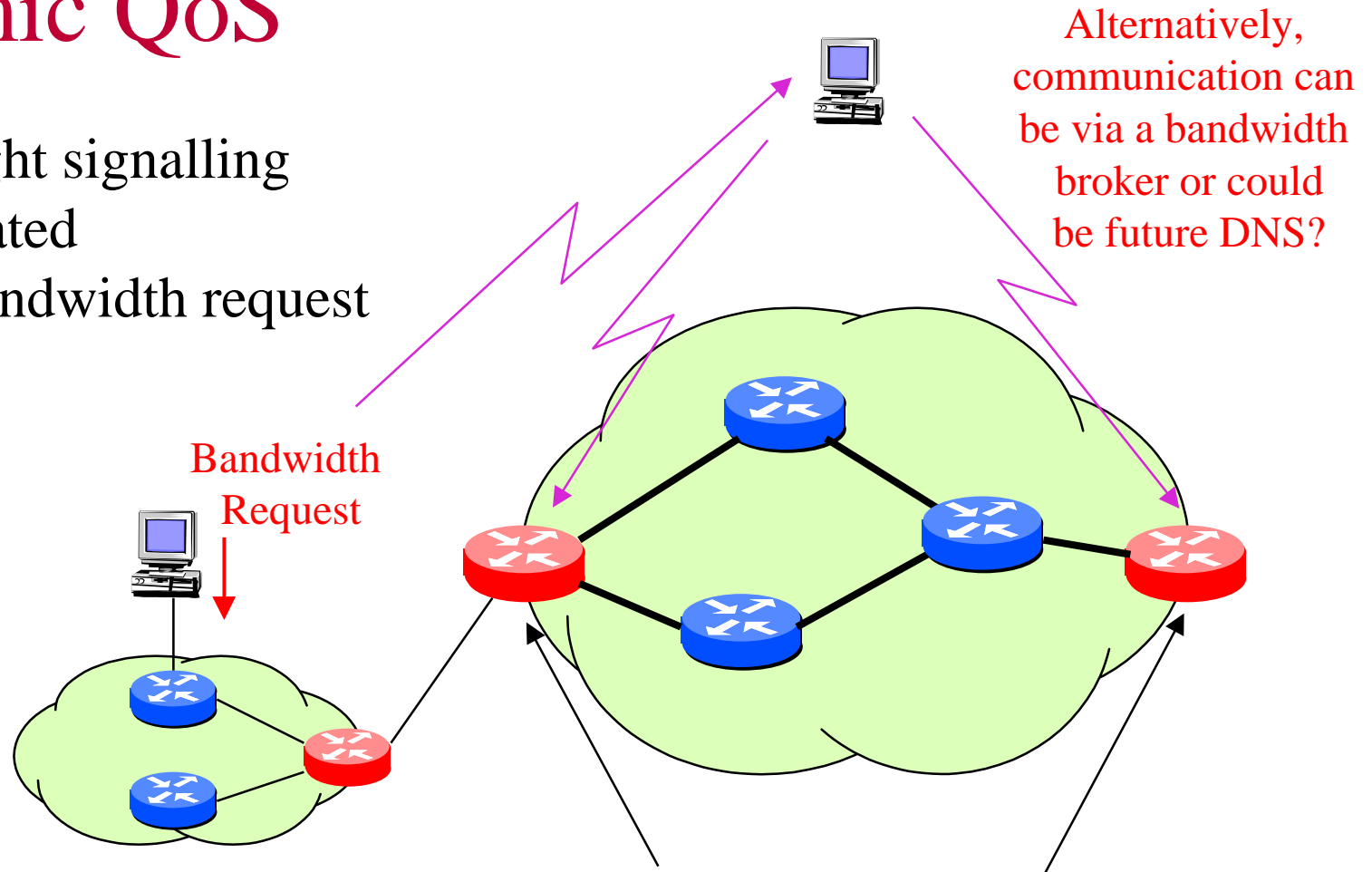
- Long timescales to 'sort' incoming packets



- Bounded Delay assumes high speed core
- Packetisation delay dominant
- FIFO queuing is sufficient

Dynamic QoS

- Lightweight signalling
- User initiated
- Simple bandwidth request

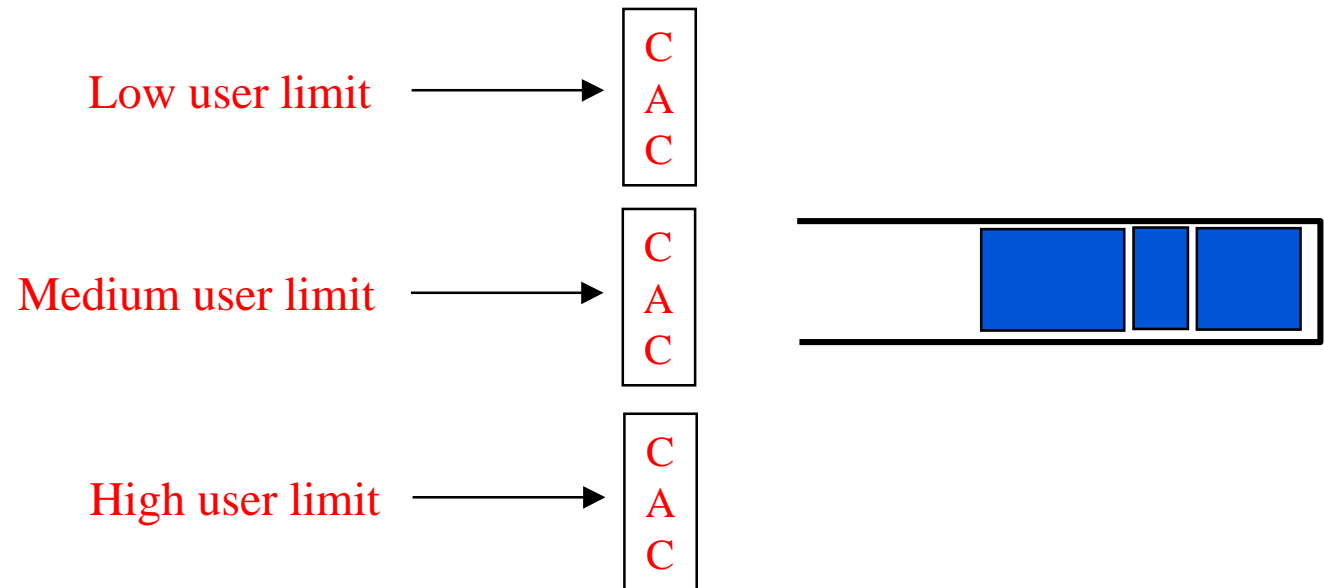


Alternatively, communication can be via a bandwidth broker or could be future DNS?

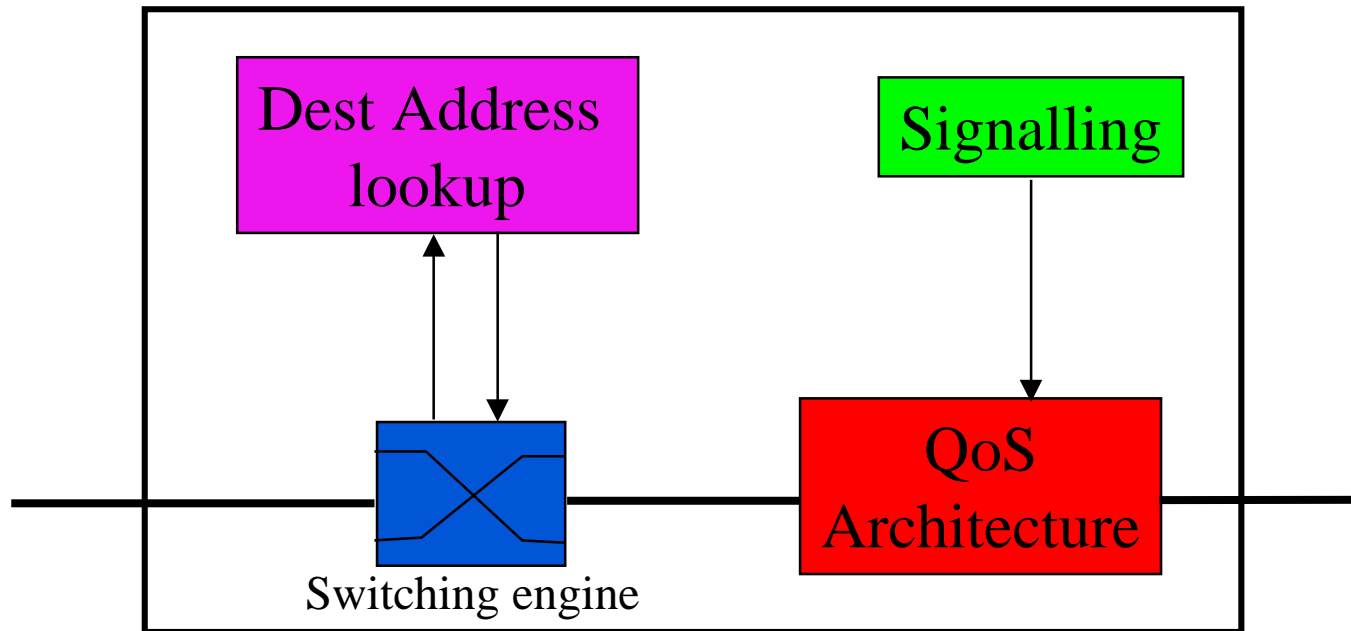
Bandwidth request can involve only edge nodes, or depending on how onerous, all nodes.

Bounded Delay: Grade of Service

- Use CAC to restrict users
- Provides varying QoS from one “pool” of bandwidth

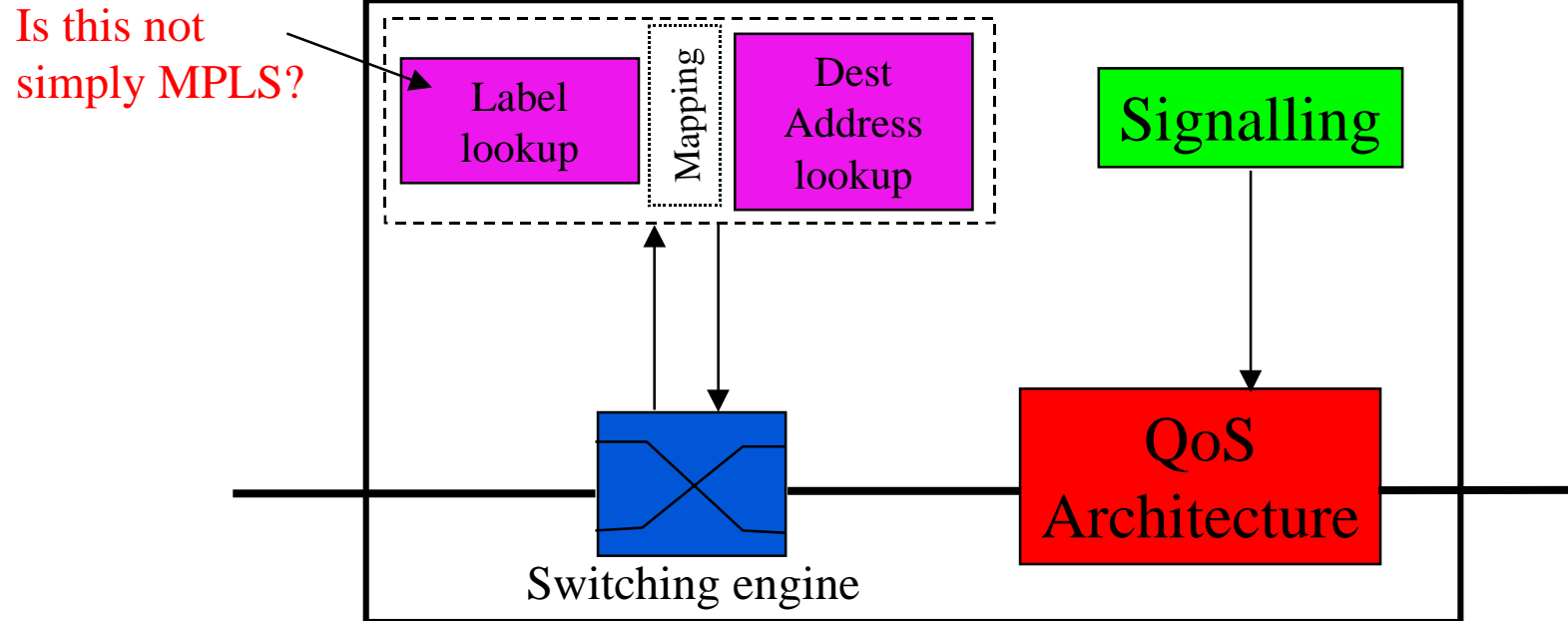


Generic QoS Node



Current IP architecture does not support connections!

Connection Oriented Routing



CO routing does not affect the QoS Architecture

Future Work

- “We don’t believe in Kings and Queens...
Just general consensus and running code” - Dave Clarke
- Implementing in FreeBSD using AltQ

Conclusions

- Migration to control layer
- QoS is application, routing independent
- Common reservation method
- Common signalling method
- Range of QoS supported
- QoS architecture not dependant on other NW functions
- Work needs to be done on how and when to use these services

Resources

- Bounded Delay Draft
Carter S. et al, “A Bounded Delay Service for the Internet”
<ftp://ftp.labs.bt.com/Internet-Research/Bdelay.pdf>
- Contact Info:
e-mail stewart@mirror.bt.co.uk