Resource Management and Differentiated Services

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with input from many others

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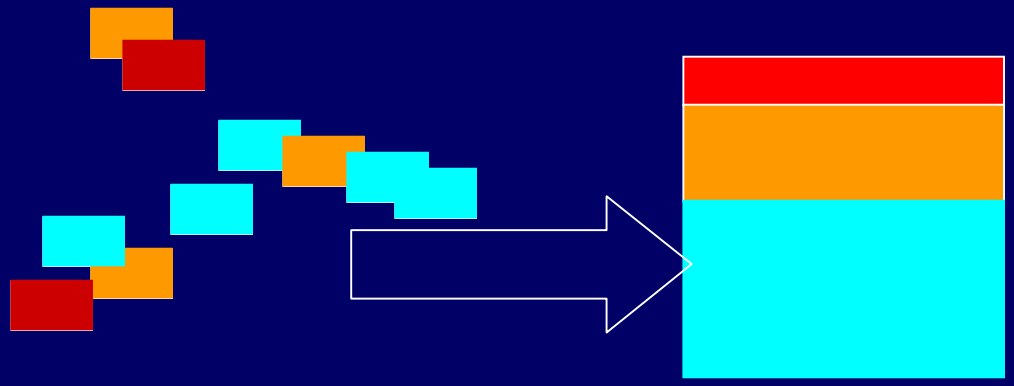
Network QoS support seen from 10,000 feet:

1 Define packet treatments at switches/routers

2 Control the amount of resources allocated to each treatment class

3 Sort packets into classes



What this talk is about

- How to provide scalable, robust, and manageable resource management
  - Ongoing research/development effort
  - incorporating others visions/ideas

What this talk is *not* about

- how many different traffic classes needed, or how to set the TOS field value
  - the charters of IETF intserv & diff-serv Working Groups

What is pushing diff-serv effort

- A market need since yesterday: simple mechanisms that can be *quickly* and *incrementally* deployed to provide differentiated services
  - no one wants to sell “bad” services
  - everyone wants to sell varying levels of “good” services
- Various doubts on feasibility of intserv framework
  - Complexity?
  - Scalability?
  - Quick deploy-ability?

How and how much do diff-serv & intserv differ?

- Where to start:
  - defining end-to-end services, vs.
  - defining packet treatments at individual components

A sidenote:

- IP started by defining hop-by-hop forwarding, rather than end-to-end delivery service

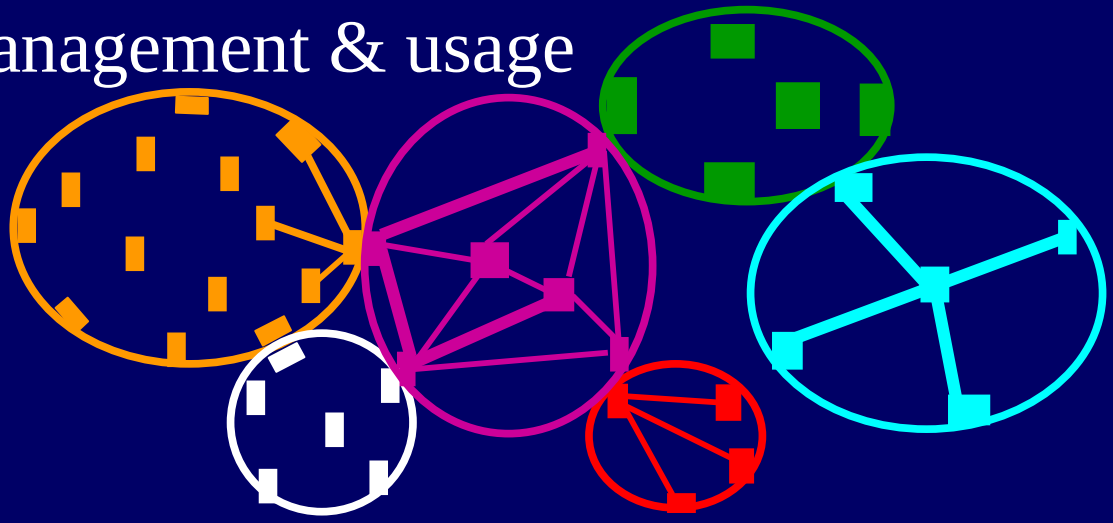
How and how much diff-serv & intserv differ (II)

- How to control the amount of resources allocated
  - end-to-end QoS support requires end-to-end signaling
  - per-hop treatment can work with either static configuration or dynamic signaling
- How to sort packets into classes
  - old RSVP way:
    - identify individual flows
    - map packets of each flow to proper traffic classes
  - diff-serv: use TOS field as class ID
    - pre-classified somewhere

Network resource management

Emerging model:

- interconnects of administrative domains
- a priori bilateral agreement between neighboring domains
- each domain responsible for its internal resource management & usage



An analogy to global routing

- Hierarchical
  - needed for scaling
  - needed for administrative control
  - different granularity at different levels
- routes are *pre*-computed (or *pre*-configured)
- concatenation of hop-by-hop forwarding provides end-to-end data delivery
- routes dynamically adjustable
  - adapt to topology/policy changes

A proposed picture for **Scalable QOS support**

- Two-tier resource management
  - inter-administrative domains
  - intra-administrative domains
- Inter-domain: pre-negotiated neighboring relation
  - infeasible to set up business relation upon every new flow in real-time?
- concatenation of bilateral agreement leads to end-to-end QoS delivery paths
- amount of resources adjustable
  - adapt to demand/policy/topology changes

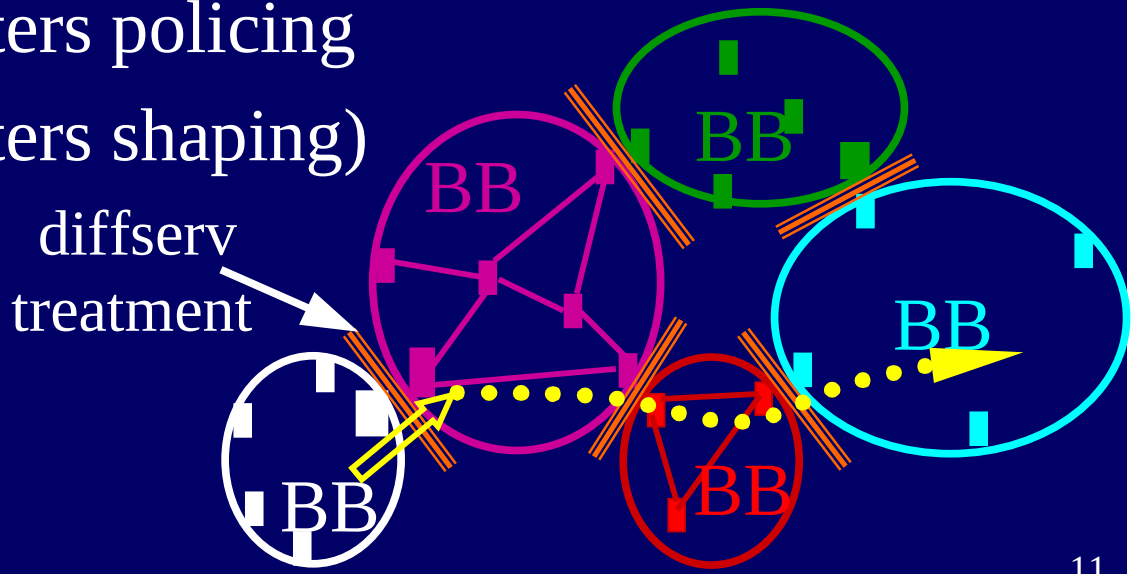
Resource manager: **Bandwidth Broker (BB)**

- A logical entity residing in each administrative domain
  - Managing internal demands & resources according to the policy database (who can do what when)
  - setting up & maintaining bilateral agreement with neighbor domains
    - bookkeeping how much traffic entering which border router & going out which border router
- today's BB: network administrators & operators
  - would like to automate over time

"A Two-bit differentiated services architecture for the Internet"
Nichols, Jacobson, Zhang
draft-nichols--diff-arch-00.txt, November 1997

An overall picture

- "Keep complexity at edges, leave the core simple"
  - peripheral domains may manage internal traffic and resources in any way they wish
  - border-crossing packets carrying right TOS value and treated diffserv way
- ingress border routers policing
- (egress border routers shaping)



Some of the questions

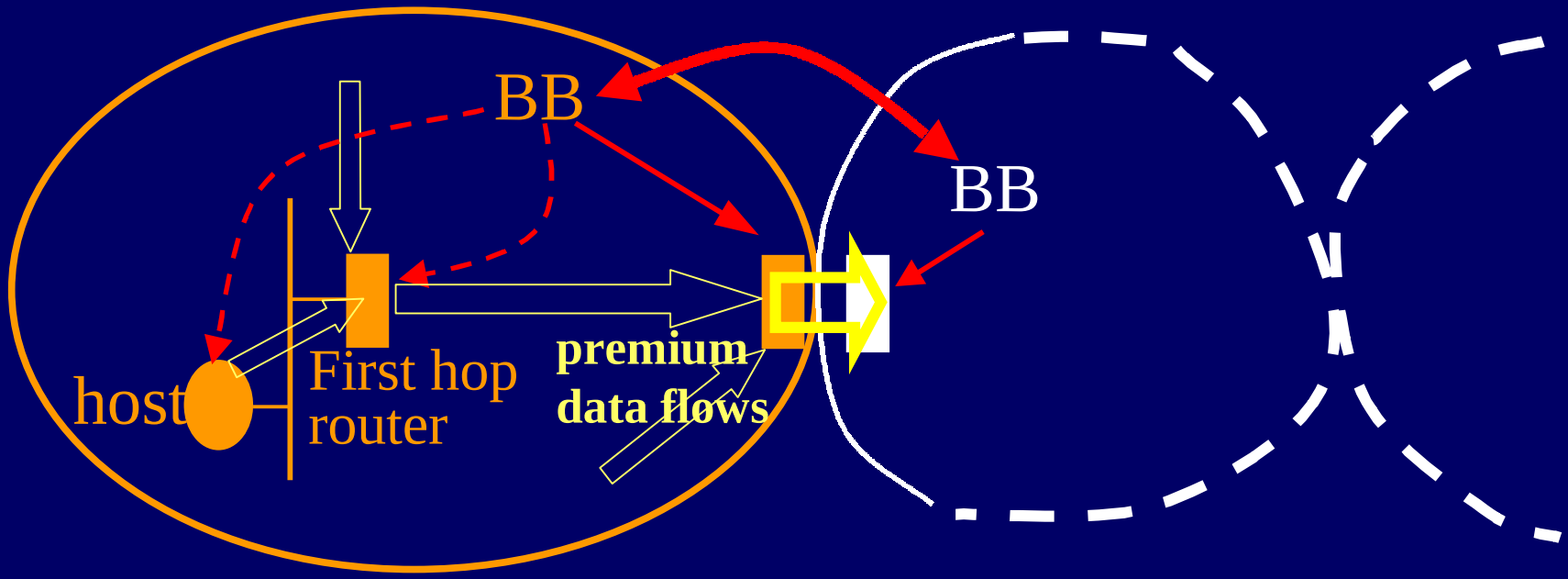
1. How does a leaf domain BB know the total local demands for each egress border router?
2. How does a transit domain BB map its inter-domain commitment to internal resource allocation?
3. How much (& what) state must BB keep?
4. How much (& what) state must a router keep?
   - Router in leaf domains
   - Router in core networks

Choices for implementation

- adequate provisioning
  - eliminate Questions 2, 3, & 4
- manual configuration
  - not that different from static routing
- using some setup protocols
  - inter-domain: BB-to-BB
  - Intra-domain: RSVP as a ready candidate

follows slide 213

An example of **provisioning in a local domain**

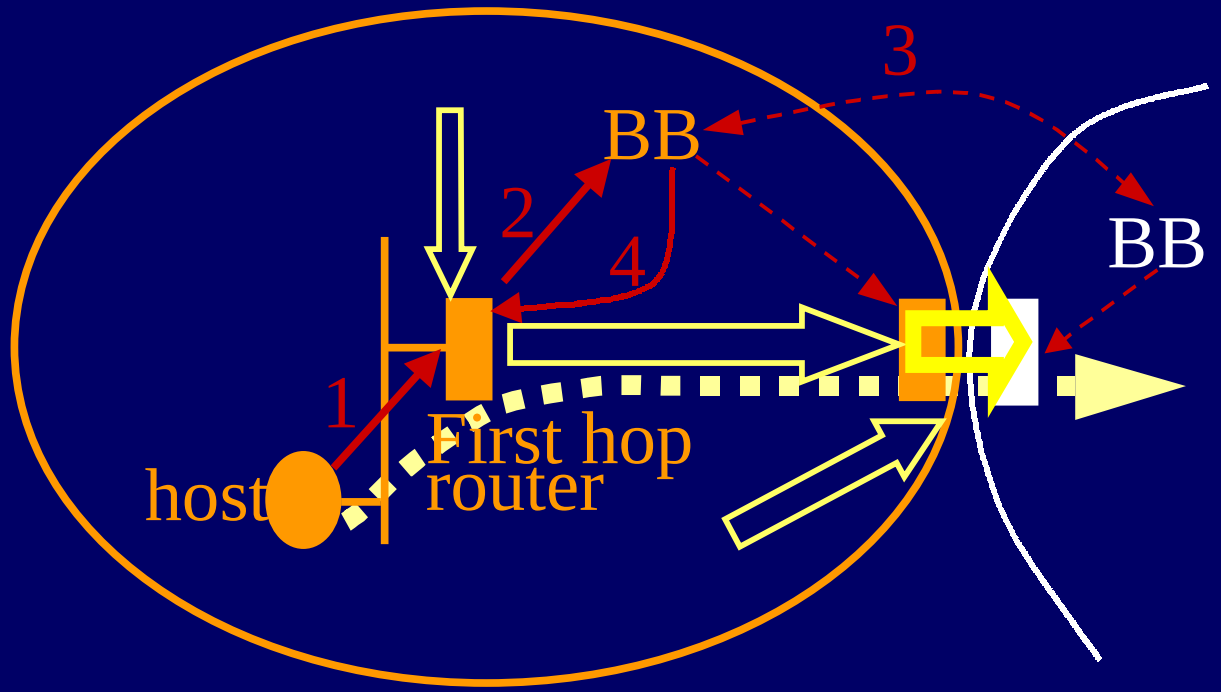


BB is assumed to have adequate knowledge about internal demand; may readjust the allocation over time.

BB & BB instruct their edge devices how to shape/police.

Indicating additional configurations (shaping/policing) if the domain cannot solely rely on provisioning.

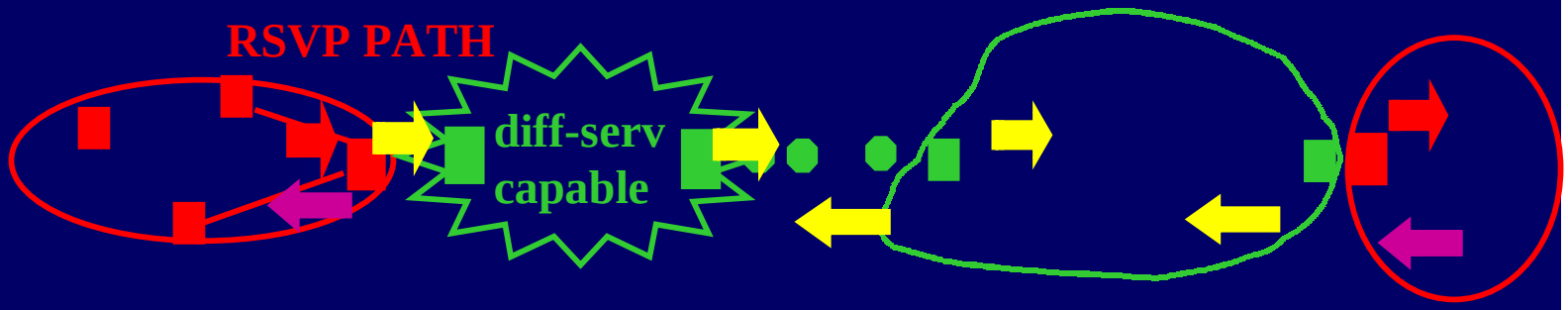
An example of
using RSVP in a local domain



BB may pre-reserve adequate bandwidth with BB to avoid readjusting the inter-domain allocation everytime
(the actions indicated by the dashed lines)

“Tunnel” RSVP messages between leaf domains

- Why “tunnel through”: do *not* want intermediate routers to see/act on end-to-end RSVP messages
- One way of doing it



- drawback
  - assuming both ends using RSVP internally
  - intra-domain signaling msgs crossing boundaries

“A Framework for End-to-End QoS Combining RSVP/Intserv and Differentiated Services” draft-bernet-intdiff-00.txt

Intra-transit domain implementation

Choices of implementation

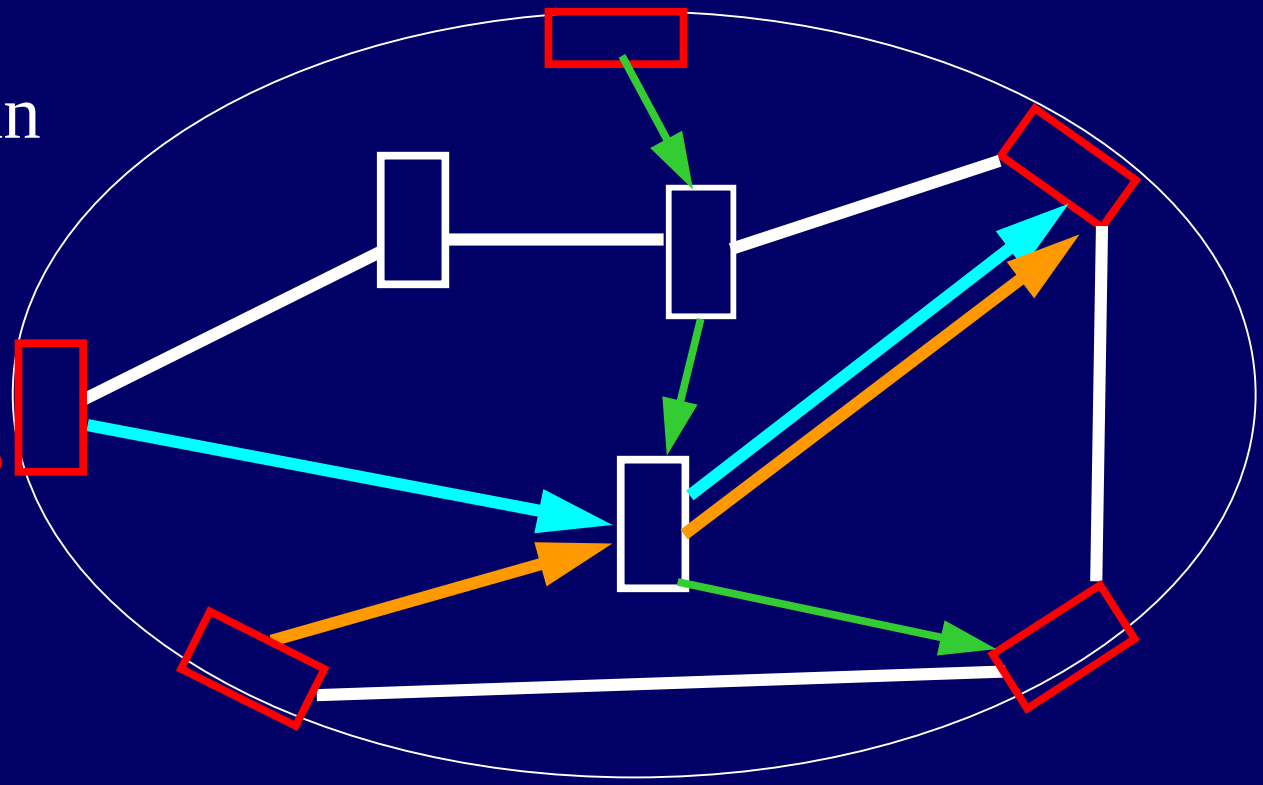
- provisioning
- manual configuration, or SNMP
- use an automatic setup protocol, such as RSVP

How to use RSVP in core networks

- border routers behave as sources & destinations for ingress and egress traffic
  - similar idea discussed in PASTE draft

Here is a picture

A transit domain



- Set up an RSVP session for each ingress flow
  - RSVP msgs tell each router along the way how much to reserve
  - Routers classify packets by TOS field
- Reservations follow routing changes automatically

Some of FAQ's

- Is this sender or receiver driven?
  - At BB level: yes to all, sender domain BB, receiver domain BB, possibly 3rd party BB
- How to handle allocation for multicast traffic?
  - See above
    - details being worked out
- relation between the two levels of resource control?
  - Inter-domain (BB) level:
    - independent from whether one does anything internally
  - intra-domain: local decision

Summary: One possible picture for **diff-serv resource management**

- two-level hierarchy
  - inter-domain management
    - currently human
    - automate over time; BB as one proposal
  - intra-domain management: multiple possible choices
    - provisioning, manual-configuration, SNMP, RSVP
- packet classification
  - cross-domain traffic: classified by bits in TOS field
  - leaf domain: one's own choice
- Work underway for a prototype implementation