



IP Differentiated Services

From: Engineering the Internet QoS
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Overview



- ❑ What are Differentiated Services?
- ❑ DiffServ Concepts, Per-hop Behaviors
- ❑ Expedited and Assured Forwarding
- ❑ Bandwidth Broker
- ❑ Problems with DiffServ

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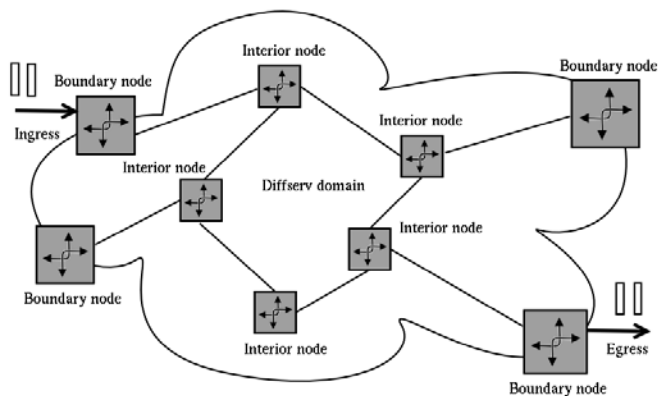
DiffServ Overview

- ❑ Simple traffic differentiation
 - avoids per-flow, per-user state within core
- ❑ Semantics which inter-operate across administrative domains
- ❑ Scalable mechanisms
 - Doesn't depend on hop-by-hop application signalling
- ❑ Accommodate incremental deployment

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DiffServ Domain

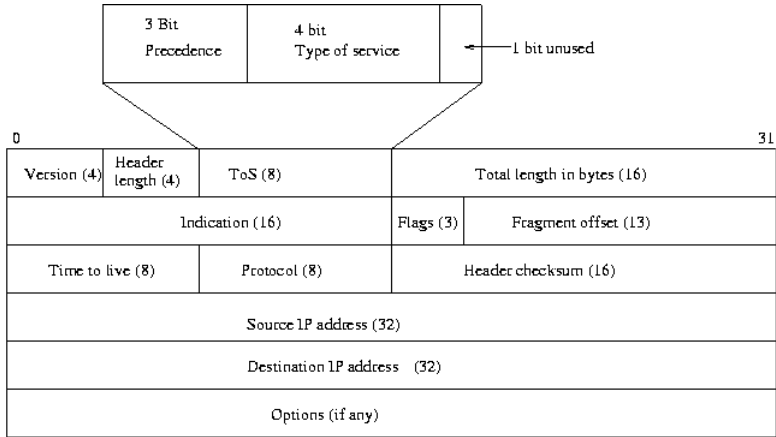


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IPv4 Packet Header

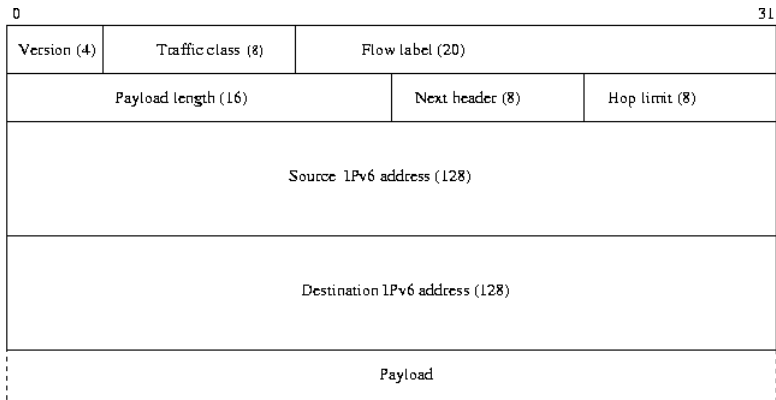


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IPv6 Header



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Existing TOS

Existing RFC1349 semantics for TOS

```
1000 -- minimise delay
0100 -- maximise throughput
0010 -- maximise reliability
0001 -- minimise monetary cost
0000 -- normal service
```

Existing RFC701 semantics for IP precedence

```
111 - Network Control
    110 - Internetwork Control
    101 - CRITICAL/ECP
    100 - Flash Override
    011 - Flash
    010 - Immediate
    001 - Priority
    000 - Routine
```

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Differentiated Services

- ❑ OSPF can compute paths for each ToS
- ❑ Many vendors use IP precedence bits but the service varies ⇒ Need a standard ⇒ Differentiated Services
- ❑ DS working group formed February 1998
- ❑ Charter: Define DS byte (IPv4 ToS field, IPv6 Traffic Class field)

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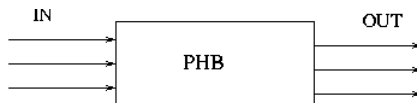
DiffServ Concepts (Cont.)

- Service: Offered by the protocol layer
 - Application: Mail, FTP, WWW, Video,...
 - Transport: Delivery, Express Delivery, ...
Best effort, controlled load, guaranteed service
 - DS group will not develop services
They will standardize 'Per-Hop Behaviors'

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Per-hop Behaviors

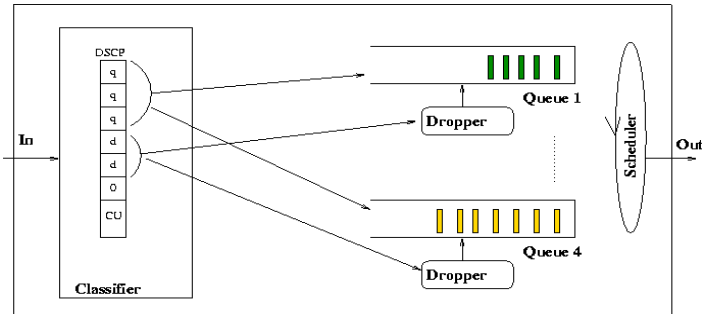


- Externally Observable Forwarding Behavior
- x% of link bandwidth
- Minimum x% and fair share of excess bandwidth
- Priority relative to other PHBs
- PHB Groups: Related PHBs. PHBs in the group share common constraints, e.g., loss priority, relative delay

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Assured Forwarding



Four Classes: No particular ordering

Three drop preference per class

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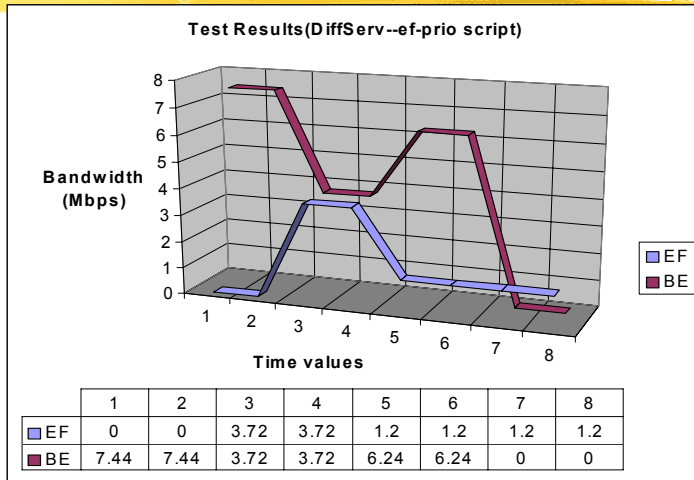
Assured Forwarding (Cont.)

- ❑ DS nodes SHOULD implement all 4 classes and MUST accept all 3 drop preferences. Can implement 2 drop preferences.
- ❑ Code Points:

Drop Prec.	Class 1	Class 2	Class 3	Class 4
Low	010 000	011 000	100 000	101 000
Medium	010 010	011 010	100 010	101 010
High	010 100	011 100	100 100	101 100

Avoids 11x000 (used for network control)

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BE on EF 1.2Mbps BE off

Protecting R/T Traffic



DiffServ Problems (Cont.)

- ❑ QoS is for the aggregate not micro-flows.
Not intended/useful for end users. Only ISPs.
 - Large number of short flows are better handled by aggregates.
 - Long flows (voice and video sessions) need per-flow guarantees.
 - High-bandwidth flows (1 Mbps video) need per-flow guarantees.
- ❑ All IETF approaches are open loop control ⇒ Drop
Closed loop control ⇒ Wait at source
Data prefers waiting ⇒ Feedback

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09/10/2009

Open Issues with DiffServ

- ❑ Standards are in the early stages of development
- ❑ How to build arbitrary end-to-end services out of standard PHBs is still under investigation
- ❑ How to address inter-domain communication

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09/10/2009

Challenges

- ❑ How to decide what users get special service?
- ❑ Where to implement bandwidth sharing policy?
- ❑ Who is responsible for ensuring that simultaneous uses of special service fit within allocation?
- ❑ Solution : Bandwidth Broker
 - proposed by Jacobson

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09/10/2019

Summary

- ❑ DiffServ is a scalable solution for QoS in the Internet
- ❑ Packets are classified at the edge and marked with certain codes, intermediate routers forward packets based on the codes only
- ❑ Unlike IntServ, DiffServ cannot support per-flow QoS guarantee

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09/10/2019