

Quality of Service



Motivation

- Quality of Service (QoS)
- Provide circuit-switched features in a packet-switched network
- Guarantees on rate, latency, and jitter
- Two approaches
 - Differentiated Services
 - Integrated Services



Differentiated Services (DiffServ)

- IP provides “best effort” service
 - All packets treated equally
 - Anyone’s packets can be dropped when network is congested
- DiffServ
 - Class-based QoS
 - Coarse-grained
 - Each packet assigned a service class
 - Prioritizes packets
 - Higher priority ones sent first
 - Lower priority ones sent last or dropped
 - Priority FIFO queues

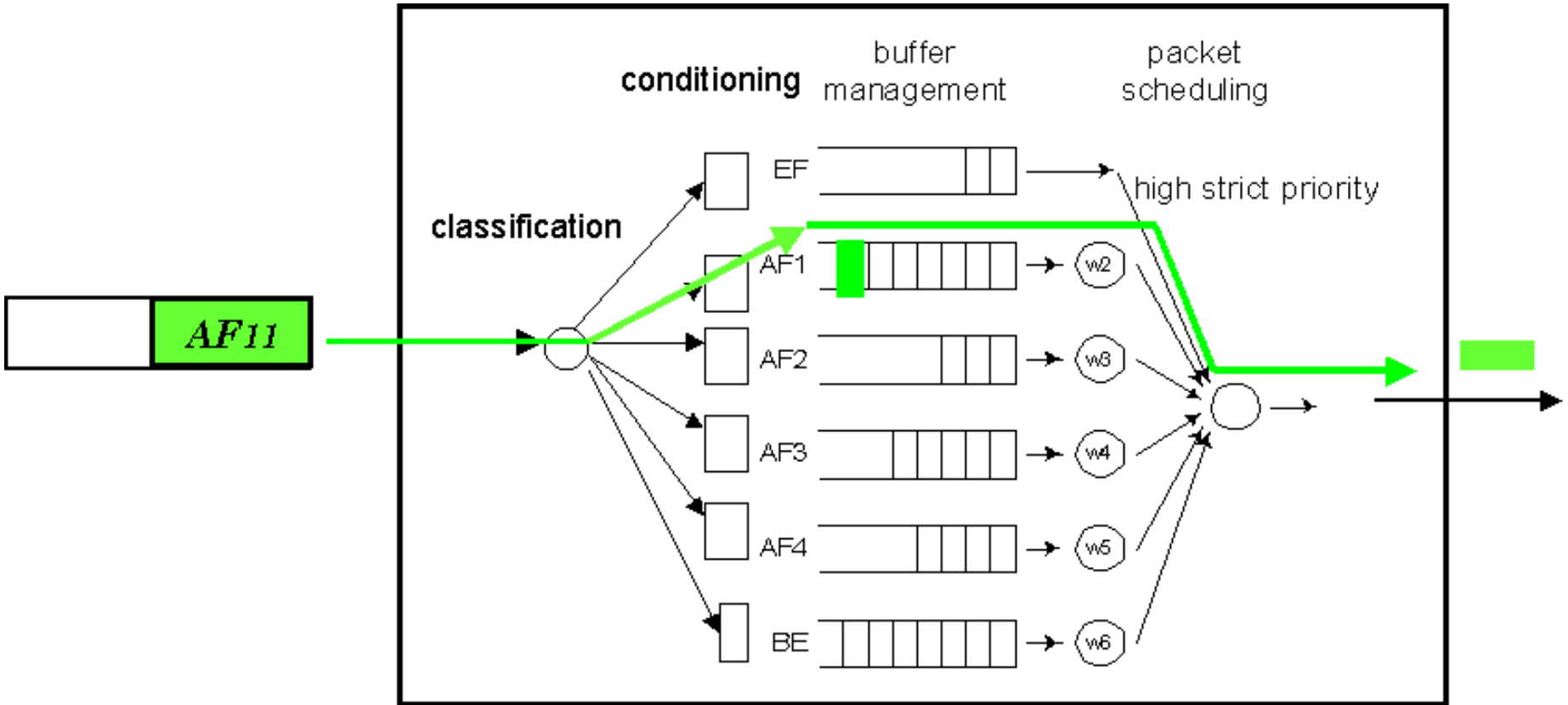


DiffServ Implementation

- Differentiation based on Flow
- Assigned traffic class
- 8-bit DS field in IP header (TOS field)
 - 6-bit DiffServe Code Point (DSCP)
 - Theoretically $2^6 = 64$ different traffic classes
 - Default per-hop behavior (PHB) = 000000
 - Expedite Forwarding PHB (highest priority)
 - Assured Forwarding PHB

	Class 1	Class 2	Class 3	Class 4
Low Drop	AF11	AF21	AF31	AF41
Med Drop	AF12	AF22	AF32	AF42
High Drop	AF13	AF23	AF33	AF43

DiffServ Router



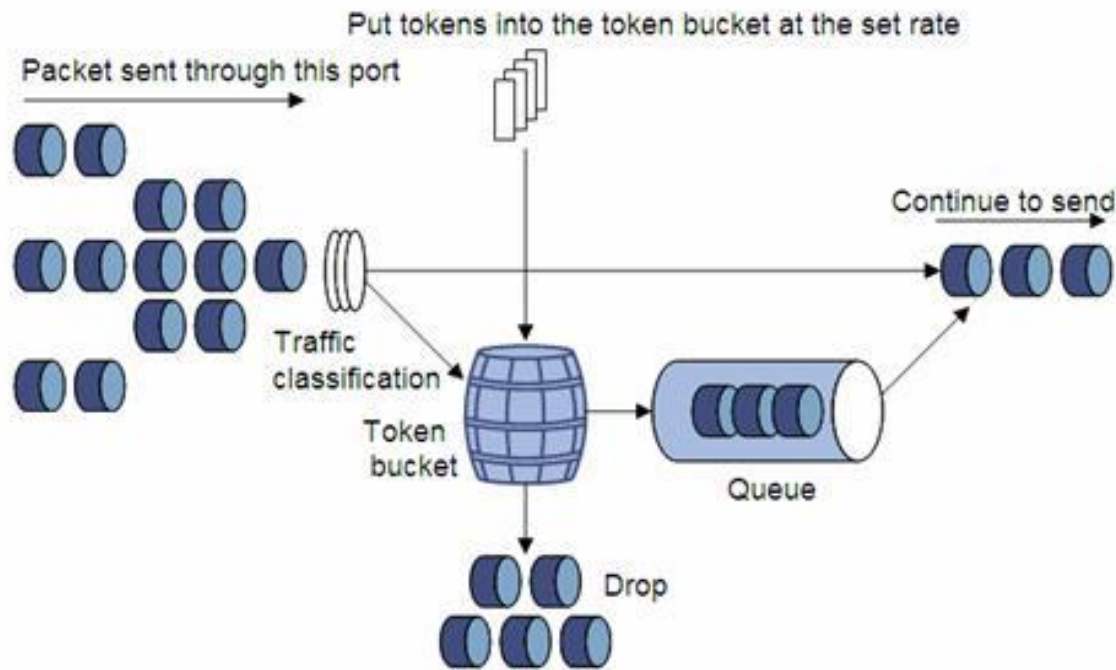
DiffServ Pros/Cons

- Prioritization is flexible, each administrative domain can reclassify or ignore
- No advanced setup or registration required
- Different routers can treat DSCP very differently
- May waste resources getting packets through with highest priority only to have the dropped later on by a non DiffServ router



Integrated Services (IntServ)

- Fine-grained QoS
- Requires additional protocols
- Token Bucket Flow Control



Token Bucket

- Token bucket is like cell-phone roll over minutes
- If you get 500 min/month, normally if you don't use them they get thrown out
 - This caps you to 500 min/month
- With roll over minutes, let's say you can roll-over up to 1000 minutes
 - If you don't use all your minutes one month, you can save them for next month – perhaps you have a “burst” of calls the next month
 - You can only save up to 1000 minutes (size of your bucket)
 - This means that in the long term your average phone use will be 500 min/month, but some months may be larger, others smaller, but the long-term average will be under 500 min/month



Resource reSerVation Protocol (RSVP)

- Provides admission control
 - Applications ask for guaranteed simplex service
 - Hosts or Routers can make requests
 - Routers decide whether the request can be accommodated
- Each flow receives a service class and a label
- Intermediate routers enforce reserved bandwidth



IntServ Pros/Cons

- Fine-grained control
- Enforce complex QoS
- Requires state on routers, preconfiguration, complex policies

