

QUALITY OF SERVICE MODELS

| | | |
|-------------|------------------------------------|---|
| Best Effort | DiffServ | IntServ |
| | Soft QoS or Differentiated Service | Hard QoS or Integrated Service (or Guaranteed Service) RSVP |

This reference card is about Differentiated Service

QUALITY OF SERVICE MECHANISMS

- Classification
- Marking
- Congestion Management
- Congestion Avoidance
- Policing and Shaping
- Link Efficiency Mechanisms

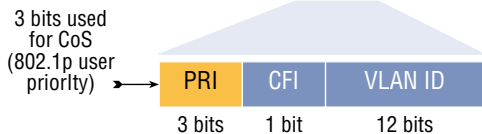
CLASSIFICATION AND MARKING AT THE DATA LINK LAYER

Priority at the Layer 2 is called Class of Service (CoS). Depending on the protocol run at the data link layer, respectively 1 (Frame Relay, ATM), 2 (ISL) or 3 (IEEE 802.1p/Q, MPLS) bits are used in order to prioritize the traffic.

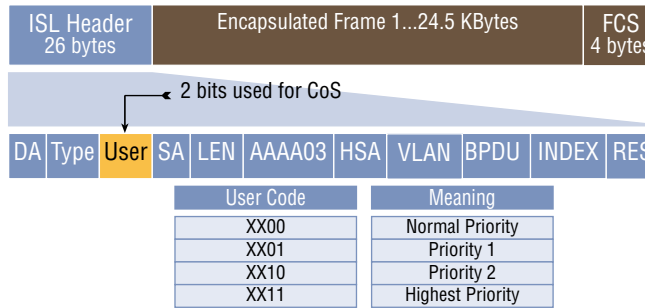
Following table shows a possible baseline when 3 bits are used.

| Class of Service | CoS Value | Baseline |
|------------------|-----------|----------------------|
| CoS 7 | 111 | |
| CoS 6 | 110 | |
| CoS 5 | 101 | Voice Bearer |
| CoS 4 | 100 | Videoconference |
| CoS 3 | 011 | Call-Signalling |
| CoS 2 | 010 | High-Priority Data |
| CoS 1 | 001 | Medium-Priority Data |
| CoS 0 | 000 | Best Effort |

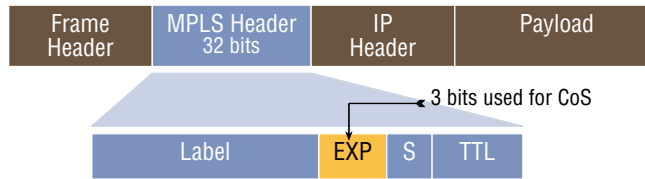
IEEE 802.1p/Q



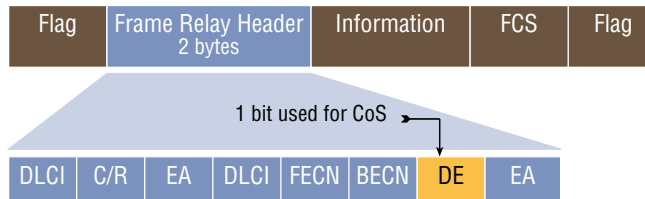
ISL (Cisco Proprietary)



MPLS

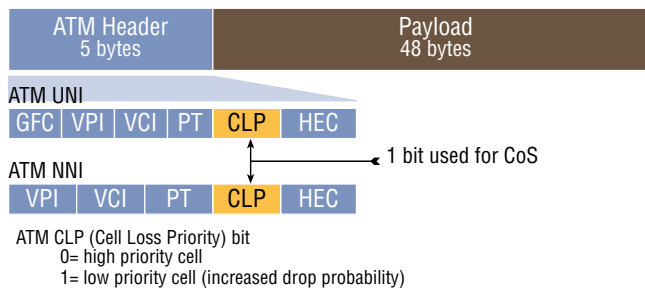


Frame Relay



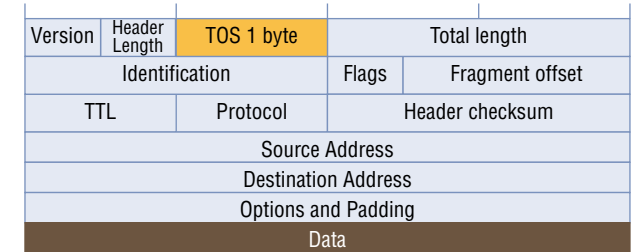
Frame Relay DE (Discard Eligible) bit
 0= high priority frame
 1= low priority frame (increased drop probability)

ATM

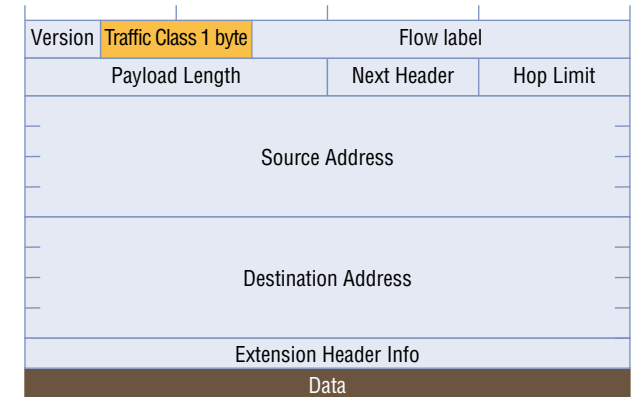


CLASSIFICATION AND MARKING AT THE NETWORK LAYER

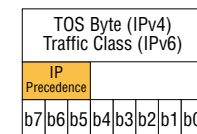
IPv4



IPv6



- ToS Byte (IPv4) / Traffic Class (IPv6) : IP precedence



| IP Precedence Value | Description | Baseline |
|---------------------|---------------------|----------------------|
| 111 | Network (reserved) | |
| 110 | Internet (reserved) | |
| 101 | Critical | Voice Bearer |
| 100 | Flash-override | Videoconference |
| 011 | Flash | Call-Signalling |
| 010 | Immediate | High-Priority Data |
| 001 | Priority | Medium-Priority Data |
| 000 | Routine | Best Effort |

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- ToS Byte (IPv4) / Traffic Class (IPv6) : DSCP

| | | TOS Byte (IPv4) Traffic Class (IPv6) | | | | | | | PHB | DCSP Value (decimal) | TOS Value (decimal) | Drop Probability | |
|--|---|---|----|----|----|----|----|-----------------|-----|-------------------------|------------------------|---------------------|--------|
| | | DSCP | | | | | | Flow control | | | | | |
| | | IP Precedence | | | | | | | | | | | |
| | | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | | | | |
| Best Effort | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Default | 0 | 0 | |
| | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | CS1 | 8 | 32 | |
| Class Selector (Backward Compatibility with IP Precedence) | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | CS2 | 16 | 64 | |
| | | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | CS3 | 24 | 96 | |
| | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | CS4 | 32 | 128 | |
| | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | CS5 | 40 | 160 | |
| | | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | CS6 | 48 | 192 | |
| | | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | CS7 | 56 | 224 | |
| Assured Forwarding | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | AF11 | 10 | 40 | Low |
| | | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | AF12 | 12 | 48 | Medium |
| | | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | AF13 | 14 | 56 | High |
| | | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | AF21 | 18 | 72 | Low |
| | | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | AF22 | 20 | 80 | Medium |
| | | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | AF23 | 22 | 88 | High |
| | | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | AF31 | 26 | 104 | Low |
| | | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | AF32 | 28 | 112 | Medium |
| | | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | AF33 | 30 | 120 | High |
| | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | AF41 | 34 | 136 | Low |
| Expedited Forwarding | | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | AF42 | 36 | 144 | Medium |
| | | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | AF43 | 38 | 152 | High |
| | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | EF | 46 | 184 | | |

ECN: Explicit Congestion Notification

| | | | | | | | | |
|---|---|---|---|---|---|---|---|-------------------------------|
| x | x | x | x | x | x | 0 | 0 | Non ECN-Capable |
| x | x | x | x | x | x | 0 | 1 | ECN-Capable Transport (ECT 1) |
| x | x | x | x | x | x | 1 | 0 | ECN-Capable Transport (ECT 0) |
| x | x | x | x | x | x | 1 | 1 | Congestion Experienced (CE) |

| Application | L3 Classification | |
|-----------------------|-------------------|------|
| | PHB | DSCP |
| IP Routing | CS6 | 48 |
| Voice | EF | 46 |
| Interactive-Video | AF41 | 34 |
| Streaming-Video | CS4 | 32 |
| Mission-Critical Data | AF31 | 26 |
| Call-Signaling | CS3 | 24 |
| Transactional Data | AF21 | 28 |
| Network-Management | CS2 | 16 |
| Bulk Data | AF11 | 10 |
| Scavenger | CS1 | 8 |
| Best-Effort | 0 | 0 |

REFERENCES

Intserv

- RFC 2212: Specification of Guaranteed Quality of Service, see www.ietf.org/rfc/rfc2212.txt
- RFC 2211: Specification of the Controlled-Load Network Element Service, see www.ietf.org/rfc/rfc2211.txt

ToS Byte / Traffic Class

- RFC 791: Internet Protocol Darpa Internet Program Protocol Specification, see www.ietf.org/rfc/rfc0791.txt
- RFC 1349: Type of Service in the Internet Protocol Suite, see www.ietf.org/rfc/rfc1349.txt
- RFC 2474: Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers, see www.ietf.org/rfc/rfc2474.txt

DiffServ

- RFC 3246 (previously RFC2598): An Expedited Forwarding PHB (Per-Hop Behavior), see www.ietf.org/rfc/rfc3246.txt
- RFC 2597: Assured Forwarding PHB Group, see www.ietf.org/rfc/rfc2597.txt
- RFC 3168: The Addition of Explicit Congestion Notification (ECN) to IP, see www.ietf.org/rfc/rfc3168.txt