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CCNP Wireless 642-742 IUWVN

Quick Reference

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About the Author

Jerome Henry is technical leader at Fast Lane. Jerome has more than 10 years of experience teaching technical Cisco courses in more than 15 countries and in 4 different languages, to audiences ranging from Bachelor degree students, to networking professionals, to Cisco internal system engineers. Jerome joined Fast Lane in 2006. Before this, he consulted and taught Heterogeneous Networks and Wireless Integration with the European Airespace team, which was later acquired by Cisco and became its main wireless solution. He is a Certified Wireless Networking Expert (CWNE #45), CCIE Wireless (#24750), and CCNP Wireless, and has developed several Cisco courses focusing on wireless topics, including CUWSS, IAUWS, IUWNE, IUWMS, IUWVN, CWLBS, and the CWMN lab guide. With more than 20 IT industry certifications and more than 10,000 hours in the classroom, Jerome was awarded the IT Training Award Best Instructor silver medal in 2009. He is based in Cary, North Carolina.

About the Technical Reviewer

Denise Papier is senior technical instructor at Fast Lane. Denise has more than 11 years of experience teaching technical Cisco courses in more than 15 different countries, to audiences ranging from Bachelor degree students to networking professionals and Cisco internal system engineers. Focusing on her wireless experience, Denise joined Fast Lane in 2004. Before that, she was teaching the Cisco Academy Program and lecturing BSc (Hons) Information Security at various universities. She is CCNP Wireless and developed several Cisco courses focusing on wireless topics (IUWNE, IAUWS, ACS, ISE, lab guides, and so on). With more than 15 IT industry certifications (from Cisco CCNP R & S, CCIP to Microsoft Certified System Engineer and Security Specialist, CICSP - Cisco IronPort Certified Security Professional) and more than 5000 hours in the classroom, Denise is a fellow member of the Learning and Performance Institute (LPI). She is based in the United Kingdom.

Chapter 1
QoS for Wireless Applications

Quality of service (QoS) for wireless applications is an important topic because it can lead, if misunderstood, to many structural mistakes in wireless networks deployments and poor quality when QoS-dependent devices (for example, VoIP phones) are added. Expect to be tested extensively on this topic on the IUWVN exam. Make sure to understand the concepts and their related configuration.

QoS Concepts

QoS is described as a tool for network convergence (that is, the efficient coexistence of VoIP, video, and data in the same network). QoS does not replace bandwidth, but provides a means to ensure that all traffic gets the best treatment (adapted to each traffic type) in times of network congestion. QoS can be implemented in three different ways:

- **Best effort, this is basically "no implementation":** All traffic is treated the same way. When buffers are full, additional frames are dropped, regardless of what type of traffic they carry.

- **Integrated services (IntServ), also called "hard" QoS:** Out-of-band control messages are used to check and reserve end-to-end bandwidth before sending packets into the network. *Resource Reservation Protocol (RSVP)* and H.323 are both examples of IntServ QoS methods. Each node on the path must support IntServ, which is difficult to achieve in large IP networks.

- **Differentiated services (DiffServ), the most common method:** Each type of traffic receives an importance value represented by a number. Each node on the path independently implements one or several prioritization techniques based on each traffic number.

DiffServ is the method used in most IP networks and can be implemented with different techniques, as detailed in the following sections. You can use each alone or in combination with others.

Classification and Marking

The first step in a QoS approach is to identify the different types of traffic that traverse the network and classify them into categories, such as:

- **Internetwork control traffic:** *Control and Provisioning of Wireless Access Points (CAPWAP) Protocol*, *Enhanced Interior Gateway Routing Protocol (EIGRP)* updates that need to be transmitted for the network to function

- **Critical traffic:** VoIP that cannot be delayed without impacting the call quality

- **Standard data traffic:** Email, web browsing, and so on

- **Scavenger traffic:** Traffic that is accepted but receives the lowest priority, such as peer-to-peer file download and so forth

Classification can be done through deep packet inspection to look at the packet content at Layer 7 (for example, Cisco *Network Based Application Recognition [NBAR])* is a function of the IOS that can recognize applications); through *access control lists (ACL)* based on incoming interface, source, or destination ports or addresses; or through many other techniques. Once each traffic type is established, mark each identified packet with a number showing the traffic priority value. This marking should be done as close to the packet source as possible. Some devices (IP phones, for example) can mark their own traffic. You should decide where traffic is identified and marked, and from where marking is trusted (called the *trust boundary*). This trust boundary should be as close as possible to the point where the packet enters the network (for example, at the sending device network interface, or at the access switch where the device connects). You cannot always trust devices or user marking, or that the access switch will perform the classification, so you might have to move this trust boundary to the distribution switch.

To apply marking on Cisco IOS using standard QoS configuration commands (called the *Modular QoS Console [MQC])*, which is a component of the IOS command set), you can create a class map and specify one or several conditions that identify the traffic. (Each condition can be enough to identify the traffic if you use the keyword **match-any**, or they must all match if you use the keyword **match-all**.) Example 1-1 shows a class map.

Example 1-1   Class Map

```
Router(config)# access-list 101 permit tcp any host 192.168.1.1 eq 80
Router(config)# class-map match-any MyExample
Router(config-cmap)# match ip dscp 46
Router(config-cmap)# match ip precedence 5
Router(config-cmap)# match access-group 101
Router(config-cmap)# match protocol http
Router(config-cmap)# exit
```

Marking can be done at Layer 2 or Layer 3. At Layer 2, the priority tag can be inserted into the *Class of Service (CoS)* field available in the 802.1p section of the 802.1Q 4-byte element, which is added to frames transiting on a trunk. The CoS field offers 3 bits and 8 values (from 0 [000] to 7 [111]). Its limitations are that it is only present on frames that have an 802.1Q VLAN tag (that is, not on frames sent on switch ports set to access mode, and not on frames using the native VLAN on trunks) and that it does not survive routing (a router removes the Layer 2 header before routing a packet, thus losing the CoS value). Its advantage is that it is on a low layer and can be used efficiently by Layer 2 switches.

At Layer 3, the *Type of Service (ToS)* field in the IP header can be used for marking. One way to use this field is called *IP Precedence*, and uses 3 bits to duplicate the Layer 2 CoS value and position this value at Layer 3, allowing the QoS tag to survive routing. Eight values may still be a limited range for advanced classification, and the ToS field contains 8 bits. Therefore, another way to use this field exists: *Differentiated Service Code Point (DSCP)*. DSCP uses 6 of the 8 bits (allowing for 64 QoS values). The last 2 bits are used to inform the destination point about congestion on the link. The first 3 bits are used to create a priority category (or class). There are four types of classes: *Best Effort (BE)* for class 000, *Assured Forwarding (AF)* for classes 001 to 100, and *Expedited Forwarding (EF)* for class 101. A special class, *Class Selector (CS)*, is also used when only these first 3 bits are used (and the other bits set to 0), thus mapping perfectly to IP Precedence and CoS. The next 2 bits are used to determine a *drop probability (DP)*; a higher DP means a higher probability for the packet to be dropped if congestion occurs. (Therefore, within a class, a packet with a DP value of 2 is dropped before another packet of the same class with a DP of 1 or 0.) The last bit is usually set to 0. Figure 1-1 shows the various tagging methods.
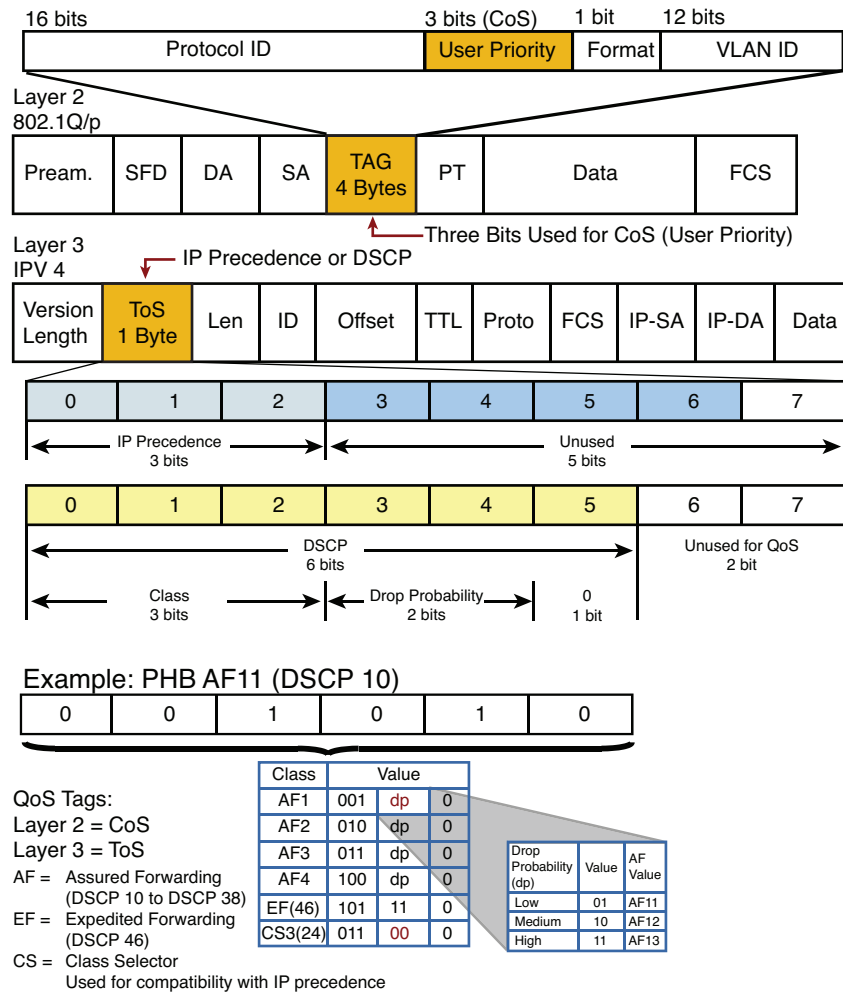
16 bits | 3 bits (CoS) | 1 bit | 12 bits

| Protocol ID | User Priority | Format | VLAN ID |

Layer 2
802.1Q/p

| Pream. | SFD | DA | SA | TAG 4 Bytes | PT | Data | FCS |

Three Bits Used for CoS (User Priority)

Layer 3
IPV 4

IP Precedence or DSCP

| Version Length | ToS 1 Byte | Len | ID | Offset | TTL | Proto | FCS | IP-SA | IP-DA | Data |

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

IP Precedence 3 bits ◄──► Unused 5 bits

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

DSCP 6 bits ──────► Unused for QoS 2 bit

Class 3 bits ◄──► Drop Probability 2 bits ◄──► 0 1 bit

Example: PHB AF11 (DSCP 10)

| 0 | 0 | 1 | 0 | 1 | 0 |

QoS Tags:
Layer 2 = CoS
Layer 3 = ToS
AF = Assured Forwarding
      (DSCP 10 to DSCP 38)
EF = Expedited Forwarding
      (DSCP 46)
CS = Class Selector
      Used for compatibility with IP precedence

Class	Value	
AF1	001	dp	0
AF2	010	dp	0
AF3	011	dp	0
AF4	100	dp	0
EF(46)	101	11	0
CS3(24)	011	00	0

Drop Probability (dp)	Value	AF Value
Low	01	AF11
Medium	10	AF12
High	11	AF13

Figure 1-1 Marking Techniques

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