DELIVER QUALITY OF SERVICE USING THE DIFFSERV MODEL

Similar to services, such as VoIP, video conference, file transfer, and DNS, which have varying different needs for packet delay, packet loss, bandwidth, availability, etc., different classes of service also require varying levels of preferential traffic treatment. Consequently, organizations are seeking ways to guarantee that the most important traffic is always given the highest priority throughout the network. In 1998, the Internet Engineering Task Force (IETF) published Request for Comments (RFC) 2475, which defined an architecture for Differentiated Services (DiffServ) that has since supplanted other models, including IntServ and the ToS/IP Precedence solution, for delivering Quality of Service (QoS).

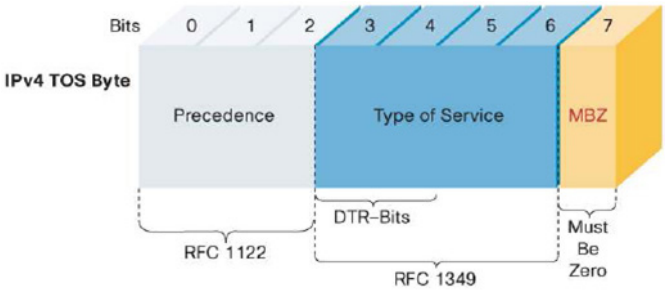
> *"Differentiation is the operative word here, because before you can provide a higher quality of service to any particular customer, applications, or protocol, you must classify the traffic into classes and then determine the way in which to handle the various traffic classes as traffic moves throughout the network."*[1]

The DiffServ Model

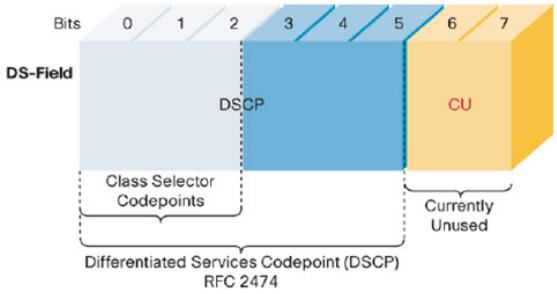
DiffServ provides a framework for delivering QoS through two major components: packet classification and per-hop behavior (PHB). These components facilitate partitioning network traffic into multiple priority levels, or classes of service, so each service belonging to a particular service class receives the same forwarding treatment.

Packet Classification - Packet classification, or marking, occurs via Differentiated Services Code Point (DSCP) values. Notably, all classification and QoS revolves around the DSCP in the DiffServ model. The DSCP consists of the six most significant bits of the Differentiated Services-field, which supersedes the ToS byte within the packet header. This six-bit DSCP supports up to 64 (2^6) distinct service classes and, as such, enables the network device to map these service classes to the appropriate operator-specified forwarding treatments.

ToS byte *before* DiffServ



ToS byte *after* DiffServ



Per Hop Behavior (PHB) – The per-hop behavior defines the packet forwarding properties associated with a particular class of traffic. This enables the network device to prioritize traffic accordingly. The following four standard PHB Groups are typically used:

- *Express Forwarding (EF)* – Premium, highest priority traffic
- *Assured Forwarding (AF)* – Multiple AF types and AF precedences can be used with other PHB groups, or by itself to implement the "Olympic Service" consisting of three service classes: Gold, Silver and Bronze.
- *Class Selector (CS)* – Backwards compatible with the ToS/IP Precedence Solution
- *Default Forwarding (DF)* – Best effort

The operator ultimately maps the Service Class as indicated by the DSCP value(s) to the appropriate PHB Group, Type and Precedence.

Mapping Service Class to Forwarding Treatment

The following table provides a sample mapping of services with packet classification (DSCP) and forwarding treatment (PHB). Services here are listed in descending order from highest priority, or most critical (e.g. VoIP), to lowest priority, or least critical (e.g. DNS). Though the values listed below are recommended QoS queues, multiple types of traffic are often assigned a specific PHB.

Service Class (Associated Services)	DSCP Value (Binary Number)	Forwarding Treatment (Per Hop Behavior)
Telephony (VoIP, Voice band data, . . .)	46 ('101110')	Expedited Forwarding
Signaling (Peer-to-Peer IP, signaling for IPTV apps, . . .)	40 ('101000')	Class Selector 5
Multimedia Conferencing (Video conferencing, mission critical apps, . . .)	34 ('100010')	Assured Forwarding 4
Real-Time Interactive (Interactive Gaming, IP VPN, . . .)	32 ('100000')	Class Selector 4
Multimedia Streaming (Buffered Streaming Audio, webcasts, . . .)	26 ('011010')	Assured Forwarding 3
Broadcast Video (Video surveillance, video on demand, . . .)	24 ('011000')	Class Selector 3
Low-Latency Data (Web transactions, financial wire transfers, . . .)	18 ('010010')	Assured Forwarding 2
High-Throughput Data (File transfers, email, . . .)	10 ('001010')	Assured Forwarding 1
Standard (DNS, DHCP, . . .)	0 ('000000')	Default Forwarding

DiffServ at Work in the Network

Once routers are configured by the operator to differentiate traffic based on class, then edge routers classify packets and mark them with the appropriate DSCP value. Network devices in the core then use this DSCP value to apply the appropriate forwarding treatment. For example, using the data in Table 1, when VoIP traffic arrives at the edge of the network, the edge routers mark the VoIP packets with a DSCP value of 46. From this point forward, VoIP traffic will receive Expedited Forwarding treatment inside the network, ensuring that VoIP traffic receives the highest priority treatment.

StealthWatch QoS Monitoring and Reporting

StealthWatch® by Lancope® supports QoS efforts by monitoring, reporting and trending traffic volume for each DSCP value on each interface across the network. This helps to ensure that actual traffic passing through individual interfaces matches configured or desired traffic levels for each service. As such, StealthWatch enables verifying operator-defined Per-Hop Behaviors and facilitates planning for capacity upgrades. Consequently, StealthWatch helps ensure that the most important traffic is always given the highest priority throughout the network.

Sources:
RFCs 2474, 2475, 2597, 2598, 3140, 3246, 3260, 4594
Cisco white paper, "DiffServ – The Scalable End-to-End Quality of Service Model"
"Quality of Service", Paul Ferguson & Geoff Huston
"Implementing Quality of Service Policies With DSCP", Cisco Systems, Document ID: 10103

About Lancope, Inc.

Lancope®, Inc. is the leader in NetFlow Analysis and the provider of the StealthWatch® for flow-based anomaly detection and network performance monitoring. Delivering unified visibility across physical and virtual networks, StealthWatch eliminates network blind spots and reduces total network and security management costs.

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MB11042009