



Quick Note 15

Quality of Service (QoS) on a TransPort router

UK Support

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1 INTRODUCTION

1.1 Outline

This document contains configuration instructions for configuring QoS on a TransPort router.

1.2 Assumptions

This guide has been written for use by technically competent personnel with a good understanding of the communications technologies used in the product, and of the requirements for their specific application.

Configuration: This application note assumes that the router will be connecting to an ADSL service provider.

- The TransPort router's configuration is set to factory defaults.
- The user has prior experience of configuring a TransPort router.
- This guide has been written for technically competent personnel who have an understanding of QoS. It is not the intention of this technical note to give lessons on the workings of QoS and therefore if additional information is required on this subject, users should refer to the relevant RFC (request for comments) document. However to assist understanding there is a brief guide to QoS and DSCP markings in section 6.0 at the end of this document.

This application note applies to;

Models shown: Digi Transport DR64

Other Compatible Models: All Digi Transport products.

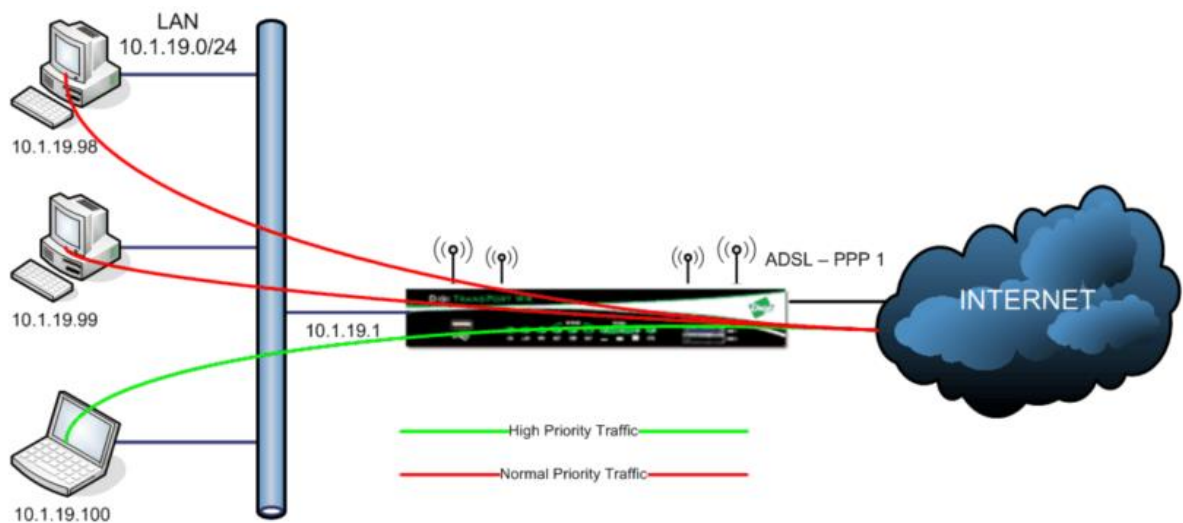
Firmware versions: 4.900 and above.

Configuration: This Application Note assumes the devices are set to their factory default configurations. Most configuration commands are only shown if they differ from the factory default.

1.3 Version

Version Number	Status
1.0	Published
1.1	Rebranded & updated
1.2	Rebranded

2 SCENARIO



For the purpose of this technical note the following assumptions apply;

- The ADSL WAN link (PPP 1) has a potential through-put of 10Mbps (10240 Kbps).
- Behind the router there is a LAN using a subnet of 10.1.19.0/24 and is connected to the router's ETH 0 interface.
- Outbound Internet traffic from a device with IP address 10.1.19.100 will be treated with priority over all other devices on the LAN.
- Priority packets from device 10.1.19.100 will be tagged with a DSCP value of 46 (EF or expedited forwarding).
- All other devices on the LAN will have normal priority traffic.

3 CONFIGURATION

3.1 Tagging Priority Traffic in the TransPort Firewall.

Configuration - Security > Firewall

The screenshot shows the 'Firewall' configuration page. At the top, there's a breadcrumb 'Configuration - Security > Firewall'. Below it, a section titled 'Firewall' contains the text: 'The firewall can be used to restrict or modify traffic on particular interfaces. (You may specify up to 400 rules)'. A table lists two rules:

Hits	#	Rule	Action
0	1	dscp 46 in on eth 0 from 10.1.19.100 to any	Delete Insert Edit
0	2	pass break end	Delete Insert Edit

Below the table are buttons for 'Reset Hit Counters', 'Save', and 'Restore'. Further down, text states: 'The firewall can be enabled on Ethernet, PPP and GRE interfaces. Click [here](#) to jump to the GRE configuration page.' Below this is a table for enabling the firewall on interfaces:

Interface	Enabled
ETH 0	<input checked="" type="checkbox"/>
ETH 1	<input type="checkbox"/>
ETH 2	<input type="checkbox"/>

The first task is to tag priority packets from 10.1.19.100 to any destination IP address with a DSCP value of 46 (EF or expedited forwarding). This is done by applying the following firewall rule to packets on interface ETH 0

dscp 46 in on eth 0 from 10.1.19.100 to any

NB: The default action of a TransPort firewall when enabled on an interface is to block everything. Therefore unless you have an existing firewall, you now need another rule to allow other traffic to pass uninhibited. The following firewall rule will do this -

pass break end

Then enable the firewall on interface Ethernet 0.

3.2 Configure QoS

First a quick overview of how a TransPort implements QoS.

DSCP 46 is by default assigned to Q-Profile 0. All other traffic will by default use Q-Profile 4.

Take a look at the Q profiles.

QoS

DSCP Mappings

Queue Profiles

Queue Profile	Minimum kbps	Maximum kbps	Maximum Packet Queue Length	WRED Minimum Threshold	WRED Maximum Threshold	WRED Maximum Drop Probability (%)	WRED Queue Length Weight factor
0	8192	10240	50	25	50	10	1
1	64	64	50	25	50	10	1
2	64	64	50	25	50	10	1
3	64	64	50	25	50	10	1
4	10240	10240	50	25	50	10	1
5	64	64	50	25	50	10	1
6	64	64	50	25	50	10	1
7	64	64	50	25	50	10	1
8	64	64	50	25	50	10	1
9	64	64	50	25	50	10	1
10	64	64	50	25	50	10	1
11	64	64	50	25	50	10	1

Apply

Parameter	Setting	Description
Q Prof 0 Minimum kbps	8192	Sets the minimum throughput to 8192 kbps (8Mbps)
Q Prof 0 Maximum kbps	10240	Sets the maximum throughput to 10240 kbps (10Mbps)
Q Prof 4 Minimum kbps	10240	Sets the minimum throughput to 10240 kbps (10Mbps)
Q Prof 4 Maximum kbps	10240	Sets the maximum throughput to 10240 kbps (10Mbps)

NB: it doesn't actually matter what you set Q-profile 4's minimum to as there are no other lower priority queues but 10240 looks more "logical".

What this says is;

PC with IP address 10.1.19.100 has priority and has full priority until it is taking up to 8192 kbps (8 Mbps) of the bandwidth.

Once the PC reaches 8192 Kbps throughput, then any further packets sent come from 'any' other device first.

However, the PC with IP address 10.1.19.100 is allowed to go right up to the max 10240 Kbps (10Mbps) if other devices on the LAN don't have anything to send.

All devices are allowed to go to the max 10240 Kbps (10Mbps) but if ALL devices want to go to the max together then device with IP address 10.1.19.100 gets 8192 Kbps (8Mbps) and other devices gets 2048 Kbps (2Mbps).

NB: Just adjust the 8192 value if the 2Mbps left for other devices is too big/small.

3.3 Enable QoS on the WAN interface

Finally you need to enable QoS on the WAN interface only (**PPP 1**) and tell QoS what the link speed is 'supposed' to be on that interface (i.e. 10Mbps in this example).

Browse to **Configuration - Network > Interfaces > Advanced > PPP 1 > QoS**

Configuration - Network > Interfaces > Advanced > PPP 1 > QoS

▼ QoS

Enable QoS on this interface

Link speed kbps

Queue	Profile	Priority
0	0 ▼	Very High ▼
1	1 ▼	High ▼
2	2 ▼	Medium ▼
3	3 ▼	Low ▼
4	4 ▼	Very Low ▼
5	4 ▼	Very Low ▼
6	4 ▼	Very Low ▼
7	4 ▼	Very Low ▼
8	4 ▼	Very Low ▼
9	4 ▼	Very Low ▼

Enable QoS on PPP 1 (WAN interface) and set the link speed to match the bandwidth of this interface

Parameter	Setting	Description
Enable QoS on this interface	✓	Enable QoS on the WAN interface
Link speed (kbps):	10240	Enter the WAN link's bandwidth in kbps

4 ANALYSER TRACE

4.1 High Priority Traffic

Here is an incoming FTP packet from PC **10.1.19.100** to destination IP address 82.86.26.27 on Ethernet port 0.

```
----- 31-7-2008 10:29:01.290 -----
45 00 00 30 CE 0C 40 00 80 06 DA F6 0A 01 13 64   E..0ï...€.Üö...d
52 44 E2 1B 07 F9 00 15 C3 BC FE E2 00 00 00 00   RDâ..ù....þâ....
70 02 FF FF 66 AD 00 00 02 04 05 B4 01 01 04 02   p...f.....

IP (In) From REM TO LOC          IFACE: ETH 0
45          IP Ver:              4
00          Hdr Len:             20
          TOS:                  Routine
          Delay:                 Normal
          Throughput:            Normal
          Reliability:           Normal
00 30          Length:           48
CE 0C          ID:              52748
40 00          Frag Offset:      0
          Congestion:           Normal
          Don't Fragment
          Last Fragment

80          TTL:                128
06          Proto:              TCP
DA F6          Checksum:        56054
0A 01 13 64   Src IP:          10.1.19.100
52 44 E2 1B   Dst IP:          82.86.26.27
TCP:
07 F9          SRC Port:        ??? (2041)
00 15          DST Port:        FTP CTL (21)
C3 BC FE E2   SEQ Number:      3283943138
00 00 00 00   ACK Number:      0
70 02          Flags
          Data Offset          28
          SYN
FF FF          window:          65535
66 AD          Checksum:        26285
00 00          URG Ptr:         0
```

The FTP packet is passed to the ADSL (WAN) interface (PPP 1) for routing to the internet - NAT has been applied. .

```
----- 31-7-2008 10:29:01.300 -----
45 B8 00 30 CE 0C 40 00 7F 06 C8 4C 58 60 D7 F6   E..0ï.....LX.xö
52 44 E2 1B 07 F9 00 15 C3 BC FE E2 00 00 00 00   RDâ..ù....þâ....
70 02 FF FF 53 BB 00 00 02 04 05 B4 01 01 04 02   p...S.....

IP (Final) From LOC TO REM      IFACE: PPP 1
45          IP Ver:              4
          Hdr Len:             20
B8          TOS:              CRITIC/ECP
          Delay:               Low
          Throughput:           High
          Reliability:           Normal
00 30          Length:           48
CE 0C          ID:              52748
40 00          Frag Offset:      0
          Congestion:           Normal
          Don't Fragment
          Last Fragment

7F          TTL:                127
06          Proto:              TCP
C8 4C          Checksum:        51276
58 60 D7 F6   Src IP:          88.96.215.246
52 44 E2 1B   Dst IP:          82.86.26.27
TCP:
07 F9          SRC Port:        ??? (2041)
00 15          DST Port:        FTP CTL (21)
C3 BC FE E2   SEQ Number:      3283943138
00 00 00 00   ACK Number:      0
70 02          Flags
```

```

Data Offset      28
                SYN
FF FF           window: 65535
53 BB           checksum: 21435
00 00           URG Ptr: 0

```

Note the **TOS**, **Delay** and **Throughput** values. QoS has been applied to this packet. The TOS: Byte is now **B8**

B8 is **10111000** and maps to DSCP 46 (EF)

4.2 Normal Priority Traffic

Here is an incoming FTP packet from PC **10.1.19.99** to destination IP address 82.86.26.27 on Ethernet port 0.

```

----- 31-7-2008 10:42:41.760 -----
45 00 00 30 D7 78 40 00 80 06 D1 8B 0A 01 13 63   E..0xx..€.Ñ....c
52 44 E2 1B 08 9C 00 15 E5 0C 89 24 00 00 00 00   RDâ..æ..ä.%,....
70 02 FF FF BA 79 00 00 02 04 05 B4 01 01 04 02   p....y.....

IP (In) From REM TO LOC          IFACE: ETH 0
45                IP Ver:          4
                  Hdr Len:         20
00                TOS:              Routine
                  Delay:            Normal
                  Throughput:       Normal
                  Reliability:      Normal
00 30             Length:          48
D7 78             ID:              55160
40 00             Frag offset:     0
                  Congestion:      Normal
                                Don't Fragment
                                Last Fragment
80                TTL:             128
06                Proto:           TCP
D1 8B             Checksum:        53643
0A 01 13 63       Src IP:          10.1.19.99
52 44 E2 1B       Dst IP:          82.86.26.27
TCP:
08 9C             SRC Port:        ??? (2204)
00 15             DST Port:        FTP CTL (21)
E5 0C 89 24       SEQ Number:      3842804004
00 00 00 00       ACK Number:      0
70 02             Flags
                  Data Offset     28
                                SYN
FF FF             window:          65535
BA 79             checksum:        47737
00 00             URG Ptr:         0

```

The FTP packet is passed to the ADSL (WAN) interface (PPP 1) for routing to the internet - NAT has been applied.

```

----- 31-7-2008 10:42:41.770 -----
45 00 00 30 D7 78 40 00 7F 06 BF 98 58 60 D7 F6   E..0xx.....~X.xö
52 44 E2 1B 08 9C 00 15 E5 0C 89 24 00 00 00 00   RDâ..æ..ä.%,....
70 02 FF FF A7 86 00 00 02 04 05 B4 01 01 04 02   p....†.....

IP (Final) From LOC TO REM       IFACE: PPP 1
45                IP Ver:          4
                  Hdr Len:         20
00                TOS:              Routine
                  Delay:            Normal
                  Throughput:       Normal
                  Reliability:      Normal
00 30             Length:          48
D7 78             ID:              55160
40 00             Frag offset:     0
                  Congestion:      Normal
                                Don't Fragment

```

7F		TTL:	Last Fragment
06		127	
BF 98		Proto:	TCP
58 60 D7 F6		Checksum:	49048
52 44 E2 1B		Src IP:	88.96.215.246
		Dst IP:	82.86.26.27
		TCP:	
08 9C		SRC Port:	??? (2204)
00 15		DST Port:	FTP CTL (21)
E5 0C 89 24		SEQ Number:	3842804004
00 00 00 00		ACK Number:	0
70 02		Flags	
		Data Offset	28
			SYN
FF FF		window:	65535
A7 86		Checksum:	42886
00 00		URG Ptr:	0

Note the **TOS**, **Delay** and **Throughput** values. QoS has NOT been applied to this packet. Because no QoS marking has been applied on this interface, the TOS: Byte is now 0 – it uses *best effort*

5 QOS AND DSCP MARKINGS BRIEF OVERVIEW

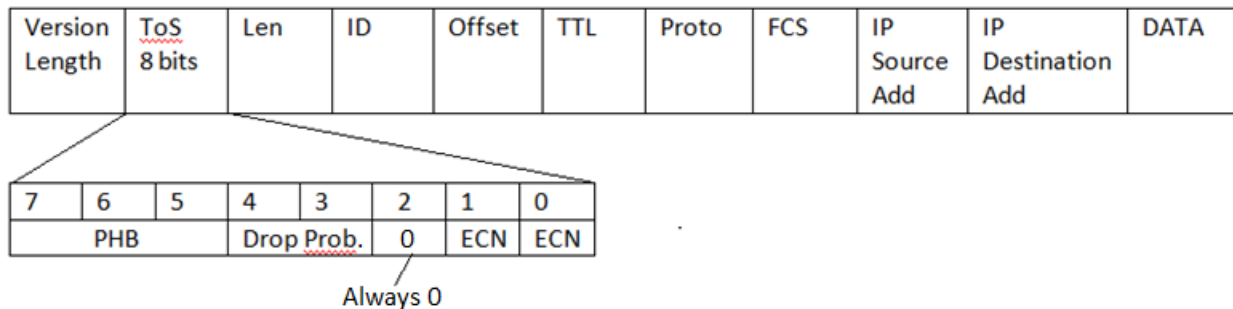
5.1 QoS (Quality-of-Service)

QoS is a general term that incorporates bandwidth, latency, and jitter to describe a network's ability to customise the treatment of specific classes of data. For example, QoS can be used to prioritise certain types of IP traffic, say video transmissions over web browsing traffic. Advanced networks can offer greater control over how data traffic is classified into classes and greater flexibility as to how the treatment of that traffic is differentiated from other traffic.

It is important to note that for QoS to be totally effective, the network service provider you are using must implement QoS over their network. Failing that, if QoS is correctly enabled on the router it will still prioritise traffic accordingly until the point of delivery to the network but from there on the network will treat priority packets the same as any other class of data.

5.2 DSCP (Differentiated Services Code Point)

DSCP markings use the 6 left most bits in the TOS byte of an IP packet. The 3 most significant bits represent the PHB (per hop behaviour). The next 3 bits represent the drop probability (**note**: only the left 2 bits are currently used). The least significant bit of the drop probability is always 0). The 2 least significant bits in the TOS byte are used for flow control (ECN explicit congestion notification)



With 3 bits available, PHB values can be range from **0** (best effort) to **5** (EF or expedited forwarding). Values above 5 (i.e. 6 or 7), are reserved for Network protocol use.

If the PHB values are equal then the drop probability is the tie breaker. With 2 bits available, the drop probability can be 1, 2 or 3.

In addition to Expedited Forwarding (EF) at one extreme and Best Effort (0) at the other, there are 12 Assured forwarding (AF) values.

Name	PHB Per hop behaviour	Drop probability	DSCP (Decimal)	DSCP (Bits)
Default	Best effort		0	000000
AF11	1	1	10	001010
AF12	1	2	12	001100
AF13	1	3	14	001110
AF21	2	1	18	010010
AF22	2	2	20	010100
AF23	2	3	22	010110
AF31	3	1	26	011010
AF32	3	2	28	011100
AF33	3	3	30	011110
AF41	4	1	34	100010
AF42	4	2	36	100100
AF43	4	3	38	100110
EF (Expedited Forwarding)			46	101110

From the table above it can be seen can see for example that:

AF41 represents a PHB of 100 and a drop probability of 01 (1)
Expressed in DSCP form this is 100010 or 34 (decimal)

AF43 represents a PHB of 100 and a drop probability of 11 (3)
Expressed in DSCP form this is 100110 or 38 (decimal)

When there is congestion, packets marked with AF43 will be dropped before those marked with AF41 due to the higher drop probability of 3.

For high priority traffic such as voice, Expedited Forwarding (EF) is recommended. This is DSCP 46 or 101110 (decimal). These packets will not be dropped

Note: When the Drop probability bits are both zero then the DSCP value is identical to the IP Precedence value which means that routers that don't have DSCP configured can still recognize the basic QoS settings.

6 TRANSPORT CONFIGURATION FILES

6.1 Config.da0

```
eth 0 IPAddr "10.1.19.1"
eth 0 mask "255.255.0.0"
eth 0 firewall ON
lapb 0 ans OFF
lapb 2 dtemode 2
lapb 3 dtemode 2
def_route 0 ll_ent "PPP"
def_route 0 ll_add 1
def_route 1 ll_ent "PPP"
def_route 1 ll_add 2
def_route 2 ll_ent "PPP"
def_route 2 ll_add 3
ppp 1 IPAddr "0.0.0.0"
ppp 1 username "Enter ADSL Username"
ppp 1 timeout 0
ppp 1 aodion 1
ppp 1 autoassert 1
ppp 1 echo 10
ppp 1 echodropcnt 5
ppp 1 lliface "AAL"
ppp 1 qos ON
ppp 2 l_pap OFF
ppp 2 l_chap OFF
ppp 2 l_addr ON
ppp 2 r_pap ON
ppp 2 r_chap ON
ppp 2 r_addr OFF
ppp 2 IPAddr "1.2.3.5"
ppp 2 username "Enter ISDN Username"
ppp 3 l_pap OFF
ppp 3 l_chap OFF
ppp 3 l_addr ON
ppp 3 r_chap OFF
ppp 3 r_addr OFF
ppp 3 IPAddr "0.0.0.0"
ppp 3 username "ENTER WWAN Username"
ppp 3 epassword "KD51SVJDVVg="
ppp 3 phonenum "*98*1#"
ppp 3 timeout 0
ppp 3 use_modem 1
ppp 3 aodion 1
ppp 3 autoassert 1
modemcc 0 info_asy_add 8
modemcc 0 init_str "+CGQREQ=1,0,0,0,0,0"
modemcc 0 init_str1 "+CGQMIN=1,0,0,0,0,0"
modemcc 0 apn "Your.APN.Goes.Here"
modemcc 0 link_retries 10
modemcc 0 stat_retries 30
modemcc 0 sms_interval 1
modemcc 0 init_str_2 "+CGQREQ=1,0,0,0,0,0"
```

```
modemcc 0 init_str1_2 "+CGQMIN=1,0,0,0,0,0"
modemcc 0 apn_2 "Your.APN.Goes.Here"
modemcc 0 link_retries_2 10
modemcc 0 stat_retries_2 30
modemcc 0 sms_interval_2 1
ana 0 anon ON
ana 0 lapdon 0
ana 0 lapbon 0
ana 0 maxdata 200
ana 0 logsize 45
cmd 0 unitid "ss%s>"
cmd 0 cmdnua "99"
cmd 0 hostname "SS.6000r"
cmd 0 asyled_mode 1
cmd 0 tremto 1200
user 0 name "username"
user 0 epassword "KD5lSVJDVVg="
user 0 access 0
user 1 name "Sarian"
user 1 epassword "HA0gDhQc"
user 1 access 0
user 2 access 0
user 3 access 0
user 4 access 0
user 5 access 0
user 6 access 0
user 7 access 0
user 8 access 0
local 0 transaccess 2
qos 1 linkkbps 10240
qprof 0 minkbps 8192
qprof 0 maxkbps 10240
qprof 4 minkbps 10240
qprof 4 maxkbps 10240
```

6.2 Fw.txt

```
dscp 46 in on eth 0 from 10.1.19.100 to any
pass break end
```