Teldat Router

Bandwidth Reservation System

Doc. *DM715-I* Rev. *10.11*
June, 2003

INDEX

Chapter 1
Introduction

1. Bandwidth Reservation System (BRS)

The Bandwidth Reservation System (BRS) is a feature that allows you to decide which packets to drop when demand (traffic) exceeds supply (throughput) on a network connection. **Teldat Router** does not use BRS until there are requests for more than 100 % of the available line bandwidth.

BRS reserves transmission bandwidth for a network connection. This reservation feature allocates minimum percentages of total connection bandwidth for specific classes of traffic. Table 1 shows the components of BRS classes.

These reserved percentages are a minimum slice of bandwidth for the network connection. If a network is operating to capacity, the router can only transmit a message if transmitting it does not exceed the bandwidth allocated for the class. When this happens, the **Teldat Router** holds the transmission until other bandwidth transmissions have been satisfied. In the case of a light traffic path, a packet stream can use bandwidth exceeding its allowed minimum up to 100% if there is no other traffic.

Bandwidth reservation is really a safeguard. In general, a network should not attempt to use greater than 100% of its line speed. If it does, a faster line is probably needed. The bursty nature of traffic, however, can drive the requested transmission rate to exceed 100% for a short time. In these cases, bandwidth reservation is enabled and the higher priority traffic is ensured delivery (i.e., it is not discarded). If the traffic, over time, surpasses the line capacity, packets will begin to be discarded although in such a way that the bandwidth percentages assigned to the distinct classes are still fulfilled.

Bandwidth reservation is a feature that runs over the following data-link types:

- Frame Relay
- X.25 Line
- PPP Line
- ATM Subinterfaces
- Ethernet Interfaces
- TNIP Interfaces

Table 1

WAN Interface[1]	Class[2] A	Bandwidth[3] %	protocol, tag or filter[4]	priority level[5]
			protocol, tag or filter	priority level
			protocol, tag or filter	priority level
	Class B	Bandwidth %	protocol, tag or filter	priority level
			protocol, tag or filter	priority level
			protocol, tag or filter	priority level
	Class C	Bandwidth %	protocol, tag or filter	priority level
			protocol, tag or filter	priority level
			protocol, tag or filter	priority level

1. An X.25 Line, PPP Line, ATM subinterface, Ethernet interface, TNIP interface, or Frame Relay permanent virtual circuit.

2. BRS class.
3. Percent of the interface's bandwidth for this BRS class. Use the **CLASS** command.
4. Type of packet in the BRS class. Use the **ASSIGN** command.
5. Priority level for packets with a given protocol, tag or filter. Use the **ASSIGN** command.

> ***Note: In Frame Relay, the interface bandwidth is shared among the circuits based on other classes. In these classes, only the percentage of the bandwidth and the circuits sharing this is defined.***

> ***Note: When you configure a PPP over an ATM subinterface, the BRS must be configured in the PPP and not in the ATM subinterface. Contrariwise, if the ATM subinterface directly encapsulates IP, the BRS must be configured in the ATM subinterface.***

2. Priority Queuing

Bandwidth reservation allocates percentages of total connection bandwidth for specified traffic classes (defined by the user). A BRS class is a group of packets identified by the same name; for example, a class called "ipx" to designate all IPX packets.

The BRS subsystem allows you to prioritize some classes of traffic over others. Prioritization is understood as where different types of traffic are processed before others. This is strictly carried out and a determined bandwidth percentage is not reserved.

There are two types of prioritization, inter-class prioritization and intra class prioritization.

Inter-class Prioritization:

Each class of traffic has a percentage of the bandwidth assigned to it and a priority. This priority can take the following values. The default value is NORMAL:

- REAL-TIME
- HIGH
- NORMAL (default value)
- LOW

When selecting the class whose the packets will be transmitted, the first class searched for is REAL-TIME. If there aren't any classes with REAL-TIME priority or they exist but currently there aren't any queued packets to be transmitted, a search is executed among classes with HIGH priority as so on until finally classes with LOW priority are processed.

Bandwidths assigned for each class are respected within classes having the same priority.

Example:

There are four classes in a configuration apart from the local and the default classes. One class known as voip with real-time priority, two classes important1 and important2 with high priority and a fourth called data with normal priority. The local and default classes are always present to represent local traffic and traffic that does not pertain to any other class respectively and in this case take normal priority.

```
class default 20
class voip 100 real-time
class important1 30 high
class important2 70 high
class data 60
class local 20
```

In this scenario the first class to be transmitted is always voip as this has the highest priority. If voip does not have any data to transmit at this point, then classes important1 or important2 will be transmitted respecting the bandwidth assigned to each. I.e. for each 70 bytes transmitted by important2, 30 will be transmitted by important1.

In cases where voip, important1 and important2 do not have any data to transmit, classes' data, default and local will transmit their data depending on their bandwidth.

Suppose we have a bandwidth of 100 Kbps and the following throughputs:

CLASS	THROUGHPUT	SENT	DROPPED
Voip	20000 bps	20000 bps	0 bps
Important1	60000 bps	(100000 - 20000)*0.3 = 24000 bps	36000 bps
Important2	50000 bps	(100000 - 20000)*0.7 = 34000 bps	16000 bps
Data	100000 bps	0 bps	100000 bps
Local	10000 bps	0 bps	10000 bps
Default	20000 bps	0 bps	20000 bps

Suppose we have a bandwidth of 100 Kbps and the following throughputs:

CLASS	THROUGHPUT	SENT	DROPPED
Voip	10000 bps	10000 bps	0 bps
Important1	10000 bps	10000 bps	0 bps
Important2	15000 bps	15000 bps	0 bps
Data	100000 bps	(100000 – 35000) * 0.60 = 39000 bps	61000 bps
Local	15000 bps	(100000 – 35000) * 0.20 = 13000 bps	2000 bps
Default	20000 bps	(100000 – 35000) * 0.20 = 13000 bps	7000 bps

IMPORTANT: As you can see from the tables, classes with the highest priorities can completely block data transmission for classes with lower priorities. This does not happen when you exclusively use the bandwidth reservation (all classes having normal priority.

Intra-class Prioritization:

Each BRS class has four queues, one for each priority through which access lists or tags can be associated to a determined class. When it has been decided which class is going to transmit (see previous section) the queues in the said class are examined in the following order.

- URGENT
- HIGH
- NORMAL (the default setting)
- LOW

When deciding which packets will be sent within those pertaining to the same class, packets assigned with URGENT are sent first. These packets are followed by HIGH, NORMAL, and then LOW packets respectively. When all URGENT packets have been transmitted the HIGH priority packets are transmitted etc. Only when there are no URGENT, HIGH, or NORMAL packets remaining are the LOW priority packets transmitted. If no priority setting is assigned, the setting defaults to NORMAL.

You can also set the number of packets that can be queued for each priority level in each bandwidth class. The BRS **QUEUE-LENGTH** command sets the maximum number of output packets that can be queued in each BRS priority queue. It also sets the maximum number of output packets that can be queued in each BRS priority queue when the router input buffers are scarce.

CAUTION: If you set the values for queue length too high, you may seriously degrade the performance of your router.

You can set priority queue lengths for each type of interface that supports BRS: X.25 Line, PPP, ATM subinterface, Ethernet, TNIP and Frame Relay.

The priority settings in one bandwidth class do not affect other bandwidth classes. No one bandwidth class has priority over the others. You can only map a network protocol (or several grouped protocols) or filters and a class.

3. Bandwidth Reservation With Priority Queuing

When you configure priority queuing without bandwidth reservation, the router delivers the highest priority traffic first. In instances of heavy high priority traffic, the router can never attend or give service to the lower priority levels. By combining priority queuing with bandwidth reservation, however, you can allocate packet transmission to all bandwidths.

> ***WARNING: We recommend that prioritizing is only configured for very important traffic that is both sporadic and light such as alarms etc. If not, you run the risk of paralyzing traffic that has a lower priority.***

4. Traffic-shaping

Teldat routers allow traffic-shaping to be carried out over all interfaces supporting BRS. Traffic-shaping permits you to limit the maximum throughput for an interface, a pvc or a specific traffic class.

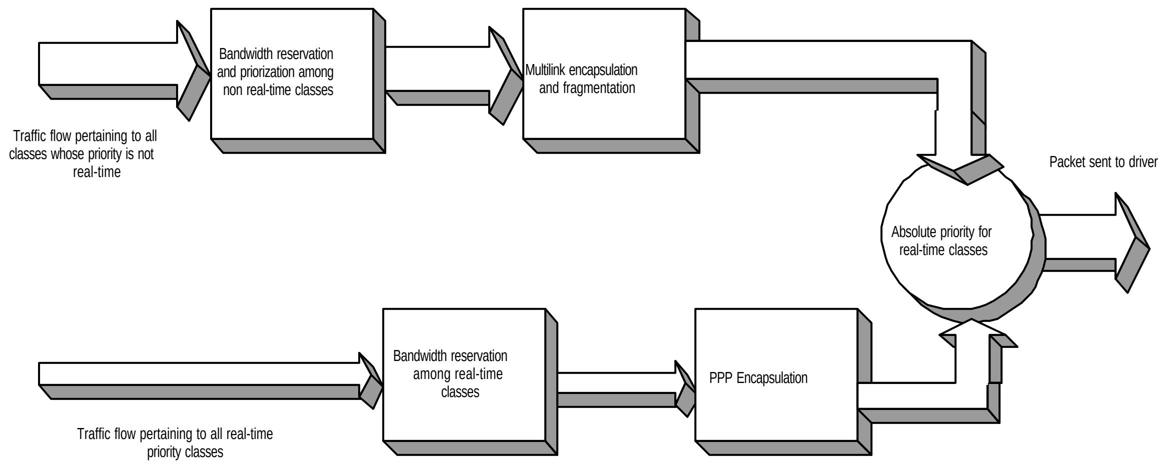
Therefore you can specify which FTP traffic class will have a 10% guaranteed bandwidth, however this cannot exceed 40 kbps for the maximum throughput.

You can also limit the maximum throughput for an ATM subinterface to a value guaranteed by the operator. This is usually inferior to the real physical speed so that it is the router that drops the packets when the maximum throughput is exceeded depending on its class and not the network which always indiscriminately drops packets.

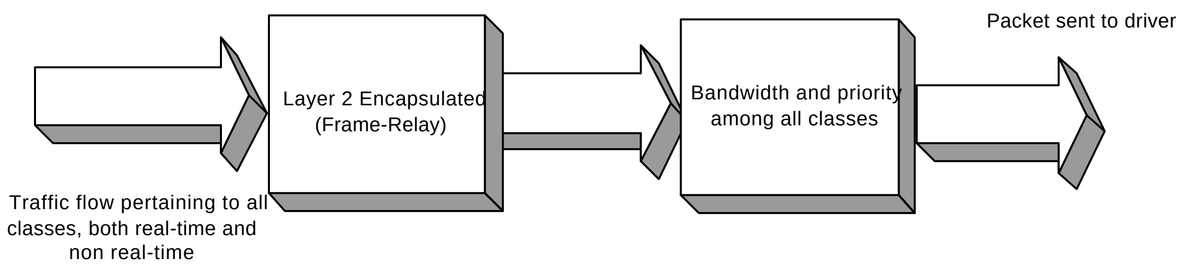
5. Quality of Service in Multilink links

In links where MP is configured, the BRS subsystem operates in a slightly different way compared to what it does for the rest of the encapsulation, placing the BRS subsystem before encapsulating in MP.

The operating scheme for MP links is as follows:



This scheme is contrasted with the generic scheme used for the rest of the encapsulations as, for example, Frame Relay where the process is as follows:



In cases of MP, the generic scheme is not valid as the MP assigns a sequence number to each packet. This number is used at the reception end to reorder them thus avoiding the possible disorder that can occur when using various links. The problem arises if BRS is placed after encapsulation in MP. Consequently after a sequence number has been assigned to the packets these become so disordered that in the majority of cases the end MP is incapable of reordering them and they are dropped.

The solution for this problem lies in placing BRS before encapsulation in MP. I.e. firstly disorder the packets as needed in order to preserve the bandwidth assigned to each class, subsequently encapsulate them in MP and tag them with the sequence numbers. In this way, you can avoid disorder in the sequence numbers produced by BRS and the packets will arrive sufficiently ordered at the other end so the receiver is capable of ordering them.

The drawback for this solution is when traffic such as VoIP is delay sensitive. If this traffic enters BRS before being encapsulated in MP and therefore before being fragmented, the delays provoked in large packets will be equivalent to those provoked without fragmentation as traffic priority is carried out before fragmentation.

Therefore, these types of packets are sent to distinct queues to BRS (real-time traffic queues). These have complete priority over the rest of the traffic when this latter has been encapsulated in MP and therefore fragmented. Real-time packets cannot be encapsulated in MP as this provokes sequence number disordering so they are directly encapsulated in PPP.

6. Filtering and Bandwidth Reservation

Using bandwidth reservation, you can assign the following filters (via the assign command) to specific types of traffic:

- IP
- X28
- ARP
- BAN/ASRT
- TUNNELING-IP
- SDLC-IP
- RLOGIN-IP
- TELNET-IP
- NETBIOS
- SNA
- SNMP-IP
- MULTICAST-IP
- DLSW-IP
- XOT-IP

You can also assign tags in order to filter MAC frames (you need to have previously configured the MAC filter facility assigning the tag corresponding to a MAC filter):

- TAG1
- TAG2
- TAG3
- TAG4
- TAG5

You can additionally assign IP filters. In order to do this, use the tags detailed below. The assignment between ports and tags is carried out within the Bandwidth Reservation configuration itself.

- FILTER0
- FILTER1
- FILTER2
- FILTER3
- FILTER4
- FILTER5
- FILTER6
- FILTER7
- FILTER8
- FILTER9

6.1. Filters and Tags for IP Multicast Addressing and MAC Addressing

The router handles MAC address filtering by a joint effort between bandwidth reservation and MAC Filtering (MCF) using tags. For example, a user with bandwidth reservation is able to categorize bridge traffic by assigning a tag to it.

You assign tags by creating a filter in the MAC filtering configuration process and then assigning a tag to it. This tag is then used to set up a bandwidth class for all packets associated with this tag. Tag values must be in the range of 1 to 64.

> ***Note: Tags can only be applied to bridged packets, and ONLY the MAC Address fields of the packet can be used in applying the tag. Up to five tagged MAC filters can be set from 1 to 5. TAG1 is searched for first, then TAG2, and so on up to TAG5. A single MAC filter tag can consist of any number of MAC Addresses set in MCF.***

Once a tagged filter has been created in the MAC filtering configuration process, it is assigned a class and priority in the bandwidth reservation configuration process. The **TAG** command is then used in the bandwidth reservation process to reference the tag.

Tags can also refer to "groups", as in the example of IP Tunnel. IP Tunnel endpoints can belong to any number of groups. Packets are assigned to a particular group through the tagging feature of MAC filtering.

Applying bandwidth reservation and queuing priority to tagged packets involves the following:

1. Use the MAC filtering configuration commands at the *filter Config>* prompt to set up tags for packets passing through the bridge.
2. Use the bandwidth reservation **TAG** command to reference a tag for bandwidth reservation.
3. With the bandwidth reservation **ASSIGN** command, specify a class name for the tag. The assign command then prompts you for a queuing priority within that BRS class.

6.2. Filters for IP Traffic

The Bandwidth Reservation permits you to create filters in order to distinguish between IP traffic depending on the transport protocol (TCP, UDP etc.), source and destination IP addresses or TCP/UDP ports. In this way, traffic that coincides with the indicated profile is classified in a specific class. Therefore you can reserve a percentage of the bandwidth for UDP, TCP traffic, for SPF with source or destination in a specific host or subnet etc. E. g. if you create a filter for the port range 20 to 21 with a protocol range 6,6 (TCP) and any source/destination address, you are filtering all FTP traffic whether the router itself is the source or destination or whether the traffic is simply forwarded by it.

In order to create an IP filter, you need to use the **IP-FILTER** command. This permits you to assign a range of protocols, source or destination subnets and a range of TCP/UDP ports both for source and destination.

Once the filter has been created, a class and a priority can be assigned through the **ASSIGN** command.

6.3. Order of Precedence

It is possible for a packet to fall under several filterable classes. For example, an IP Tunneled bridged packet for SNA with a filter for a MAC Address. The order for resolving the filtering priority for this packet goes as follows:

1. MAC Address match for bridging (IP/ASRT) tag 1 to tag 5
2. NETBIOS for bridging (IP/ASRT)
3. SNA for bridging (IP/ASRT)
4. IP tunneling (IP)
5. SDLC relay (IP)
6. Multicast (IP)
7. SNMP (IP)
8. Rlogin (IP)
9. Telnet (IP)
10. DLSw (IP)
11. XOT (IP)

If there are various classes belonging to the same category (two classes with IP filters for example) and a packet pertains to both, this packet is assigned to the first class added in the configuration.

7. Bandwidth Reservation Over Frame Relay

When you run bandwidth reservation over Frame Relay, there are two areas where you can allocate bandwidth: the circuit layer and the interface layer.

The per-circuit bandwidth allocation works similarly to X.25 Line. Packets are filtered and queued into BRS classes based on protocols and filters assigned to the configured per-circuit classes.

The actual amount of bandwidth available for bandwidth reservation depends upon how you configure the interface and circuit:

- If you enable Frame Relay CIR monitoring, the bandwidth available to the circuits is allocated strictly according to its Committed Information Rate (CIR), its Committed Burst Size (CBS), and its Excess Burst Size (EBS).
- If you disable CIR monitoring, up to 100 percent of the bandwidth of the interface may be available to a circuit.

Orphaned circuits and circuits without BRS explicitly enabled may use a default BRS queuing environment.

Each circuit also competes for bandwidth on the physical serial line. Bandwidth allocation at the physical interface segments the circuit into classes. The percentage of bandwidth allocated to each class of circuits is configurable. Orphaned circuits and circuits not assigned to a circuit class are put in the default circuit class.

To display reservation counters for the classes at the Frame Relay interface layer, use the following bandwidth reservation monitoring commands:

- CLEAR-CIRCUIT-CLASS
- COUNTER-CIRCUIT-CLASS
- LAST-CIRCUIT-CLASS

The interface is the one shown in your prompt for the bandwidth monitoring commands. For example, *BRS [i serial0/0] Config>* is the prompt for the interface corresponding to the WAN1.

BRS classes are most useful when CIR monitoring is not enabled. If you do not want to use BRS classes, leave all circuits in the default class and do not create any other circuit classes.

7.1. Queuing Support in Frame Relay interfaces

In those Frame Relay interfaces that do not have the Bandwidth Reservation facility enabled, the traffic from all the DLCIs is put into a single queue whose length is determined by the current availability of the buffers in the router. This characteristic permits the device to cope with heavy traffic bursts during a certain period of time without discarding frames.

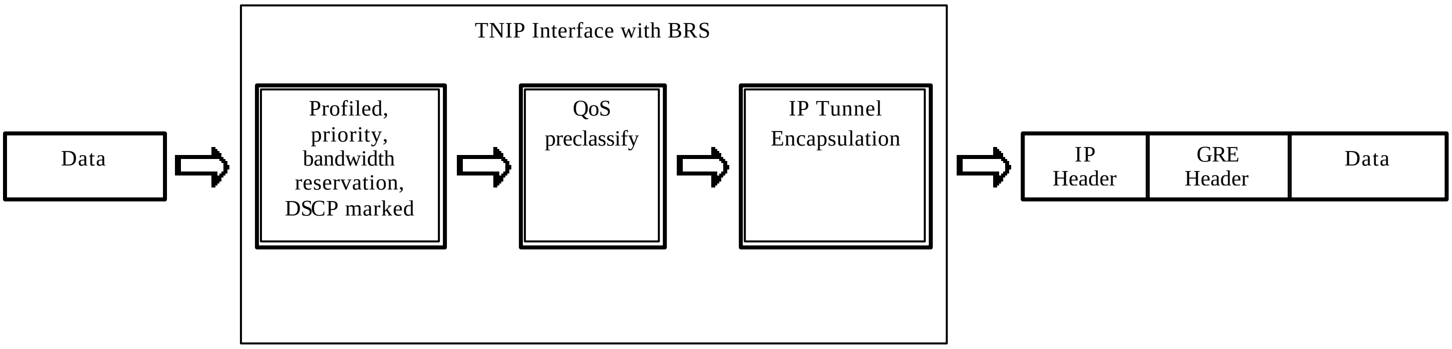
When the Bandwidth Reservation is enabled, although neither class nor protocol has been configured, a queue exists for each DLCI whose lengths are determined in the Bandwidth Reservation default configuration.

8. Bandwidth reservation over TNIP interface

The TNIP interfaces (IP tunnel interface), despite not being physical interfaces, also support bandwidth reservation. The fact these are not physical interfaces implies that the bandwidth is infinite. Therefore, if you do not limit the bandwidth (through traffic-shaping) all traffic is sent to the output interface, independently of load and the configured percentages.

There is no point in reserving bandwidth in a TNIP interface if you do not limit through traffic-shaping, as the TNIP interface has an infinite bandwidth.

When you configure traffic-shaping in the TNIP interface, you must bear in mind the throughput considered is traffic **before** being encapsulated in the tunnel (i.e. before adding the IP, GRE etc. headers.) In the following graph you can see how the quality of service is applied to the data and only after being encapsulated in the IP tunnel.



You can also see here that the *qos-preclasify* option is applied **after** the packet has been marked with a DSCP value. You must take this into account if BRS in the tunnel output interface is also applied.

9. BRS and virtual private networks

In some scenarios containing virtual private networks, it can be worthwhile prioritizing certain types of traffic both over common IP tunnels and IPSEC. The **Teldat Routers** are able to differentiate between distinct traffic that is encapsulated within the same tunnel.

In order to do this, you need to enable the *qos-preclassify* option. This is carried out in the IPSEC configuration menu or in the IP tunnel menu depending on which one you are using for the virtual private network.

Once this option has been configured, the packet classification in the distinct BRS classes is carried out before encapsulating. This enables you to differentiate between the distinct types of traffic that will be encapsulated in the same tunnel.

For further information, please see the IPSEC manual Dm 739-I and the manual on IP tunnel interfaces Dm 719-I.

Chapter 2
Configuration

1. Displaying the BRS Configuration Prompt

To access BRS configuration commands and to configure BRS on your router, do the following:

1. At the *Config>* prompt, enter **LIST DEVICES** to see a list of interfaces configured on the router. You use the interface name to configure an interface for bandwidth reservation.

2. At the *Config>* prompt, enter **FEATURE BANDWIDTH-RESERVATION**.

```
Config>FEATURE BANDWIDTH-RESERVATION
Bandwidth Reservation User Configuration
BRS Config>
```

3. At the *BRS Config>* prompt, enter **NETWORK** followed by the name of the interface you want to configure for BRS. For example, to configure interface serial0/0 for BRS enter

```
BRS Config>NETWORK serial0/0
BRS [i serial0/0] Config>
```

4. At the *BRS [i serial0/0] Config>* prompt, enter **ENABLE**.

```
BRS [i serial0/0] Config>ENABLE
```

5. For Frame Relay interfaces select PVCs using the **CIRCUIT** command. At the *BRS [i serial0/0] [dlci 16] Config>* prompt, enter **ENABLE**. (This is the circuit prompt, and the circuit number is 16 in this example).

```
BRS [i serial0/0] Config>CIRCUIT
Circuit to reserve bandwidth[16]? 16


BRS [i serial0/0] [dlci 16] Config>ENABLE
BRS [i serial0/0] [dlci 16] Config>
```

6. Repeat steps 2 through 4 to configure BRS for the particular interface that you have enabled.

7. At the *BRS [i serial0/0] Config>* prompt, configure the bandwidth reservation parameters for the selected interface by using the appropriate configuration commands discussed in this chapter. If this is a Frame Relay interface, configure circuit classes at this prompt.

8. For Frame Relay interfaces, select PVCs using the **CIRCUIT** command. At the *BRS [i serial0/0][dlci 16] Config>* prompt configure the bandwidth reservation parameters for the selected circuit using configuration commands discussed in this chapter. (This is the circuit prompt, and the circuit number is 16 in this example).

9. Restart your router.

To return to the *Config>* prompt at any time, enter **EXIT** at the *BRS Config>* prompt.

IMPORTANT: The Bandwidth reservation system configuration must be carried out once the device's interfaces have been configured. However should you wish to make any subsequent changes in the interface configuration it is strongly recommended that as a general rule you eliminate any previously configured BRS. In order to do this, use the CLEAR-BLOCK command.

2. Configuration Commands

The following table describes the bandwidth reservation configuration commands. The commands and options marked by an asterisk are only used in the Frame Relay interface layer.

Command	**Function**
? (HELP)	Displays the bandwidth reservation configuration commands or lists options for specific commands.
ACCESS-LIST	Assigns an access list to a class.
ASSIGN	Assigns a circuit*, protocol or filter to reserved class.
CLASS	Allocates a designated amount of bandwidth to a user-defined bandwidth class.
CIRCUIT*	Selects the DLCI of a Frame Relay permanent virtual circuit.
CLEAR-BLOCK	Clears the current reservation configuration from configuration memory (**Note**: This command requires a router restart).
DEASSIGN	Restores a specified circuit*, protocol or filter to its default class and priority.
DEFAULT-CLASS	Sets the default class and priority to a desired value.
DISABLE	Disables bandwidth reservation on the interface or Frame Relay circuit. (**Note:** This command requires a router restart).
ENABLE	Enables bandwidth reservation on the interface or Frame Relay circuit. (**Note:** This command requires a router restart).
IP-FILTER	Associates a tag with a determined IP traffic profile in order to subsequently assign a class and priority through the **ASSIGN** command. (For Frame Relay, this command appears in the PVC level prompt).
LIST	Displays the currently defined bandwidth classes by their guaranteed percentage rates and priority queuing values stored in the SRAM. Also displays the assigned protocols and filters. (For Frame Relay, this command provides two levels of information).
MAX-PACKETS-IN-DRIVER	Limits the maximum number of packets that can be simultaneously found in the driver.
NETWORK	Selects the serial interface that will run bandwidth reservation. Use this command to enable BRS on an interface. **Note**: You must enter this command **BEFORE** using any other configuration command, at the *BRS Config>* prompt.
NO CLASS	Eliminates a previously configured bandwidth class from a specified interface.
NO IP-FILTER	Eliminates an association between a tag (0 to 9) and a determined IP traffic profile. (For Frame Relay, this command appears in the PVC level prompt).
QUEUE-LENGTH	Sets maximum and minimum values for the number of packets in a priority queue.

TAG	Assigns a class and priority to a filter that has been tagged during the configuration of the MAC filtering feature. (For Frame Relay, this command appears in the PVC level prompt).
UNTAG	Removes the tag/tag name relationship and the tag name from the list of assignable filters. (For Frame Relay, this command appears in the PVC level prompt).
RATE-LIMIT	Specifies a maximum throughput for a Frame Relay interface or circuit. This is measured in kilobits per second.
EXIT	Exits from one BRS level to another or exits the bandwidth reservation configuration process.

Except for the commands marked with an asterisk, which are only for Frame Relay, the commands in the above table are the same for configuring bandwidth reservation for Frame Relay, PPP, ATM subinterface and X.25.

Note: When you enter the CLEAR-BLOCK, DISABLE, ENABLE, and LIST commands from within the BRS interface layer, they affect or list the bandwidth reservation information configured for the selected interface. When you enter these commands from within the BRS circuit layer, they affect only the FR bandwidth reservation information configured for the Permanent Virtual Circuit (PVC).

Before using the bandwidth reservation commands, keep the following in mind:

- You must use the **NETWORK** command to select a serial interface **BEFORE** you use any other configuration commands. BRS configuration enforces this.
- The <class-name> parameter can be written in both upper and lower case.
- To view the current class names, use the **LIST** command.

2.1. ? (HELP)

Lists the available commands from the current prompt level. You can also enter **?** after a command to list its options.

Syntax:

```
BRS [i #] Config>?
```

Example:

```
BRS [i #] Config>?
NETWORK
LIST
EXIT
BRS [i #] Config>
```

2.2. ACCESS-LIST

Use the **ACCESS-LIST** command to assign an access list to a class. Traffic pertaining to this access list will be classified as pertaining to the class where this is assigned. The access lists are associated to a class with a determined priority, default priority being Normal. When selecting the next packet to send for a specific class, a search is first executed for urgent priority. If there are no packets with this priority then high priority is searched for and if there are no high priorities then normal and so on.

The four types of priority are as follows:

- Urgent
- High
- Normal (default priority)
- Low

You can also indicate that all packets matching the list are marked with a specific DSCP specifying the mark-dscp option followed by the value.

Syntax:

```
BRS [i #] Config>ACCESS-LIST <list> <class> [priority] [mark-dscp <dscp-val>]
```

Example:

Assigning the access list 100 to class pepe with normal priority within the said class and marking all matching packets with value 20 for the dscp field.

```
BRS [i #] Config>ACCESS-LIST 100 pepe normal mark-dscp 20
BRS [i #] Config>
```

2.3. ASSIGN

Use the **ASSIGN** command to assign circuits to a given class if this is found at the Frame Relay interface layer or specified tags, protocol packets, or filters if this is not found at the Frame Relay interface layer. The tags, protocol packets and filters have an associated priority. The four priority types include:

- Urgent
- High
- Normal (the default priority)
- Low

Syntax:

```
BRS [i #] Config>ASSIGN <protocol> or <tag> or <filter> <class-name>
```

Example:

```
BRS [i #] Config>ASSIGN SNA test
priority <URGENT/HIGH/NORMAL/LOW> [NORMAL]? low
BRS [i #] Config>
```

2.4. CIRCUIT

Selects the DLCI of a Frame Relay PVC to configure. You can issue this command only from the BRS interface configuration prompt (*BRS [i #] Config>*).

Syntax:

```
BRS [i #] Config>CIRCUIT <permanent-virtual-circuit #>
```

Example:

```
BRS [i #] Config>CIRCUIT 16
BRS [i #] Config>
```

When the Frame Relay circuit is enabled, you can use the following commands at the circuit prompt:

- ENABLE
- DISABLE

- CLASS
- NO CLASS
- CHANGE-CLASS
- DEFAULT-CLASS
- TAG
- UNTAG
- IP-FILTER
- ASSIGN
- DEASSIGN
- QUEUE-LENGTH
- LIST
- CLEAR-BLOCK
- EXIT

2.5. CLASS

Use the **CLASS** command to allocate a designated amount of bandwidth to be used by a group of Frame Relay circuits if you are at the Frame Relay interface layer, either through filters, IP, tags etc., defined by the user if you are not at the Frame Relay interface layer.

Syntax:

```
BRS [i #] Config>CLASS <%> [priority] mark-dscp  <tos> rate-limit <cir> <bc> <be>
```

<%> [priority]	Configures the percentage reserved for the said class and its priority.
mark-dscp <tos>	Marks packets with a specific differv value for this class.
rate-limit <cir> <bc> <be>	Limits the maximum throughput for this class.

Parameters configured in the rate-limit option are as follows:

Cir: Average-maximum throughput for this class in kilobits per second.

Bc: Maximum permitted burst size.

Be: Maximum permitted excess burst size.

Example 1:

```
BRS [i #] Config>CLASS alpha 10
BRS [i #] Config>
```

Example 2:

```
BRS [i #] Config>CLASS beta 10 real-time
BRS [i #] Config>
```

Optionally, you can specify a priority for the new class; see section 2 (Priority) in this manual. Priority default is normal.

Example 3:

Configuring a class with a 30% guaranteed bandwidth, however the maximum throughput is limited to 40 kilobits per second.

```
BRS [i #] Config>CLASS beta 30
BRS [i #] Config>CLASS beta rate-limit 40
```

2.6. CLEAR-BLOCK

Clears the current bandwidth reservation configuration from SRAM for the current interface or Frame Relay PVC. This command requires a router restart.

Syntax:

```
BRS [i #] Config>CLEAR-BLOCK
```

Example:

```
BRS [i #] Config>CLEAR-BLOCK
You are about to clear BRS configuration information
Are you sure you want to do this (Yes or No): y
BRS [i #] Config>
```

2.7. DEASSIGN

Use the **DEASSIGN** command to restore a specified circuit (only at the Frame Relay interface layer), protocol, tag, or filter to its default class and priority.

Syntax:

```
BRS [i #] Config>DEASSIGN <protocol> or <tag> or <filter>
```

Example:

```
BRS [i #] Config>DEASSIGN IP
BRS [i #] Config>
```

2.8. DEFAULT-CLASS

Sets the default class and priority to a desired value. If no value has been previously assigned, system default values are used. Otherwise, the last previously assigned value is used.

Syntax:

```
BRS [i #] Config>DEFAULT-CLASS <class-name>
```

Example:

```
BRS [i #] Config>DEFAULT-CLASS test
BRS [i #] Config>
```

2.9. DISABLE

Disables bandwidth reservation on the interface or Frame Relay circuit. This command requires a router restart. To verify that bandwidth reservation is disabled, enter **LIST**.

Syntax:

```
BRS [i #] Config>DISABLE
```

Example:

```
BRS [i #] Config>DISABLE
BRS [i #] Config>
```

2.10. ENABLE

Enables bandwidth reservation on the interface or Frame Relay circuit. This command requires a router restart.

Syntax:

```
BRS [i #] Config>ENABLE
```

Example:

```
BRS [i #] Config>ENABLE
BRS [i #] Config>
```

2.11. IP-FILTER

> ***Important: This command will be obsolete in future releases. In order to implement the IP traffic filtering functionality, use the ACCESS-LIST command found in this manual.***

Assigns an IP filter tag (0 to 9) to a determined IP traffic profile. Once the filter has been created you can assign a class and configure priority through the **ASSIGN** command.

An IP traffic profile is defined through the following parameters:

- *DiffServ Codepoint:*

Permits you to specify that only those packets with a specific DSCP (IP header TOS field) are included within this filter. This also permits you to subsequently modify this field.

- *Protocol range:*

Permits you to specify a range within the protocols that are able to transport IP (TCP, UDP, SPF etc.). In this way, any IP packet with the protocol within this range will be included in the filter. By default the range varies from 1 to 255 i.e. the filter includes any protocol.

- *Source subnet:*

Permits you to specify a source IP subnet. If you only specify a source subnet, the packets with the source IP address included in this subnet will be included in the filter. The subnet is defined through an IP address and mask. Any source IP is included by default.

- *Destination subnet:*

Permits you to specify a destination IP subnet. If you only specify a destination subnet, the packets with the destination IP address included in this subnet will be included in the filter. The subnet is defined through an IP address and mask. Any destination IP is included by default.

- *Range of source UDP/TCP ports:*

Permits you to specify a range of source UDP/TCP ports. If you only specify a source range, the packets with the source port within in this range will be included in the filter.

> ***Note: If you wish to create a filter for traffic corresponding to a single port, you must introduce a range where the lower port is the same as the higher port.***

- *Range of destination UDP/TCP ports:*

Permits you to specify a range of destination UDP/TCP ports. If you only specify a destination range, the packets with the destination port within in this range will be included in the filter.

Note: If you wish to create a filter for traffic corresponding to a single port, you must introduce a range where the lower port is the same as the higher port.

Warning: All the parameters that are configured make the filter more restrictive as a packet must fulfill more conditions in order to be filtered. However, when configuring the source and destination UDP/TCP ports, you can choose whether you want these to fulfill both conditions (AND relation) or simply fulfill one of the two (OR relation).

Syntax:

```
BRS [i #] Config>IP-FILTER <id>
destination-subnet      filter ip packets destinated to a particular subnet

classify-dscp           filter ip packets with a specific dscp field value

mark-dscp               mark ip packets with a specific dscp field value

higher                  define the higher limit of a range
        destination-port      TCP-UDP destination port
        protocol              IP protocol (ospf, icmp, udp ...)
        source-port           TCP-UDP source port

lower                   define the lower limit of a range
        destination-port      TCP-UDP destination port
        protocol              IP protocol (ospf, icmp, udp ...)
        source-port           TCP-UDP source port

no
        classify-dscp          filter ip packets with a specific dscp field value
        mark-dscp              mark ip packets with a specific dscp field value

source-subnet           filter ip packets originated by a particular subnet
```

Options:

destination-subnet: specifies a destination subnet for this filter's packets.

classify-dscp: specifies a value from the specific dscp field for this filter's packets.

mark-dscp: marks this filter's packets with a specific dscp value.

source.subnet: specifies a source subnet for this filter's packets.

higher destination-port: highest destination port admitted for this filter's packets.

higher protocol: highest IP protocol admitted for this filter's packets.

higher source-port: highest source port admitted for this filter's packets.

lower destination-port: lowest destination port admitted for this filter's packets.

lower protocol: lowest IP protocol admitted for this filter's packets.

lower source-port: lowest source port admitted for this filter's packets.

Example 1:

```
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 0 lower protocol 6 higher protocol 6
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 0 lower source-port 20
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 0 higher source-port 21
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 0 lower destination-port 20
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 0 higher destination-port 21
```

On executing these commands, the filter for all TCP traffic (protocol 6) is defined with any source or destination IP. On configuring the range of ports 20 – 21 both at source and destination and establishing an OR relation, only FTP packets will be included in the filter.

Once the filter has been created, you can assign a class and a priority through the **ASSIGN** command. For example:

```
BRS [i serial0/0] [dlci 16] Config> ASSIGN FILTER0 FTP
Priority <URGENT/HIGH/NORMAL/LOW>[NORMAL]?
BRS [i serial0/0] [dlci 16] Config>
```

Example 2:

```
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 1 lower protocol 17 higher protocol 17
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 1 lower protocol 17 higher protocol 17
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 1 source-subnet 172.24.0.0 255.255.0.0
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 1 destination-subnet 172.24.0.0
255.255.0.0
```

On executing this command, a filter that includes all UDP traffic (protocol 17) with source in subnet 172.24.0.0 and destination as subnet 174.24.0.0 is defined, whatever the source or destination port (as this has not been specified).

Example 3:

```
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 2 lower protocol 17 higher protocol 17
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 2 lower protocol 17 higher protocol 17
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 2 source-subnet 80.3.1.1
255.255.255.255
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 2 destination-subnet 80.3.2.1
255.255.255.255
```

On executing this command, a filter that includes all IP traffic with source in host 80.3.1.1 and destination in host 80.3.2.1 is defined. If you also wish to classify traffic the other way (80.3.2.1 -> 80.3.1.1) pertaining to the same class, you can add another filter with source address 80.3.2.1 and destination 80.3.1.1 and assign it to the same class. Please note however that the BRS only controls outgoing traffic, therefore a filter in one direction (with the source IP being the host located in the router's LAN and the destination the host that can be reached by the WAN) should be sufficient.

Example 4:

```
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 3 classify-dscp 20
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 3 mark-dscp 10
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 3 lower protocol 6 higher protocol 6
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 3 lower source-port 20 higher source-
port 21
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 3 lower destination-port 20
BRS [i serial0/0] [dlci 16] Config>IP-FILTER 3 higher destination-port 21
BRS [i serial0/0] [dlci 16] Config>
```

On executing this command, a filter for all TCP traffic (protocol 6) with any IP source and destination that a DSCP (TOS field value) of 20 has. On configuring the range of ports 20 – 21 both at source and destination and establishing an OR relation, only FTP packets will be included in the filter. The packets classified within a class with this filter will exit through an interface with a 10 DSCP.

The tags are assigned in ascending order. You can consult the information through the **LIST** command:

```
BRS [i serial0/0] [dlci 16] Config>LIST

BANDWIDTH RESERVATION listing from SRAM
bandwidth reservation is enabled
interface name serial0/0
maximum queue length 10 minimum queue length 3
total bandwidth allocated 80%
total classes defined (counting one local and one default) 5


class LOCAL has 10% bandwidth allocated
  protocols and filters cannot be assigned to this class.


class DEFAULT has 40% bandwidth allocated

  the following protocols and filters are assigned:
```

```
    protocol IP with default priority
    protocol X28 with default priority
    protocol ARP with default priority
    protocol SNA-X25 with default priority
    protocol BAN/ASRT with default priority


class FTP has 10% bandwidth allocated
  the following protocols and filters are assigned:
    filter FILTER0 with priority NORMAL


class HOST has 10% bandwidth allocated
  the following protocols and filters are assigned:
    filter FILTER2 with priority NORMAL


class SUBN has 10% bandwidth allocated
  the following protocols and filters are assigned:
    filter FILTER1 with priority NORMAL


ASSIGNED TAGS
-------------

ASSIGNED IP FILTERS
-------------------
  FILTER0 represents:
          Protocol range:                      6      6
          Udp-tcp source port range:          20     21
          Udp-tcp destination port range:     20     21
          Comparison rule: OR
  FILTER1 represents:
          Source subnetwork address:       172.24.0.0
          Source subnetwork mask:          255.255.0.0
          Destination subnetwork address:  174.24.0.0
          Destination subnetwork mask:     255.255.0.0
          Protocol range:                     17     17
  FILTER2 represents:
          Source subnetwork address:       80.3.1.1
          Source subnetwork mask:          255.255.255.255
          Destination subnetwork address:  80.3.2.1
          Destination subnetwork mask:     255.255.255.255
          Protocol range:                      0    255

default class is DEFAULT with priority NORMAL

BRS [i serial0/0] [dlci 16] Config>
```

With the **SHOW CONFIG** command:

```
BRS [i serial0/0] [dlci 16] Config>SHOW CONFIG
; Showing Menu and Submenus Configuration ...
; Router ATLAS 2 8 Version 10.0.0

         enable
         class FTP 10
         class HOST 10
         class SUBN 10
         ip-filter 0 lower source-port 20 higher source-port 21
         ip-filter 0 lower destination-port 20 higher destination-port 21
         ip-filter 0 lower protocol 6 higher protocol 6
;
         ip-filter 1 destination-subnet 172.24.0.0 255.255.0.0
         ip-filter 1 source-subnet 172.24.0.0 255.255.0.0
         ip-filter 1 lower protocol 17 higher protocol 17
```

```
;
        ip-filter 2 destination-subnet 80.3.2.1 255.255.255.255
        ip-filter 2 source-subnet 80.3.1.1 255.255.255.255
        ip-filter 2 lower protocol 17 higher protocol 17
;
        ip-filter 3 classify-dscp 20
        ip-filter 3 mark-dscp 10
        ip-filter 3 lower source-port 20 higher source-port 21
        ip-filter 3 lower destination-port 20 higher destination-port 21
        ip-filter 3 lower protocol 6 higher protocol 6
;
        assign FILTER0 FTP NORMAL
        assign FILTER2 HOST NORMAL
        assign FILTER1 SUBN NORMAL
BRS [i serial0/0] [dlci 16] Config>
```

2.12. LIST

Displays currently defined bandwidth classes by their guaranteed percentage rates and priority queuing values stored in SRAM. This command also displays all assigned protocols and filters.

Syntax:

```
BRS Config>LIST
```

Example:

```
BRS Config>LIST
```

Depending on the prompt at which you enter **LIST**, various outputs appear. You can enter **LIST** from the following example prompts:

BRS Config>

BRS [i x25-node] Config> (for the X.25 interface)

BRS [i ppp1] Config> (for the PPP interface)

BRS [i serial0/0] Config> (for the number 1 Frame Relay interface)

BRS [i serial0/0] [dlci 17] Config> (for circuit 17 in the number 1 Frame Relay interface)

For example, if you introduce the **LIST** command at the *BRS Config>* the following output is obtained:

Example:

```
BRS config>LIST
Bandwidth Reservation is available for 6 interfaces.

  Interface        State
---------------    -----
serial0/0          Enabled
serial0/1          Disabled
serial0/2          Disabled
x25-node         Disabled
fr1                   Enabled
fr2                   Enabled
BRS config>
```

We can see that BRS facilities are available for Frame Relay, PPP and X.25 interfaces.

The following output appears when you enter **LIST** at the *BRS [i x25-node] Config>:*

Example:

```
BRS [i x25-node] Config>LIST

BANDWIDTH RESERVATION listing from SRAM
bandwidth reservation is enabled
interface name x25-node
maximum queue length 10 minimum queue length 3
total bandwidth allocated 50%
total classes defined (counting one local and one default) 2


class LOCAL has 10% bandwidth allocated
  protocols and filters cannot be assigned to this class.


class DEFAULT has 40% bandwidth allocated

  the following protocols and filters are assigned:
    protocol IP with default priority
    protocol X28 with default priority
    protocol ARP with default priority
    protocol BAN/ASRT with default priority

ASSIGNED TAGS
-------------

ASSIGNED IP FILTERS
-------------------

default class is DEFAULT with priority NORMAL

BRS [i x25-node] Config>
```

The above list appears by default when you enter the Bandwidth Reserve configuration for the first time for an already enabled X.25 interface. From the start there are always two classes available:

- the LOCAL class: this class can never be deleted and it cannot be assigned a bandwidth of less than 10% (it can be increased). This class is reserved for traffic generated locally in the device, in other words all the traffic that does not come from switching but is generated internally and mainly comes from routing protocols (RIP, OSPF), generation of maintenance packets, pings, etc. Neither protocols nor filters can be assigned to this class.
- the DEFAULT class: as the name indicates this is the default class where initially all the available protocols in the device are assigned and at first has 40% bandwidth allocated.

The rest of the values that appear are the ones used by default.

If you enter the **LIST** command at the *BRS [i ppp1] Config>* prompt, you obtain an output similar to the above corresponding to the Bandwidth Reservation configuration for an already enabled PPP interface.

The following output appears when you enter **LIST** at the *BRS [i serial0/0] Config>*:

Example:

```
BRS [i serial0/0] Config>LIST

BANDWIDTH RESERVATION listing from SRAM
bandwidth Reservation is enabled
interface number serial0/0
maximum queue length 10 minimum queue length 3
total bandwidth allocated 10%
total circuit classes defined (counting one default) 1


class DEFAULT has 10% bandwidth allocated
  the following circuits are assigned:
      17
```

```
      16

default class is DEFAULT

BRS [i serial0/0] Config>
```

The above list appears by default when you enter the Bandwidth Reserve configuration for the first time for an already enabled Frame Relay interface. From the start there is always one class available:

- the DEFAULT class: as the name indicates this is the default class. This is the class where initially all the circuits for which the Bandwidth Reserve is enabled are assigned. This type contains two circuits (17 and 16), and this means that the Bandwidth Reserve is enabled for these two circuits. The initial bandwidth assigned for this type is 10%.

The rest of the values that appear are the ones used by default.

The following output appears when you enter **LIST** at the *BRS [i serial0/0] [dlci 17] Config>*:

Example:

```
BRS [i serial0/0] [dlci 17] Config>LIST

BANDWIDTH RESERVATION listing from SRAM
Bandwidth Reservation is enabled
interface name serial0/0 circuit number 17
maximum queue length 10 minimum queue length 3
total bandwidth allocated 100%
total circuit classes defined (counting one local and one default) 3

class LOCAL has 10% bandwidth allocated
protocols and filters cannot  be assigned to this class.

class DEFAULT has 5% bandwidth allocated
More?
the following protocols and filters are assigned:
    Protocol IP with default priority
    Protocol X28 with default priority
    Protocol ARP with default priority

class sna has 85% bandwidth allocated
the following protocols and filters are assigned:
    Protocol X28 with priority NORMAL

ASSIGNED TAGS
-------------

ASSIGNED IP FILTERS
-------------------

default class is DEFAULT with priority NORMAL

BRS [i serial0/0] [dlci 17] Config>
```

When we make this list for the first time for circuit 17 (and once the Bandwidth Reserve is enabled), we should obtain a very similar one to the one in the X.25 interface example. From the start there are always two classes available:

- the LOCAL class: this class can never be deleted and it cannot be assigned a bandwidth of less than 10% (it can be increased). This class is reserved for traffic generated locally in the device, in other words all the traffic that does not come from switching but is generated internally and mainly comes from routing protocols (RIP, OSPF), generation of maintenance packets, pings, etc. Neither protocols nor filters can be assigned to this class.
- the DEFAULT class: as the name indicates this is the default class where initially all the available protocols in the device are assigned and at first has 40% bandwidth allocated.

The rest of the values that appear are the ones used by default. However, in the above list we can see that another class has been created, the SNA class and that various protocols have been assigned to it.

> ***Note. For Frame Relay, there are two levels of this command: the interface layer and the circuit layer.***

2.13. MAX-PACKETS-IN-DRIVER

Limits the maximum number of packets that can be simultaneously found in the driver.

Once the packets have reached the driver, they will be transmitted in the same order as they were sent to the said driver. So, if in a given moment, a packet with higher priority reaches the BRS subsystem, this packet will have to wait until the packets in the driver has been transmitted even though the latter have lower priorities.

In fact, the maximum delay provoked by non-priority traffic in priority packets can be calculated as (MTU * MAX-PACKETS-IN-DRIVER)/line speed. Therefore in environments where fragmentation does not exist (elevated percentage MTUs) and low speed lines, it might well be an idea to limit this value to one so you can be sure that priority traffic suffers the least delay possible.

This parameter's default value dynamically varies depending on the MTU and the line speed so it is not usually necessary to configure it. The exception to this rule is ADSL scenarios where these default to a value of two. It's a good idea to configure this to one for scenarios where traffic is sensitive to delay and where there are low speed ADSL lines (128 Kbps).

Syntax:

```
BRS [i #] Config>MAX-PACKETS-IN-DRIVER <packet number>
```

Example:

```
BRS [i #] Config>MAX-PACKETS-IN-DRIVER 1
BRS [i #] Config>
```

2.14. NETWORK

Selects the serial interface to which bandwidth reservation configuration commands are applied. Bandwidth reservation is supported Frame Relay, PPP and X.25 interfaces.

> ***Note: To enter bandwidth reservation commands for a new interface, you must enter this command BEFORE using any other bandwidth reservation configuration commands. If you have exited the bandwidth reservation prompt and want to return in order to make changes in the Bandwidth Reservation of a previously configured interface, you must reenter this command first.***

To configure bandwidth reservation on a particular interface, at the *BRS Config>* prompt, enter the name of the interface that supports the particular protocol or feature.

Syntax:

```
BRS Config>NETWORK <interface #>
```

Example:

```
BRS config>NETWORK
BRS for which interface [ethernet0/0]? serial0/0
BRS [i serial0/0] Config>
```

2.15. NO

Deactivates the BRS configuration parameters.

a) *NO ACCESS-LIST*

Eliminates the association between an access list and a class. If the mark-dscp option is specified, the association is not eliminated. The packets are simply not marked with any specific dscp value.

Syntax:

```
BRS [i #] Config>NO ACCESS-LIST <list> <class> [priority] [mark-dscp <dscp-val>]
```

Example:

Eliminates the association between the access list 100 and class pepe with normal priority.

```
BRS [i #] Config>NO ACCESS-LIST 100 pepe normal
BRS [i #] Config>
```

b) *NO CLASS*

Eliminates a previously configured Bandwidth class from a specified interface or a Frame Relay circuit.

Syntax:

```
BRS [i #] Config>NO CLASS <class-name>
```

Example:

```
BRS [i #] Config>NO CLASS IP
BRS [i #] Config>
```

c) *NO IP-FILTER*

Eliminates an IP filter.

Syntax:

```
BRS [i #] Config>NO IP-FILTER <filter-id>
```

Example:

```
BRS [i #] Config>NO IP-FILTER 1
BRS [i #] Config>
```

d) *NO MAX-PACKETS-IN-DRIVER*

Sets the default value for this parameter. Default for this parameter dynamically varies depending on the MTU and the line speed.

Syntax:

```
BRS [i #] Config>NO MAX-PACKETS-IN-DRIVER
```

Example:

```
BRS [i #] Config>NO MAX-PACKETS-IN-DRIVER
BRS [i #] Config>
```

e) *NO RATE-LIMIT*

Removes the maximum throughput limitation imposed on an interface. The throughput will then be equal to the real speed of the interface.

Syntax:

```
BRS [i #] Config>NO RATE-LIMIT
```

Example:

```
BRS [i #] Config>NO RATE-LIMIT
BRS [i #] Config>
```

2.16. QUEUE-LENGTH

> ***Caution: Do not use this command unless it is essential to do so. TELDAT recommends the default values for queue length for most users. If you set the values for queue length too high, you may seriously degrade the performance of your router.***

Sets the number of packets that the router can queue in each BRS priority queue. Each BRS class has a priority value that you assigned to its protocols, filters and tags. Each priority queue can hold the number of packets that you specify with this command.

This command sets the maximum number of output packets that can be queued in each BRS priority queue. It also sets the maximum number of output packets that can be queued in each BRS priority queue when the **Teldat Router** input buffers are scarce (in this case the value known as *queue minimum length* is applied).

If you issue **QUEUE-LENGTH** for a X.25 or PPP interface or an ATM subinterface, this command sets the queue length values for each priority queue of each BRS class that is defined for the interface.

If you issue **QUEUE-LENGTH** for a Frame Relay interface (at a prompt like this: *BRS [i serial0/0] Config>*), the command sets the default queue length values for each priority queue of each BRS class that is defined for each permanent virtual circuit of the interface.

If you issue **QUEUE-LENGTH** for a Frame Relay PVC (at a prompt like this: *BRS [i serial0/0] [dlci 16] Config>*), the command sets the queue length values for each priority queue of each BRS class that is defined for the PVC. These values override the default queue length values set for the Frame Relay interface.

> ***WARNING: You must use this command in order to increase the size of the queues when, for example, the circuit is operating with some type of fragmentation.***

Syntax:

```
BRS [i #] Config>QUEUE-LENGTH <maximum-length> <minimum-length>
```

Example:

```
BRS [i #] Config>QUEUE-LENGTH
BRS priority queue maximum length [10]?
BRS priority queue minimum length [3]?
BRS [i #] Config>
```

2.17. TAG

Assigns a class and priority to a filter that has been tagged using the MAC filtering feature. The command requires a filter tag number (configured in Mac Filtering), to reference the tag in bandwidth reservation.

You can set up to five tagged MAC addresses 1 to 5. TAG1 is searched for first, then TAG2, and so on up to TAG5.

Any newly added addressed filter can then be assigned a tag (as any other protocol or filter) with the **ASSIGN** command.

Syntax:

```
BRS [i #] Config>TAG <tag #>
```

Example:

```
BRS [i #] Config>TAG 3
BRS [i #] Config>
```

2.18. UNTAG

Removes the tag/tag name relationship and the tag name from the list of assignable filters. A tag can only be removed if it is not assigned to any class.

Syntax:

```
BRS [i #] Config>UNTAG <tag #>
```

Example:

```
BRS [i #] Config>UNTAG 3
BRS [i #] Config>
```

2.19. RATE-LIMIT

Limits the maximum throughput for a Frame Relay interface or virtual circuit to the specified value.

The maximum throughput is specified in kilobits per second, while the burst and the excess bursts are specified in kilobits. As the quantity of transmitted bytes is measured at the IP layer, the real throughput at the link layer may be somewhat higher. This depends on the headers introduced by each specific link layer.

Syntax:

```
BRS [i #] Config>RATE-LIMIT <throughput> [burst] [excess-burst]
```

Example:

```
BRS [i #] Config>RATE-LIMIT 30 20
BRS [i #] Config>
```

2.20. EXIT

Use the **EXIT** command to return to the previous prompt.

Syntax:

```
BRS Config>EXIT
```

Example:

```
BRS Config>EXIT
Config>
```

Chapter 3
Monitoring

1. Displaying the BRS Prompt

To access bandwidth reservation monitoring commands and the **Teldat Router** bandwidth reservation monitoring on your router, do the following:

1. At the + prompt, enter **FEATURE BANDWIDTH-RESERVATION**.

```
+FEATURE BANDWIDTH-RESERVATION
-- Bandwidth Reservation console --
BRS>
```

2. At the *BRS>* prompt, enter **NETWORK** followed by the number of the interface that you want to monitor.

```
BRS>NETWORK serial0/0
BRS [i serial0/0]>
```

3. For Frame Relay PVCs, enter **CIRCUIT** to monitor BRS for a particular PVC.

```
BRS [i serial0/0]>CIRCUIT
Circuit number: [16]?
BRS [i serial0/0] [dlci 16]>?
```

To return to the + prompt at any time, enter **EXIT**.

2. Monitoring Commands

You enter the commands at the *BRS>* prompt.

Command	**Function**
? (HELP)	Displays all the bandwidth reservation commands or lists subcommand options for specific commands (if available).
CIRCUIT	Selects the DLCI of a Frame Relay permanent virtual circuit (PVC). To monitor Frame Relay bandwidth reservation traffic, you must be at the circuit prompt level.
CLEAR	Clears the current reservation counters and stores them as **LAST** command counters. Counters are listed by class usage.
CLEAR-CIRCUIT-CLASS	Clears the reservation counters for all the circuit classes of the interface.
COUNTERS	Displays the current counters.
COUNTERS-CIRCUIT-CLASS	Displays the current counters for all the circuit classes of the interface.
NETWORK	Selects the serial interface that will run bandwidth reservation. **Note**: You must enter this command **BEFORE** you use any other bandwidth reservation monitoring commands.
QUEUE-LENGTH	Displays the queue occupation for each class.
TRAFFIC-SHAPE-GROUP	Displays information relative to traffic-shaping.
LAST	Displays the last saved statistics.
LAST-CIRCUIT-CLASS	Displays the last saved statistics.
EXIT	Exits the bandwidth reservation monitoring process.

2.1. ? (HELP)

Lists the commands that are available from the current prompt. You can also enter **?** after a command to list its options.

Syntax:

```
BRS>?
```

Example:

```
BRS>?
NETWORK
EXIT
BRS>
```

2.2. CIRCUIT

Use the **CIRCUIT** command to select the DLCI of a Frame Relay PVC for monitoring. You can only enter this command from the BRS interface monitoring prompt (*BRS [i #]>*).

Syntax:

```
BRS [i #]>CIRCUIT <permanent-virtual-circuit #>
```

Example:

```
BRS [i #]>CIRCUIT 16
BRS [i #] [dlci 16]>
```

If the Frame Relay circuit is enabled, you can use the following commands at the circuit prompt:

- COUNTERS
- CLEAR
- LAST
- EXIT

2.3. CLEAR

Clears the current bandwidth reservation counters for the selected interface or Frame Relay circuit from the RAM memory, and stores them as counters that you can display with the **LAST** command.

Syntax:

```
BRS [i #]>CLEAR
```

Example:

```
BRS [i #]>CLEAR
BRS [i #]>
```

2.4. CLEAR-CIRCUIT-CLASS

Enter **CLEAR-CIRCUIT-CLASS** at the BRS [i #]> prompt. It clears the current bandwidth reservation counters for the circuit classes of the selected Frame Relay interface. This command clears the counters from RAM and stores them as counters that you can display with **LAST-CIRCUIT-CLASS**.

Syntax:

```
BRS [i #]>CLEAR-CIRCUIT-CLASS
```

Example:

```
BRS [i #]>CLEAR-CIRCUIT-CLASS
BRS [i #]>
```

2.5. COUNTERS

Displays statistics describing bandwidth reservation traffic for the selected interface or Frame Relay circuit according to the configured classes.

Syntax:

```
BRS  [i #] [dlci #]>COUNTERS
```

Example:

```
BRS  [i serial0/0] [dlci 17]>COUNTERS
Bandwidth Reservation Counters
Interface name serial0/0 circuit number 17
Class      Pkt Xmit  Bytes Xmit  Bytes Ovfl
LOCAL      25        234         0
```

```
DEFAULT    190       7409        0
sna        4         513         0

TOTAL      119       8156        0
BRS  [i serial0/0] [dlci 17]>
```

2.6. COUNTERS-CIRCUIT-CLASS

Enter **COUNTERS-CIRCUIT-CLASS** at the *BRS [i #]>* prompt. This displays statistics describing bandwidth reservation traffic for the circuit classes of the selected Frame Relay interface.

Syntax:

```
BRS  [i #]>COUNTERS-CIRCUIT-CLASS
```

Example:

```
BRS  [i #]>COUNTERS-CIRCUIT-CLASS

Bandwidth Reservation Circuit Class Counters
Interface serial0/0

Class      Pkt Xmit   Bytes Xmit  Bytes Ovfl
DEFAULT    103        57692       0
new       2149       1730056     0
CLASS 2    0          0           0

TOTAL      2252       1787748     0
BRS  [i #]>
```

2.7. NETWORK

Selects the serial interface to which bandwidth reservation monitoring commands are to be applied. Frame Relay, PPP and X.25 interfaces support bandwidth reservation.

> ***Note: To enter bandwidth reservation commands for a new interface, you must enter this command BEFORE using any other bandwidth reservation monitoring commands. If you have exited the bandwidth reservation monitoring prompt (BRS>) and want to return to monitor bandwidth reservation, you must again enter this command first.***

To monitor bandwidth reservation on a particular interface, enter the number of the interface that supports the particular facility or protocol at the *BRS>* prompt.

Syntax:

```
BRS>NETWORK <interface #>
```

Example:

```
BRS>NETWORK serial0/0
BRS [i serial0/0]>
```

2.8. LAST

Displays the last saved bandwidth reservation statistics. The statistics are displayed in the same format as they are for the **COUNTERS** command.

Syntax:

```
BRS  [i #]>LAST
```

Example:

```
BRS  [i #]>LAST

Bandwidth Reservation Counters
Interface x25-node

Class          Pkt Xmit     Bytes Xmit     Bytes Ovfl
LOCAL                 0              0              0
DEFAULT               0              0              0

TOTAL                 0              0              0

BRS  [i #]>
```

2.9. LAST-CIRCUIT-CLASS

Enter **LAST-CIRCUIT-CLASS** at the BRS [i #]> prompt. It displays the last saved bandwidth reservation statistics for the circuit classes of the selected Frame Relay interface. The statistics are displayed in the same format as they are for the **COUNTERS-CIRCUIT-CLASS** command.

Syntax:

```
BRS [i #]>LAST-CIRCUIT-CLASS
```

Example:

```
BRS [i #]>LAST-CIRCUIT-CLASS

Bandwidth Reservation Circuit Class Counters
Interface serial0/0

Class          Pkt Xmit     Bytes Xmit     Bytes Ovfl
DEFAULT               0              0              0

TOTAL                 0              0              0

BRS [i #]>
```

2.10. QUEUE-LENGTH

This command is introduced at the *BRS [i #]>* prompt. This displays the occupation of the BRS queues for each class and each priority. In cases of PPP interfaces with real-time traffic, the occupation of non-real-time traffic also appears (see traffic priority in multilink links). The current value and the maximum permitted value are displayed for each priority within a class.

Syntax:

```
BRS [i #]>QUEUE-LENGTH
```

Example:

```
BRS  [i #]>QUEUE-LENGTH

  class        urgent   high   normal   low
       local   00/10   00/10   00/10   00/10
     default   00/10   00/10   00/10   00/10
   lessimpor   00/10   00/10   00/10   00/10
   important   00/10   00/10   09/10   00/10
     non rtt   00/10   00/10   00/10   00/10
```

2.11. TRAFFIC-SHAPE-GROUP

Introduce this command at the BRS [i #]> prompt or within a Frame-Relay pvc. This displays information relative to traffic-shaping for each class and for the interface or pvc ("Global" row).

Syntax:

```
BRS [i #]>TRAFFIC-SHAPE-GROUP
```

Example:

```
BRS  [i #]>TRAFFIC-SHAPE-GROUP
Number -  CIR   -  burst - state - Queued  -  last tx  - Throughput (kbps)
-----------------------------------------------------------------------------
 Global   100      11553      B      No      12495          31
 local    0        0          R      No      12495          31
 default  0        0          R      No      0              0
 voip     60       0          R      No      0              0
```

The meaning of the fields is as follows:

CIR: Maximum average permitted throughput (0 indicates there is no limit).

Busrt: Currently used burst size (in bits).

State: There are three possible states. R: Ready, B: Bursting, C: Congested. Transmission cannot be executed when a class or an interface is congested. Transmission is possible in any other state.

Queued: When a class is queued, there is traffic to be transmitted.

Last tx: Last instant where a packet for this class was transmitted. (This parameter is for Teldat personnel use only).

Throughput: Average throughput for a class. If you wish to start measuring the throughput for a given instant, execute the **CLEAR** command. The throughput measuring will only take into account those packets which are transmitted after this instant.

2.12. EXIT

Returns to the previous prompt level.

Syntax:

```
BRS>EXIT
```

Example:

```
BRS>EXIT
+
```

Chapter 4
Examples

1. BRS over FR

The aim is to guarantee 70% of the bandwidth for ftp. FTP traffic is characterized by having ports 20 or 21 as source or destination.

Steps to carry out:

1- Configure the Frame-Relay circuit, in this case 16, as well as the WAN and LAN IP addresses.
2- Create an access list to classify FTP traffic. As it is necessary to prioritize by port and protocol, you need to use an extended access list.
3- Enable BRS at the Frame-Relay interface layer, in this case serial0/0.
4- Enable BRS at the Frame-Relay circuit layer, in this case dlci 16.
5- Decrease the bandwidth assigned to the default class from 40% to 20% so you can assign 70% of the bandwidth to the FTP class.
6- Create a class representing FTP traffic, this will be called ftp with a guaranteed bandwidth of 70%.
7- Associate the access list created in step 2 with the ftp class.
8- Save and restart.

The resulting configuration will be as follows:

```
; Showing System Configuration ...
; Router ATLAS 2 8 Version 10.1.0

no configuration
add device fr 1
set data-link frame-relay serial0/0
set data-link sync serial0/1
set data-link x25 serial0/2
set hostname atlas1
network serial0/0
; -- Frame Relay user configuration --
   pvc 16 default
;
   protocol-address 1.1.1.2 16
   no lmi
exit
;
feature access-lists
; -- Access Lists user configuration --
   access-list 100
;
      entry 1 default
      entry 1 permit
      entry 1 source port-range 20 21
      entry 1 protocol-range 6 6
;
      entry 2 default
      entry 2 permit
      entry 2 destination port-range 20 21
      entry 2 protocol-range 6 6
;
```

```
   exit
;
exit
;
;protocol ip
; -- Internet protocol user configuration --
   address  ethernet0/0     172.24.78.131    255.255.0.0
   address  serial0/0       1.1.1.1          255.255.255.0
;
;
   route 0.0.0.0         0.0.0.0         1.1.1.2         1
;
;
;
exit
;
feature bandwidth-reservation
; -- Bandwidth Reservation user configuration --
   network serial0/0
;
      enable
      circuit 16
;
         enable
         class default 20
;
         class ftp 70
;
         access-list 100 ftp
;
      exit
;
   exit
;
exit
;
; --- end ---
```

2. BRS over ATM

A company has an ATM connection to connect to Internet. This connection has also been used to create a VPN with another branch through an IP tunnel. The company wants http traffic to have a lower priority than the rest i.e. any other type of traffic to have absolute priority over http traffic when this is sent. The company also wishes traffic to be sent through the IP tunnel (traffic between the two branches) to have at least 50% of the reserved bandwidth.

Steps to carry out:

1- Configure the ATM circuit, in this case the 8 32 and create the subinterface associated as well as the ATM subinterface and the LAN IP addresses.

2- Create an access list to classify http traffic. As you need to prioritize by port and protocol, you need to use an extended access list.

3- Create another access list to classify traffic pertaining to the IP tunnel. As you need to prioritize by IP source and destination and by protocol, you need to use an extended access list.

4- Enable BRS at the ATM subinterface layer. In this case atm3/0.1.

5- Create an http class with low priority so that the rest of the traffic has preference over the said class. As this is the only class with low priority 100 % of the bandwidth for classes with the said priority will be assigned.

6- Create a class that represents the VPN traffic. This will be called vpn and have a guaranteed bandwidth of 50%.

7- Associate the access list created in point 2 with the http class.

8- Associate the access list created in point 3 with the vpn class.

9- Save and restart.

```
; Showing System Configuration ...
; Router ATLAS 2 8 Version 10.0.4

no configuration
add device tnip 1
add device atm-subinterface atm3/0 1
set data-link x25 serial0/0
set data-link x25 serial0/1
set data-link x25 serial0/2
network atm3/0
; -- ATM interface configuration --
   aal-connection 1 pvc 8 32
;
   pvc 8 32 default
;
exit
;
network atm3/0.1
; -- ATM subinterface configuration --
   aal-connection-requested 1 default
exit
;
network tnip1
; -- IP Tunnel Net Configuration --
   destination 10.30.1.1
   source 10.30.1.2
exit
;
```

```
feature access-lists
; -- Access Lists user configuration --
   access-list 100
; Access-list to classify http traffic
      entry 1 default
      entry 1 permit
      entry 1 source port-range 80 80
      entry 1 protocol-range 6 6
;
      entry 2 default
      entry 2 permit
      entry 2 destination port-range 80 80
      entry 2 protocol-range 6 6
;
   exit
;
   access-list 101
; Access-list to classify tnip traffic (Protocol 47) sent to branch
      entry 1 default
      entry 1 permit
      entry 1 source address 10.30.1.2 255.255.255.255
      entry 1 destination address 10.30.1.1 255.255.255.255
      entry 1 protocol-range 47 47
;
   exit
;
exit
;
;
protocol ip
; -- Internet protocol user configuration --
   address  ethernet0/0     172.1.1.147      255.255.0.0
   address  atm3/0.1        10.30.1.2        255.0.0.0
   address  tnip1           unnumbered       0.0.0.0
;
;The branch subnet is 192.167.0.0
   route 192.167.0.0     255.255.0.0     tnip1           1
   route 0.0.0.0         0.0.0.0         atm3/0.1        1
;
;
;
exit
;
feature bandwidth-reservation
; -- Bandwidth Reservation user configuration --
   network atm3/0.1
;
      enable
      class local 10
;
      class default 40
;
      class http 100 low
;
      class vpn 50
;
      access-list 100 http
      access-list 101 vpn
;
   exit
;
exit
;
; --- end ---
```

Note: Through this configuration, the http traffic will always be interrupted when the rest of the traffic occupies all of the available bandwidth e.g. when executing FTP. You must be completely positive that this configuration is what you require.

3. VoIP priority over MP

You wish to guarantee the quality of service for voice over IP in a point-to-point line at 64 Kbps.

As this is a low speed line, you need to fragment at the link layer so you must configure multilink with forced fragmentation, in this case at 256 bytes. The VoIP traffic is characterized as it uses ports within the range of 20000-20025 in order to send voice through RTP-UDP protocol and port 1720 (TCP protocol) for signaling.

Steps to execute:

1- Create the PPP interface and associate the serial interface to it. In turn create a PPP profile with multilink and fragmentation enabled as well as assign the PPP interface and the LAN IP addresses.

2- Create an access list to classify the VoIP traffic. As it's necessary to prioritize by port and protocol, you must use an extended access list.

3- Create another access list to classify signaling traffic. As it's necessary to prioritize by port and protocol, you must use an extended access list.

4- Enable BRS at the PPP interface layer, in this case ppp1.

5- Create a VoIP class with real-time priority so that it is not encapsulated in MP and has complete priority over the rest of the fragmented traffic. As this is the only class with real-time priority, 100% of the bandwidth is assigned to those classes with the said priority.

6- Create a class to represent signaling traffic. This will be known as signal with a guaranteed bandwidth of 50% so that calls can always be carried out.

7- Associate the access list created in point 2 with the voip class.

8- Associate the access list created in point 3 with the signal class.

9- Save and restart.

```
; Showing System Configuration ...
; Router ATLAS 2 8 Version 10.0.4

no configuration
add device ppp 1
set data-link sync serial0/0
set data-link x25 serial0/1
set data-link x25 serial0/2
global-profiles ppp
; -- PPP Profiles Configuration --
   facilities 1 default
   facilities 1 multilink
;
   multilink 1 default
   multilink 1 fragmentation 256
;
   ppp 1 default
   ppp 1 facilities-profile 1
   ppp 1 multilink-profile 1
;
exit
;
network ppp1
; -- Generic PPP User Configuration –
   ppp
; -- PPP Configuration --
      profile 1
   exit
;
   base-interface
; -- Base Interface Configuration –
```

```
      base-interface serial0/0 link
;
   exit
;
exit
;
feature access-lists
; -- Access Lists user configuration --
   access-list 100
;
      entry 1 default
      entry 1 permit
      entry 1 source port-range 20000 20025
      entry 1 protocol-range 17 17
;
      entry 2 default
      entry 2 permit
      entry 2 destination port-range 20000 20025
      entry 2 protocol-range 17 17
;
   exit
;
   access-list 101
;
      entry 1 default
      entry 1 permit
      entry 1 source port-range 1720 1720
      entry 1 protocol-range 6 6
;
      entry 2 default
      entry 2 permit
      entry 2 destination port-range 1720 1720
      entry 2 protocol-range 6 6
;
   exit
;
exit
;
;
protocol ip
; -- Internet protocol user configuration --
   address  ethernet0/0     172.24.78.131    255.255.0.0
   address  ppp1            1.1.1.1          255.255.255.0
;
;
   route 0.0.0.0         0.0.0.0         ppp1            1
;
;
;
exit
;
feature bandwidth-reservation
; -- Bandwidth Reservation user configuration --
   network ppp1
;
      enable
      class local 10
;
      class default 40
;
      class voip 100 real-time
      class voip rate-limit 40
;
      access-list 100 voip
      access-list 101 voip
;
   exit
;
exit
;
; --- end ---
```