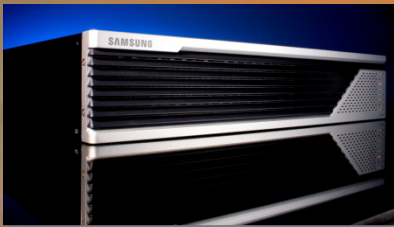


QoS Functions & Practice





● Supported Features

● Classification

- Class Based Classification
- Hierarchical Classification

● Monitoring

● Queueing

- Class Based Queueing with Priority
- Remaining Bandwidth Usage

● Policing

- Class Based Policing
- DSCP Marking

● Marking

- Header Field Marking

● Auto-QoS

● Fast Forwarding

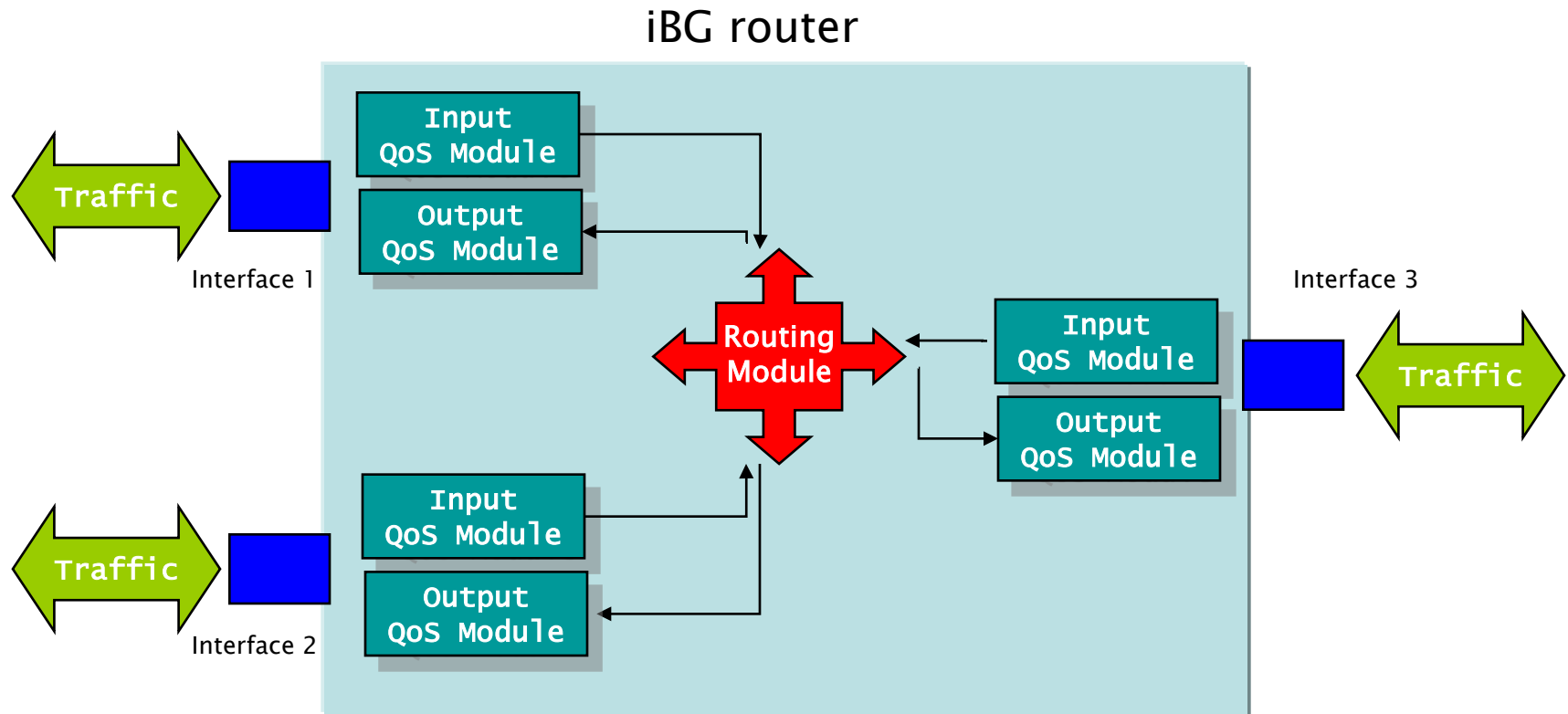
- Policy Based Routing (PBR)
 - Inbound PBR
 - Local PBR

How QoS Works?

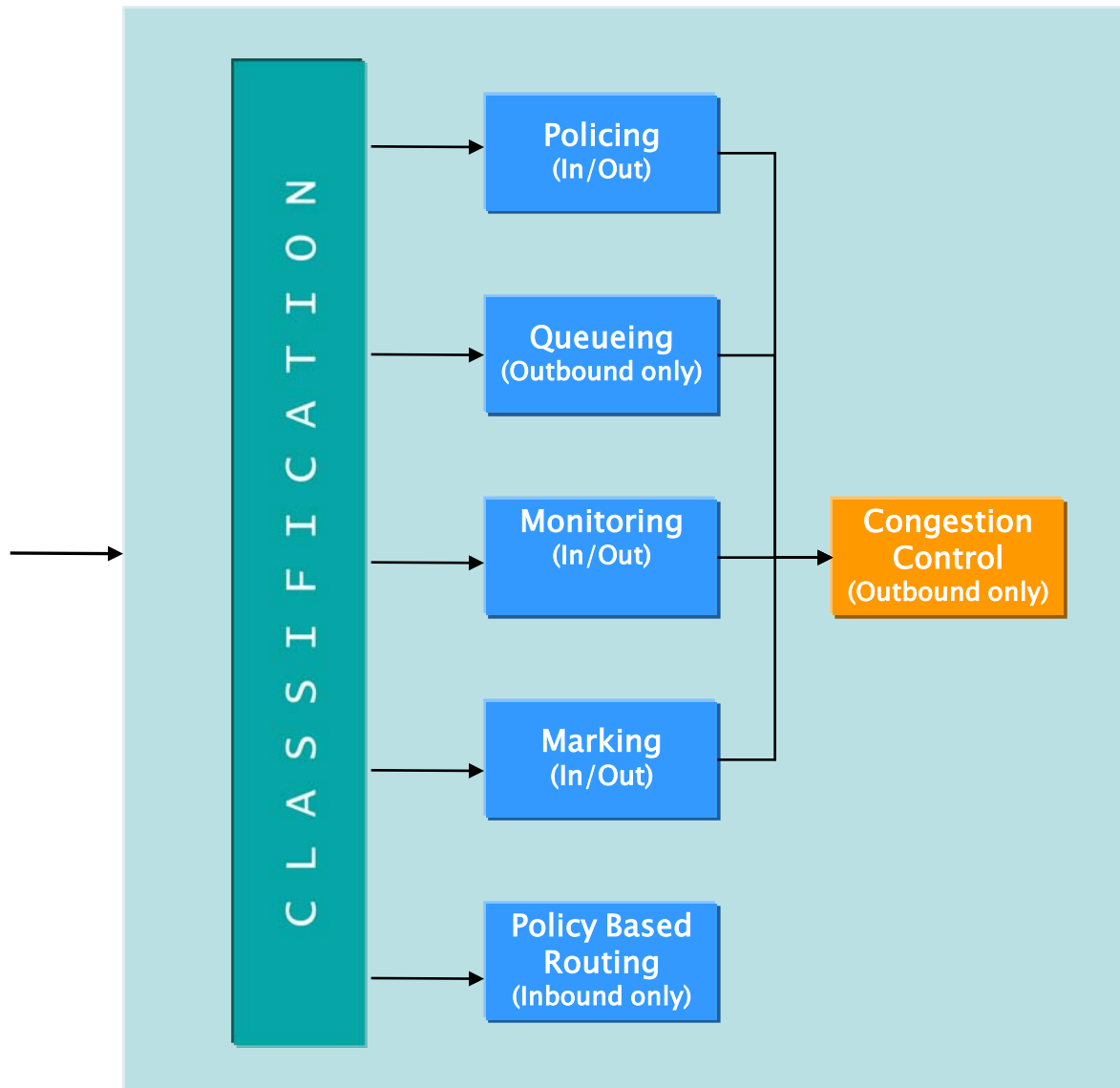


● Two QoS Modules for each interface

- Input and Output QoS Modules

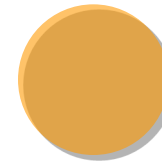
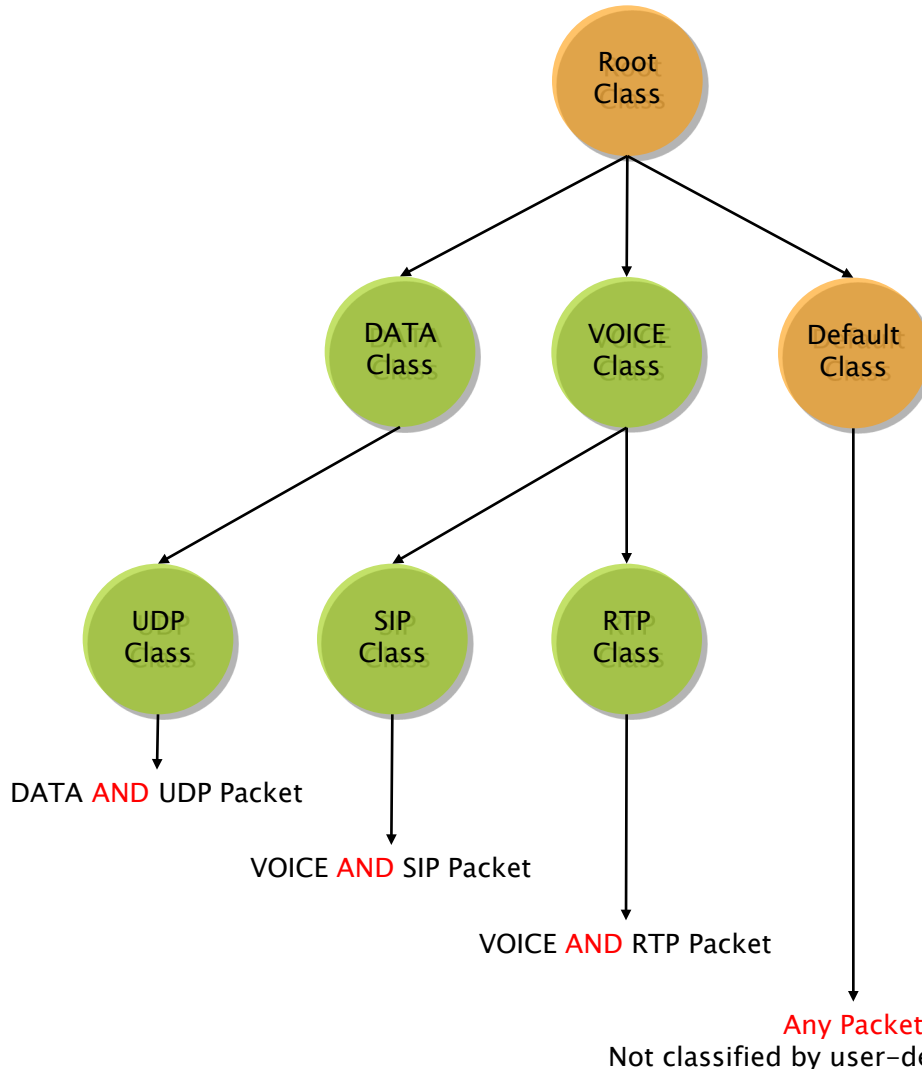


Inside QoS Module



Hierarchical Classification

All the siblings should use the same classification type.



System Class:

Classes created by System during QoS initialization on each interface. Cannot be modified.



User-defined Class:

Classes created by User on each interface.

Class Name	Classification Type	Match Value
root-out	Dest-IP Addr.	-

DATA	Dest-Port Num.	55.1.1.0/24
VOICE	Dest-Port Num.	66.1.1.0/24
outbound-default	-	default

UDP	-	1020
SIP	-	5060
RTP	-	3050



● Access-list Classification Type

```
access-list ip acl1
  add permit ip any 55.1.1.0/24
  exit ip
access-list ip acl2
  add permit ip any 66.1.1.0/24
  exit ip
access-list ip acl3
  add permit ip any any dport=1020
  exit ip
access-list ip acl4
  add permit ip any any dport=5060
  exit ip
access-list ip acl5
  add permit ip any any dport=3050
  exit ip
```

qos

```
add-policy-class DATA root-out
add-policy-class VOICE root-out
add-policy-class Default root-out
add-policy-class UDP DATA
add-policy-class SIP VOICE
add-policy-class RTP VOICE
policy-class DATA
  match-access-list acl1
  exit policy-class
policy-class VOICE
  match-access-list acl2
  exit policy-class
policy-class UDP
  match-access-list acl3
  exit policy-class
policy-class SIP
  match-access-list acl4
  exit policy-class
policy-class RTP
  match-access-list acl5
  exit policy-class
exit qos
```


The Samsung Digital logo is positioned in the upper right corner. It features the text "SAMSUNG DIGITAL" in a bold, sans-serif font, with "everyone's invited™" in a smaller font below it. To the right of the text is a circular graphic of a globe showing the Americas. The background of the slide is a deep blue with a pattern of white binary code (0s and 1s) and faint, curved lines suggesting a digital or network theme.

- 🟡 **Classification and counting**
- 🟡 **Can be used for input and output QoS**

Monitoring – Configuration Example



qos

```
add-policy-class DATA root-out
add-policy-class VOICE root-out
add-policy-class Default root-out
add-policy-class UDP DATA
add-policy-class SIP VOICE
add-policy-class RTP VOICE
policy-class DATA
  match-dest-ip 55.1.1.0 255.255.255.0
  exit policy-class
policy-class VOICE
  match-dest-ip 66.1.1.0 255.255.255.0
  exit policy-class
policy-class UDP
  match-dest-port 1020
  exit policy-class
policy-class SIP
  match-dest-port 5060
  exit policy-class
policy-class RTP
  match-dest-port 3050
  exit policy-class
exit qos
```

Classification Type:

- match-dest-ip / src-ip / dest-ipv6 / src-ipv6
- match-dest-port / src-port
- match-dscp / precedence / tos (IP header field)
- match-packet-class (L2 header field)
- match-protocol (IP header field)
- match-traffic-class (IPv6 header field)
- match-user-priority (802.1p header field)
- match-vlan-id
- match-access-list

Ethernet

```
Interface ethernet 0/1
ip address 77.1.1.1 255.255.255.0
qos
...
enable mon outbound
exit qos
exit ethernet
```

Frame-Relay

```
Interface bundle wan1
link t1 0/1
encapsulation fr
fr
  pvc 100
  ip address 77.1.1.1 255.255.255.0
  qos
  ...
  exit qos
exit pvc
exit fr
qos
enable mon outbound
exit qos
exit bundle
```

PPP

```
Interface bundle wan1
link t1 0/1
encapsulation ppp
ip address 77.1.1.1 255.255.255.0
qos
...
enable mon outbound
exit qos
exit bundle
```


Monitoring – Verify

Ethernet

```
Ubgate# show qos ethernet <slot/port>
```

PPP

```
Ubgate# show qos bundle <bundle name>
```

Frame-Relay

```
Ubgate# show qos bundle <bundle name> pvc <pvc num>
```

QoS State: Manual (QoS classes configured)

QoS Status: Enabled

Interface Outbound Configuration & Statistics

CBQ: off Policing: off **MON: on**

CBQ-CR (kbps)	CBQ-PR (kbps)	Police CIR PIR (kbps) (kbps)		Avg Out (kbps)	Avg In (kbps)	Packets (Fwded)	Packets (Dropped)	Traffic Class ID.<name>(<pID>)
0	0	-	-	0	0	24	0	3.Default(*)
0	0	-	-	0	0	0	0	2.VOICE(*)
0	0	-	-	0	0	0	0	6.RTP(2)
0	0	-	-	0	0	0	0	5.SIP(2)
0	0	-	-	0	0	145	0	1.DATA(*)
0	0	-	-	0	0	0	0	4.UDP(1)
0	0	-	-	0	0	0	0	0.outbound-default(*)

Interface Inbound Configuration & Statistics

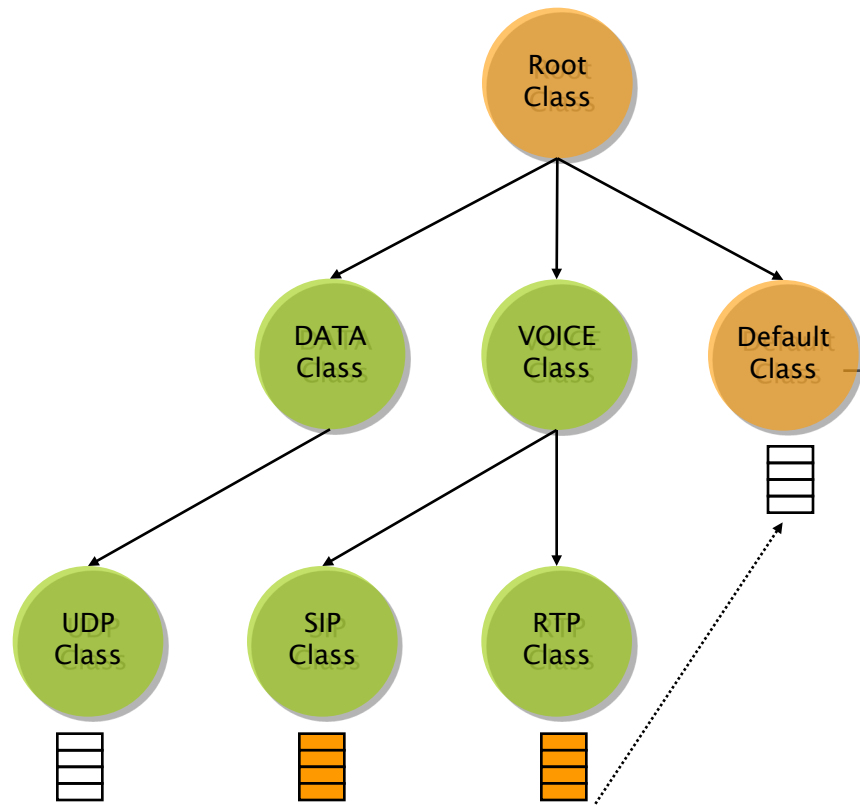
Policing: off MON: off PBR: off

Ubgate#

Queueing - Class Based Queueing



Bandwidth guarantee and priority



High Priority Queue – served first



Low Priority Queue

Priority Value: 1(Highest) ~ 8(Lowest, default)

Default Class (outbound-default)

Created automatically.

2 kbps or 1% of physical bandwidth is reserved for this class when CBQ is activated on an interface.

Class Name	Committed Rate (Minimum guaranteed bandwidth)	Peak Rate (Maximum policing rate)	Priority
root-out	1536 kbps	1536 kbps	–
DATA	300 kbps	1536 kbps	–
VOICE	100 kbps	1536 kbps	–
outbound-default	2 kbps	1536 kbps	8
UDP	300 kbps	300 kbps	8
SIP	30 kbps	1536 kbps	1
RTP	70 kbps	1536 kbps	1

Only leaf class has queue

Queueing – Remaining Bandwidth Usage



● Distribution of bandwidth remaining after 'cr' is guaranteed

● If rb-percent is not configured

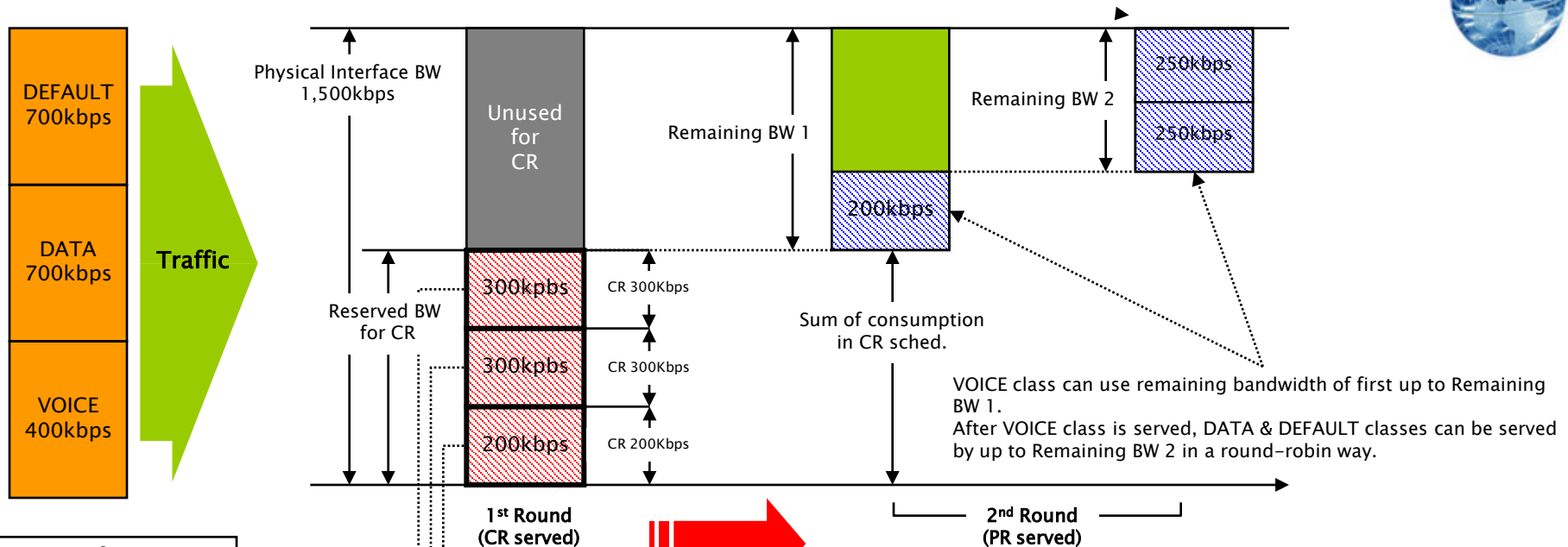
- Class can use up to "pr".
- Round-robin scheduling within classes with the same priority
- Use "pr" or "pr-percent" keyword
- Default "pr" is physical bandwidth

● If rb-percent is configured

- Each class can use remaining bandwidth of up to value proportional to rb-percent assigned among classes with the same priority or up to pr, whichever is smaller.

- cr	: committed rate
- pr	: peak rate
- rb-percent	: remaining bandwidth percent

If rb-percent is not configured,



QoS Configurations

VOICE class

- CR: 200kbps
- PR: 1500kbps
- **Priority: 1**

DATA class

- CR: 300kbps
- PR: 1500kbps
- **Priority: 2**

DEFAULT class

- CR: 300kbps
- PR: 1500kbps
- **Priority: 2**

DEFAULT class

DATA class

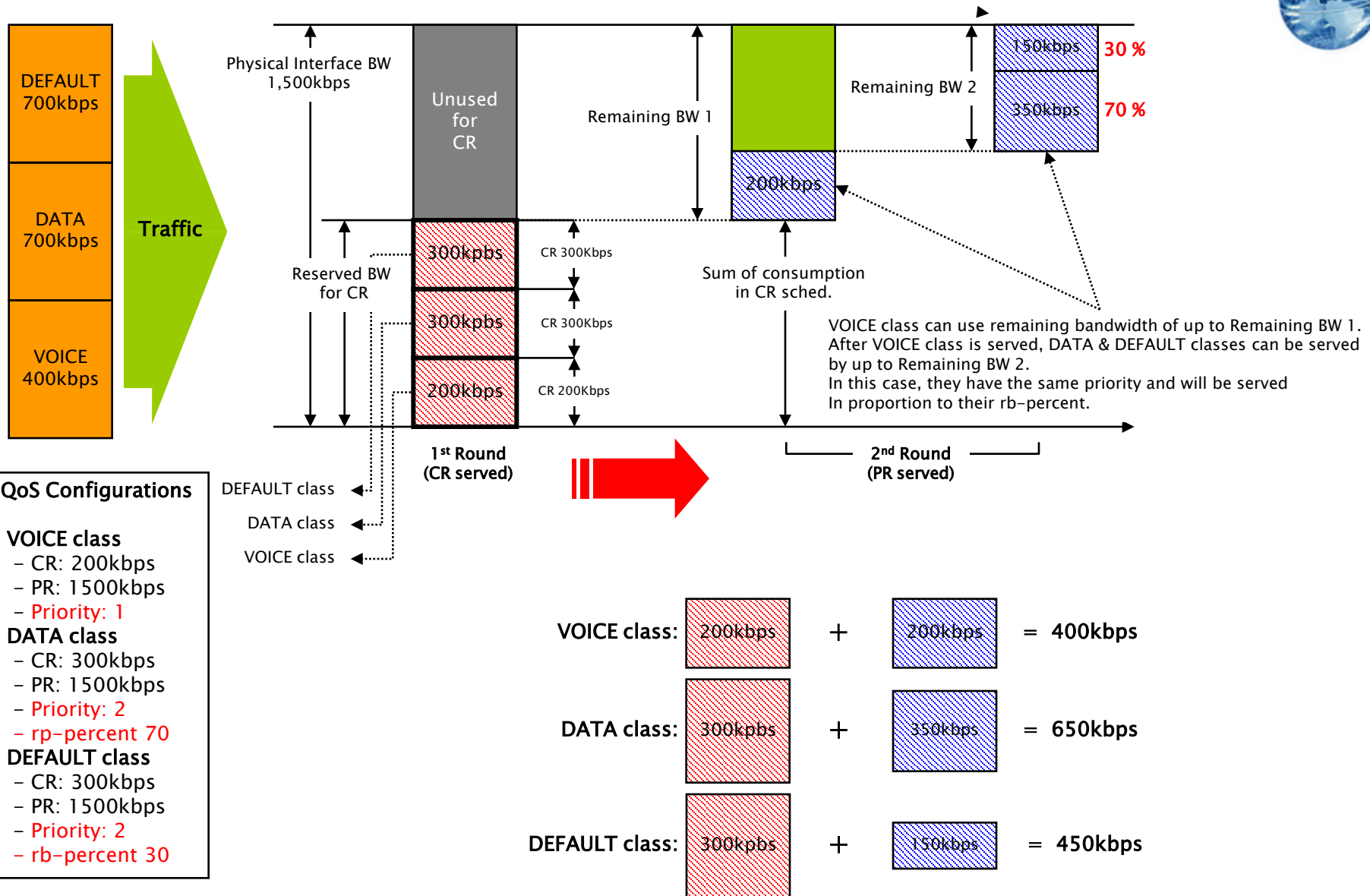
VOICE class

$$\text{VOICE class: } 200\text{kbps} + 200\text{kbps} = 400\text{kbps}$$

$$\text{DATA class: } 300\text{kbps} + 250\text{kbps} = 550\text{kbps}$$

$$\text{DATA class: } 300\text{kbps} + 250\text{kbps} = 550\text{kbps}$$

If rb-percent is configure,



CBQ – Configuration Example



qos

```
add-policy-class DATA root-out
add-policy-class VOICE root-out
add-policy-class Default root-out
add-policy-class UDP DATA
add-policy-class SIP VOICE
add-policy-class RTP VOICE
policy-class DATA
  cbq cr 300 pr 1536
  match-dest-ip 55.1.1.0 255.255.255.0
  exit policy-class
policy-class VOICE
  cbq cr 100 pr 1536
  match-dest-ip 66.1.1.0 255.255.255.0
  exit policy-class
policy-class UDP
  cbq cr 300 pr 300 rb-percent 70
  match-dest-port 1020
  exit policy-class
policy-class SIP
  cbq cr 30 pr 1536 priority 1
  match-dest-port 5060
  exit policy-class
policy-class RTP
  cbq cr 70 pr 1536 priority 1
  match-dest-port 3050
  exit policy-class
exit qos
```

outbound-default class:

- class is hidden.
- rb-percent value: 100 % - (sum of rb-percent among lowest priority(8) classes)

Ethernet

```
Interface ethernet 0/1
ip address 77.1.1.1 255.255.255.0
qos
...
enable cbq outbound
exit qos
exit ethernet
```

Frame-Relay

```
Interface bundle wan1
link t1 0/1
encapsulation fr
fr
  pvc 100
  ip address 77.1.1.1 255.255.255.0
  qos
  ...
  exit qos
  exit pvc
  exit fr
qos
enable cbq outbound
exit qos
exit bundle
```

PPP

```
Interface bundle wan1
link t1 0/1
encapsulation ppp
ip address 77.1.1.1 255.255.255.0
qos
...
enable cbq outbound
exit qos
exit bundle
```


CBQ – Verify



Ethernet

```
Ubgate# show qos ethernet <slot/port>
```

PPP

```
Ubgate# show qos bundle <bundle name>
```

Frame-Relay

```
Ubgate# show qos bundle <bundle name> pvc <pvc num>
```

Interface Outbound Configuration & Statistics

CBQ: on Policing: off MON: off

CBQ-CR (kbps)	CBQ-PR (kbps)	Police		Avg Out (kbps)	Avg In (kbps)	Packets (Fwded)	Packets (Dropped)	Traffic Class ID.<name>(<pID>)
		CIR (kbps)	PIR (kbps)					
1134	1536	-	-	0	0	0	0	3.Default(*)
100	1536	-	-	0	0	0	0	2.VOICE(*)
70	1536	-	-	0	0	0	0	6.RTP(2)
30	1536	-	-	0	0	0	0	5.SIP(2)
300	1536	-	-	0	0	0	0	1.DATA(*)
300	300	-	-	0	0	0	0	4.UDP(1)
2	1536	-	-	0	0	0	0	0.outbound-default(*)

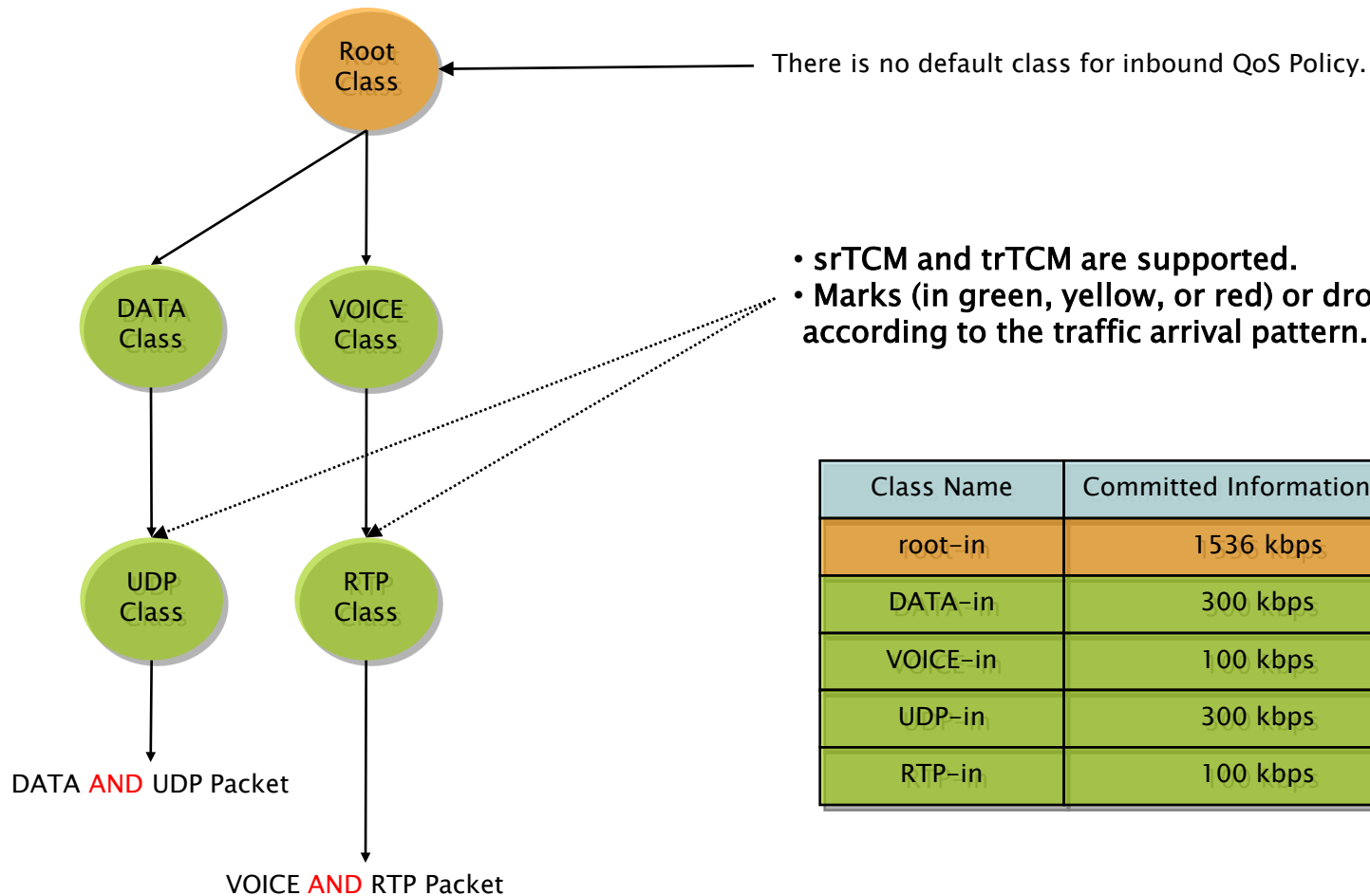
Interface Inbound Configuration & Statistics

Policing: off MON: off PBR: off

Ubgate#



- Can be applied to inbound and outbound
- Outbound policing cannot be configured with CBQ



Class Name	Committed Information Rate
root-in	1536 kbps
DATA-in	300 kbps
VOICE-in	100 kbps
UDP-in	300 kbps
RTP-in	100 kbps

Policing – Configuration Example



qos

```
add-policy-class DATA-in root-in
add-policy-class VOICE-in root-in
add-policy-class UDP-in DATA-in
add-policy-class RTP-in VOICE-in
policy-class DATA-in
  police
    srtcm 300 green-action permit yellow-action mark-dscp-43 red-action drop
  exit police
match-dest-ip 55.1.1.0 255.255.255.0
exit policy-class
policy-class VOICE-in
  police
    srtcm 100 green-action permit yellow-action mark-dscp-33 red-action drop
  exit police
match-dest-ip 66.1.1.0 255.255.255.0
exit policy-class
policy-class UDP-in
  police
    srtcm 300 green-action permit yellow-action mark-dscp-23 red-action drop
  exit police
match-dest-port 1020
exit policy-class
policy-class RTP-in
  police
    srtcm 100 green-action permit yellow-action mark-dscp-13 red-action drop
  exit police
match-dest-port 3050
exit policy-class
exit qos
```

Ethernet

```
Interface ethernet 0/1
ip address 77.1.1.1 255.255.255.0
qos
...
enable policing inbound
exit qos
exit ethernet
```

Frame-Relay

```
Interface bundle wan1
link t1 0/1
encapsulation fr
fr
  pvc 100
    ip address 77.1.1.1 255.255.255.0
    qos
    ...
    exit qos
  exit pvc
exit fr
qos
enable policing inbound
exit qos
exit bundle
```

PPP

```
Interface bundle wan1
link t1 0/1
encapsulation ppp
ip address 77.1.1.1 255.255.255.0
qos
...
enable policing inbound
exit qos
exit bundle
```


Policing – Verify



Ethernet

```
Ubigate# show qos ethernet <slot/port>
```

PPP

```
Ubigate# show qos bundle <bundle name>
```

Frame-Relay

```
Ubigate# show qos bundle <bundle name> pvc <pvc num>
```

Interface Inbound Configuration & Statistics

Policing: on MON: off PBR: off

CBQ-CR	CBQ-PR	Police		Avg Out	Avg In	Packets	Packets	Traffic Class
(kbps)	(kbps)	CIR	PIR	(kbps)	(kbps)	(Fwded)	(Dropped)	ID.<name>(<pID>)
-	-	100	-	0	0	0	0	4.UDP-in(2)
-	-	300	-	0	0	0	0	3.RTP-in(1)
-	-	100	-	0	0	0	0	2.DATA-in(*)
-	-	300	-	0	0	0	0	1.VOICE-in(*)

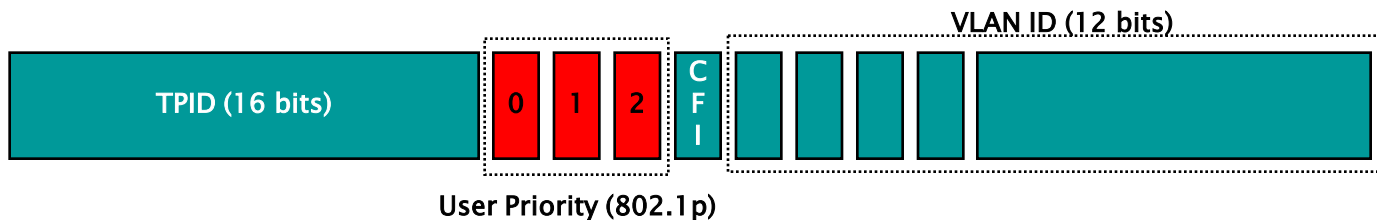
Ubigate#



● L2 / L3 Header Field Marking

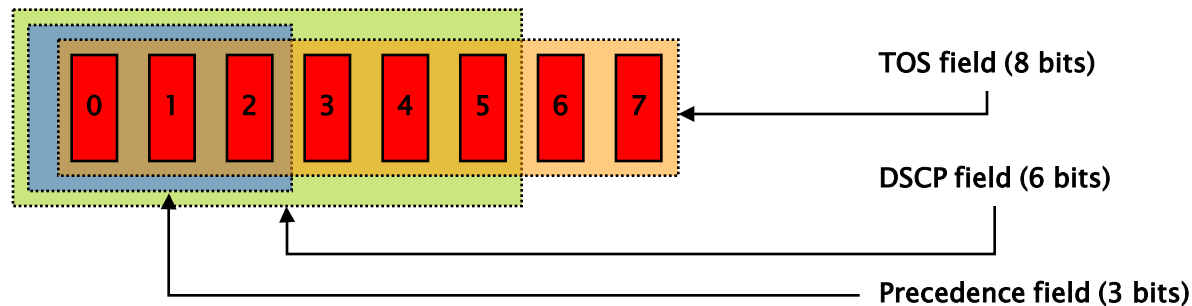
● IEEE 802.1q Header

- Marking User Priority (Priority Code Point, 802.1p, 3bit-field)



● IP Header Field Marking

- TOS field marking
 - Precedence (3 bits) marking
 - DSCP (6 bits) marking
 - TOS field (8 bits) marking



Marking – Configuration Example



qos

```
add-policy-class DATA root-out
add-policy-class VOICE root-out
policy-class DATA
  match-dest-ip 55.1.1.0 255.255.255.0
  mark-dscp 30
exit policy-class
policy-class VOICE
  match-dest-ip 55.1.1.0 255.255.255.0
  mark-tos 5
exit policy-class
```

exit qos

- mark-dscp
- mark-user-priority
- mark-precedence
- mark-tos

“mark-user-priority” for non-IP interface (Tagged VLAN)

```
Interface ethernet 0/1
switchport
bridge-group 1
qos
  policy-class DATA
    match-dest-ip 55.1.1.0 255.255.255.0
    mark-user-priority 3
  exit policy-class
exit qos
switchport mode trunk
switchport trunk allowed vlan add 100
exit ethernet
```

Ethernet

```
Interface ethernet 0/1
ip address 77.1.1.1 255.255.255.0
qos
...
enable mon outbound
exit qos
exit ethernet
```

Frame-Relay

```
Interface bundle wan1
link t1 0/1
encapsulation fr
fr
  pvc 100
    ip address 77.1.1.1 255.255.255.0
    qos
    ...
    exit qos
  exit pvc
exit fr
qos
enable mon outbound
exit qos
exit bundle
```

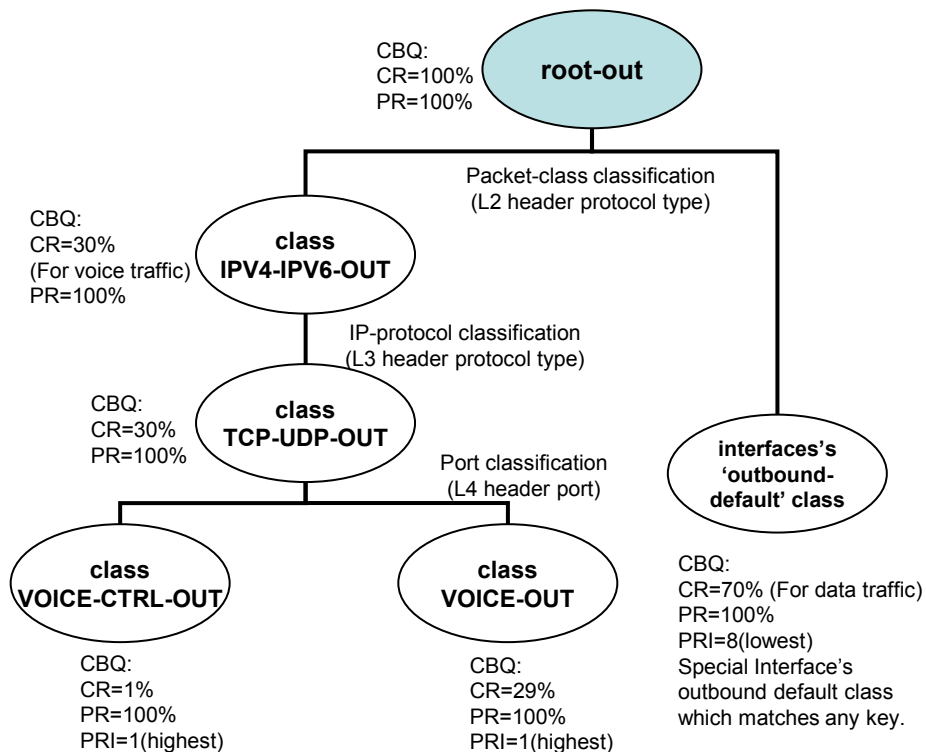
PPP

```
Interface bundle wan1
link t1 0/1
encapsulation ppp
ip address 77.1.1.1 255.255.255.0
qos
...
enable mon outbound
exit qos
exit bundle
```

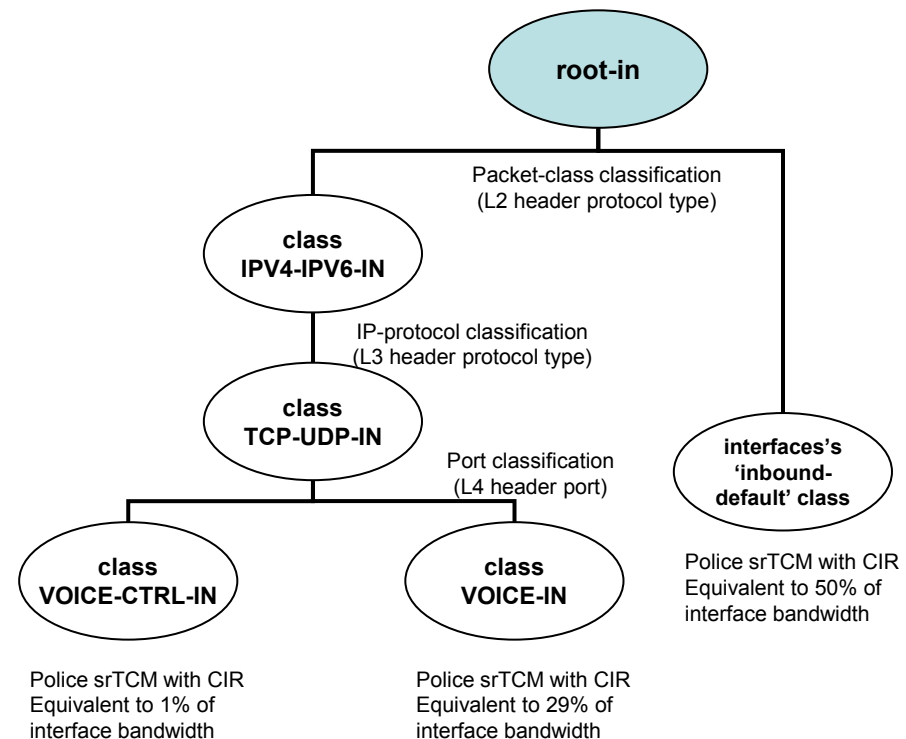



Support for both LAN & WAN Interfaces

- Defines outbound CBQ for WAN Interfaces
- Defines inbound policing for LAN Interfaces



Auto-QoS for WAN interface



Auto-QoS for Ethernet interface

● Interface Auto QoS

- Auto QoS is applied to a specific interface.

```
Ubigate/configure/interface/bundle wan1/qos# auto-qos
```

```
Ubigate/configure/interface/ethernet (0/1)/qos# auto-qos
```

● Global Auto QoS

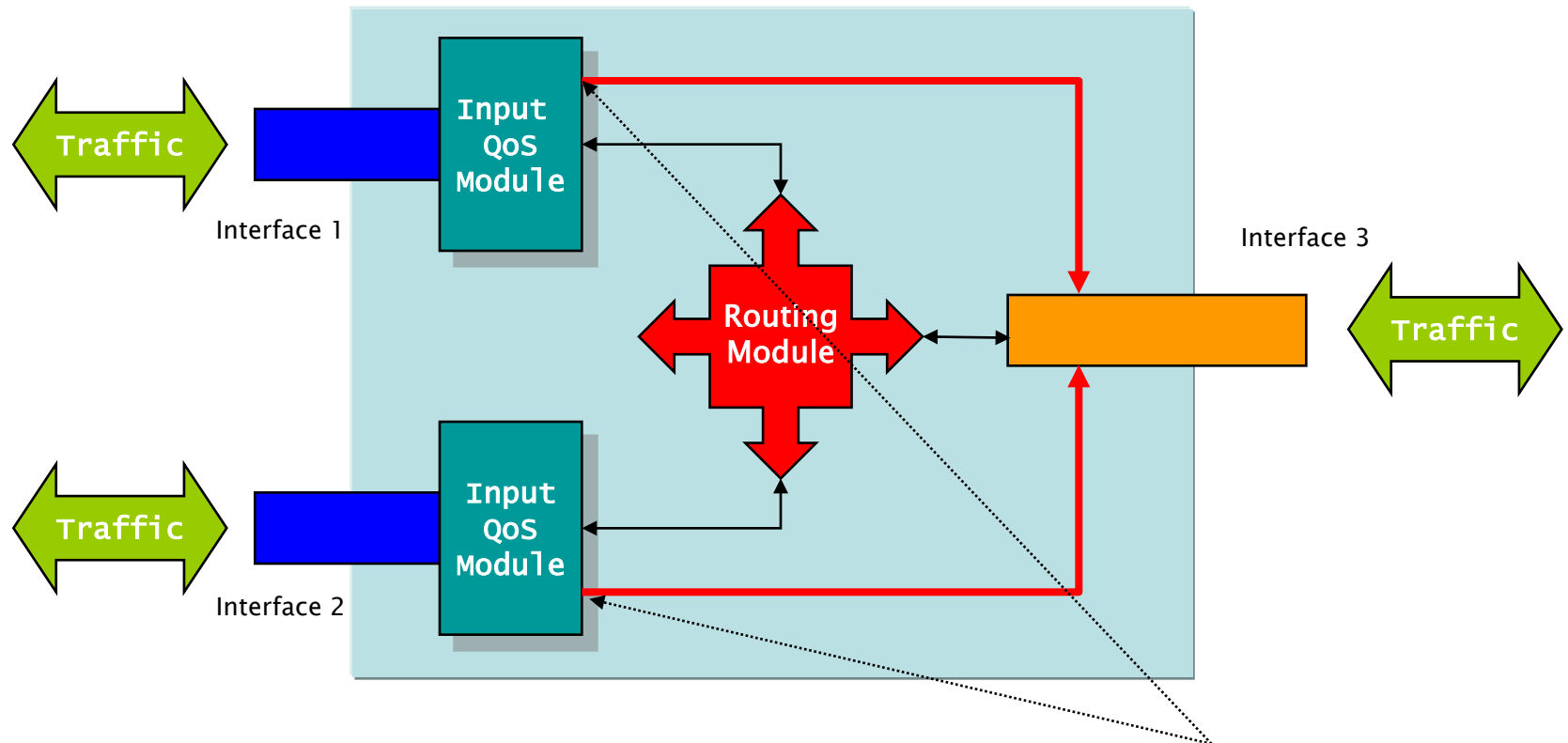
- Auto QoS is applied to all eligible interfaces.

```
Ubigate/configure/qos# auto-qos
```


Policy Based Routing – PBR



- Routes packets using a policy instead of routing protocol
- Input QoS Policy only



Forward packets to destination interface directly

PBR – Configuration Example



```
qos
add-policy-class DATA root-out
add-policy-class VOICE root-out
policy-class DATA
  match-dest-ip 55.1.1.0 255.255.255.0
  pbr-redirect interface_name wan1
exit policy-class
policy-class VOICE
  match-dest-ip 66.1.1.0 255.255.255.0
  pbr-redirect nexthop 66.1.1.2
exit policy-class
exit qos
```

- pbr-redirect interface_name <local WAN interface name>
- pbr-redirect nexthop <gateway IP address>

Ethernet

```
Interface ethernet 0/1
ip address 77.1.1.1 255.255.255.0
qos
...
enable pbr inbound
exit qos
exit ethernet
```

Frame-Relay

```
Interface bundle wan1
link t1 0/1
encapsulation fr
fr
  pvc 100
  ip address 77.1.1.1 255.255.255.0
  qos
  ...
  exit qos
exit pvc
exit fr
qos
enable pbr inbound
exit qos
exit bundle
```

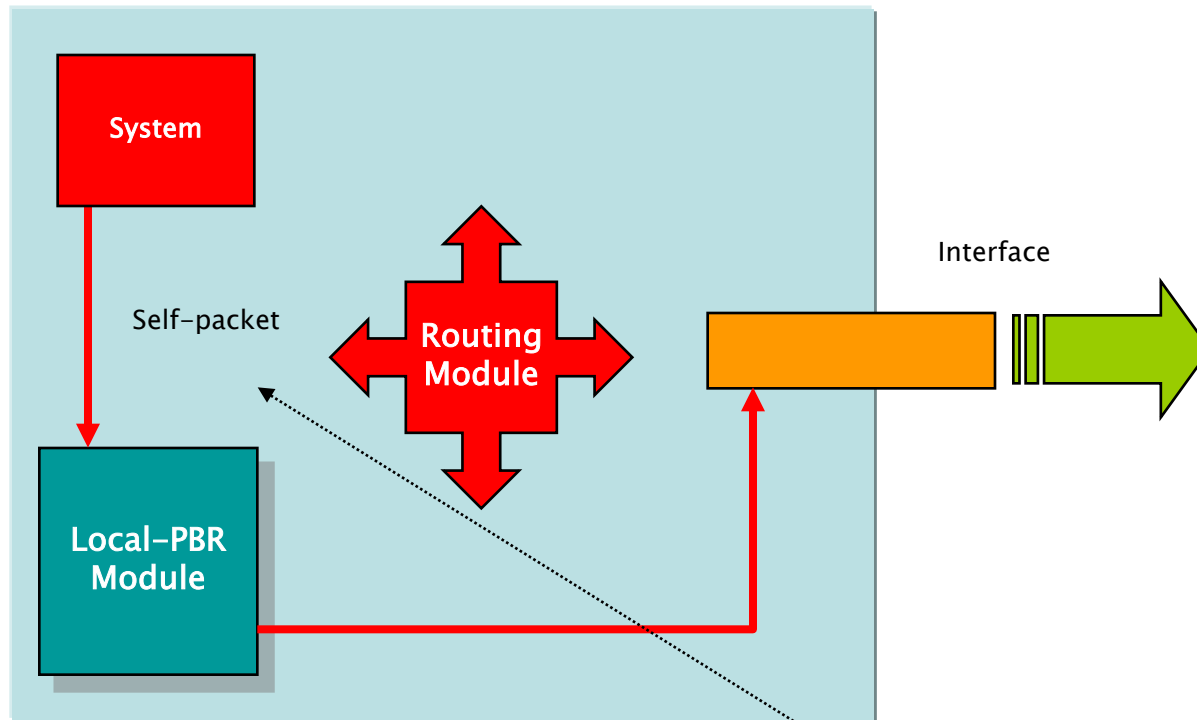
PPP

```
Interface bundle wan1
link t1 0/1
encapsulation ppp
ip address 77.1.1.1 255.255.255.0
qos
...
enable pbr inbound
exit qos
exit bundle
```




● Apply PBR for locally-generated packets

- telnet, ftp, rtp, call signaling packets generated by the system



Forward locally-generated packets to destination interface directly

Local PBR – Configuration Example



```
Ubigate/configure# qos local-pbr
```

```
qos
local-pbr
  add-policy-class DATA root-in
  add-policy-class VOICE root-in
  policy-class DATA
    match-dest-ip 55.1.1.0 255.255.255.0
    pbr-redirect interface_name wan1
  exit policy-class
enable-local-pbr
exit local-pbr
exit qos
```

- pbr-redirect interface_name <local WAN interface name>
- pbr-redirect nexthop <gateway IP address>

```
Ubigate# show qos local-pbr
```

```
Local-PBR Status           : Enabled
The Number of Classes      : 1

Counters of Local Stack    :
                             Bytes Rx: 0
                             Packets Rx: 0

Counters of Re-direction   :
                             Bytes Tx: 0
                             Packets Tx: 0

Class "DATA" -----+
| Match-rule:           Destination IPv4 |
| PBR-Redirect:         Interface(wan1) |
| Pkt Matched:           0 |
| Pkt Re-directed:       0 |
| Pkt By-passed:         0 |
+-----+
```


QoS on non-IP interface



● QoS can be configured on non-IP interface

● LAN switchport

```
Interface ethernet 0/1
switchport
bridge-group 1
qos
...
exit qos
exit ethernet
```

● Bridged WAN interface (WAN bridging)

```
Interface bundle wan1
link t1 0/1
encapsulation ppp
bcp
bridge vlan
exit bcp
qos
...
exit qos
switchport
bridge-group 1
switchport mode trunk
switchport trunk allowed vlan add 100
exit bundle
```


Thank you!

