

Application notes



version 1.0 4/12/2018 fw 1.8.x.0

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Introduction

Quality of Service (QoS) is an advanced feature that allows the user to prioritize certain types of traffic stream over the radio interface. Used to manage transmission of different traffic streams.

The QoS function is only available in Router mode.

Please see more details in *RipEX Manual*¹.

¹ http://www.racom.eu/eng/products/m/ripex/h-menu.html#qos

1. Configuration Examples

This application note describes three typical Use Cases of QoS implemented in RipEX.

- Prioritization of Serial (COM) SCADA traffic
- Prioritization of TCP application
- Prioritization of Fast Remote Access

1.1. Serial (COM) SCADA Traffic Prioritization



Fig. 1.1: Serial (COM) SCADA traffic prioritization diagram

Typical serial SCADA application is Master-Slave communication, i.e. there is only ever one application related packet on the Radio channel at a time. For such an application, no QoS is required. But collisions and lost packets might appear once we utilize other traffic simultaneously with this SCADA traffic, such as SNMP monitoring, frequent watched values, NTP data or remote radio re-configuration. Because this other traffic is not crucial (mission-critical) compared to serial communication and must not influence/limit serial traffic. QoS can be configured to prioritize (for example) serial traffic over other traffic so that this mission-critical application can run smoothly all the time.

In the first example, the central SCADA is connected via Ethernet to RipEX-Base unit. The SCADA Center utilizes Modbus TCP, but the remote RTUs are connected via RS232 (COM1) port and are configured as Modbus RTU slaves. RipEX itself enables free Modbus TCP to/from Modbus RTU conversion.

The routing is not required, Base driven protocol (BDP) is configured and all communication is configured in the Settings menu. Remote units can have default Ethernet IP address/mask.

Modbus TCP is handled in RipEX-Base and transferred as UDP to remote units. The source port on the Radio channel is UDP/8902 and the destination is UDP port 8881. The direction from remotes to RipEX-Base just switches the ports. QoS is configured accordingly. See the details in the following configuration steps.

1.1.1. RipEX-Base Configuration

Status	Values from: RipEX-Ba	ase					Fast remote	access	?
Wizards									
Settings	Device								?
Routing	Unit name RipEX-	Base	Time	NTP	Alarm management	Default	Neighbours&Statistics	Default	
Routing	Operating mode Route	r 💌	SNMP	Off	Power management	Always On	Graphs	Default	
Nomadic mode	Hot Standby Off		Firewall & NAT	Off	WiFi	On	Management	Default	
VPN	Radio		?	ETH	?	сом			?
IPsec							COM 1	COM 2	
	 Radio protocol 	Base drive	n	IP	192.168.254.1	Туре	RS232 💌	RS232	-
GRE	Station type	Base		Mask	255.255.255.0	Baud rate [b	ps] 19200 💌	19200	-
Diagnostic	IP	10.10.10.25	54	DHCP	Off	Data bits	8 💌	8	-
Neighbours	Mask	255.255.25	5.0	Shaping	Off	Parity	None 💌	None	-
	 TX frequency 	444.400.00	0	Speed	Auto	Stop bits	1 🔻	1	•
Statistic	 RX frequency 	444.400.00	0	Modbus TCP	On	ldle [bytes]	5	5	
Graphs	 Channel spacing [kHz] 	25.0	v	Terminal servers	Off	MRU [bytes]	1600	1600	
Pina	Modulation rate [kbps]	83.33 16D	EQAM	TCP proxy	Off	Flow control	None 💌	None	-
	RF power [W]	0.5	Ŧ	ARP proxy & VLAN	Off	Protocol	None	None	
Monitoring	 Optimization 	Off	Ŧ						
Maintenance	Encryption	Off							
	QoS	On							
	 MTU [bytes] 	1500							

Fig. 1.2: RipEX-Base Settings

Parameters:

Unit name	RipEX-Base
Operating mode	Router
Radio protocol	Base driven
Station type	Base
Radio IP/Mask	10.10.10.254/255.255.255.0
QoS	On
ETH IP/Mask	192.168.254.1/255.255.255.0
Modbus TCP	On

The network is configured using Base driven Radio protocol. Set the Unit name, select the Router mode and configure correct IP addresses.

Open the Radio protocol menu and configure the protocol details.

Radio protocol	Base driven										
Station type	Base 🔻										
Mode	CE 💌										
Modulation type	QAM 👻										
Modulation rate [kbps]	83.33 16DEQ/ 💌										
FEC	Off 💌										
FEC Remotes	Off •		ACK	Potrios	CTS	Connection	Rep	eater Protocol	Note	Activo	
FEC Remotes Protocol addresses	Modulation rate	FEC	ACK	Retries	CTS retries	Connection	Rep	eater Protocol addr.	Note	Active	▼ Delete
FEC Remotes Protocol addresses	Off • • • • • • • • • • • • • • • • • •	FEC Off	ACK	Retries	CTS retries 3	Connection Direct	Rep	eater Protocol addr.	Note	Active	▼ <u>Delete</u>
FEC Remotes Protocol addresses	Off Modulation rate 83.33 16DEQ4 83.33 16DEQ4 83.33 16DEQ4	FEC Off Off	ACK	Retries 3 3	CTS retries 3 3	Connection Direct Direct & Repea	Rep	eater Protocol addr.	Note	Active	▼ <u>Delete</u> ▲ ▼ <u>Delete</u>
FEC Remotes Protocol addresses	Off • • • • • • • • • • • • • • • • • •	FEC Off Off Off Off	ACK V V	Retries 3 3 3 3	CTS retries 3 3 3	Connection Direct Direct & Repea Direct Behind Repeat	Rep	eater Protocol addr.	Note	Active	▼ <u>Delete</u> ▲ ▼ <u>Delete</u> ▲ ▼ <u>Delete</u> ▲ ▼ <u>Delete</u>
FEC Remotes Protocol addresses	Off Modulation rate 83.33 16DEQ.4	FEC Off Off Off Off Off	ACK V V	Retries 3 3 3 3 3 3 3 3 3	CTS retries 3 3 3	Connection Direct Direct & Repea Direct Behind Repeat Behind Repeat	Rep 2 2	eater Protocol addr.	Note	Active V V	▼ <u>Delete</u> ▲ ▼ <u>Delete</u> ▲ ▼ <u>Delete</u> ▲ ▼ <u>Delete</u> ▲ ▼ <u>Delete</u>

Fig. 1.3: RipEX-Base Radio protocol details

Configure any Mode, Modulation type and rate, but keep the Mode and type the same within the whole network.

NOTE:

The Modulation rates and other parameters can be different for remote units. Please see more details in the *Autospeed application note*.¹

Configure all 5 remote RipEX units and focus on the "Connection" and "Repeater Protocol addr." columns.

- Protocol address 1 Direct connection
- Protocol address 2 Direct connection and configured as Repeater
- Protocol address 3 Direct connection
- Protocol address 4 Behind the Repeater #2
- Protocol address 5 Behind the Repeater #2

There is no need for any Routing rules. As stated earlier everything is controlled by the Base station by this Remotes' table and BDP functionality. The Routing menu is empty.

NOTE:

Please see more details in the BDP application note.²

Open the Ethernet option "Modbus TCP".

http://www.racom.eu/eng/products/m/ripex/app/aspeed/index.html

² http://www.racom.eu/eng/products/m/ripex/app/bdp/index.html

Modbus TCP	On 👻
My TCP Port	502
TCP Inactivity [s]	120
Broadcast	Off 👻
Address translation	Mask 👻
Base IP	10.10.10.0
Mask	255.255.255.0
UDP port (interface)	COM1 👻

Fig. 1.4: RipEX-Base Modbus TCP configuration

Turn on the Modbus TCP functionality. Keep the default TCP port 502 for local Ethernet connection over Ethernet. Based upon your configuration, turn on or off the Broadcast option.

The address translation can be "Mask" because all the remote RTU's are connected over COM1 and the Modbus RTU address equals to last Radio IP digit, e.g. RTU address 4 is connected to RipEX4 (Radio IP 10.10.10.4) via COM1 port.

Modbus TCP accepts the TCP connection from Modbus TCP SCADA Center (192.168.254.100) on port 502. The TCP connection is established only locally via Ethernet. Modbus TCP functionality in RipEX sends the Modbus TCP frames to remote units as UDP over the Radio channel. The Source port is internally set to UDP port 8902 and the destination port is the COM1's port, i.e. 8881. QoS will be configured appropriately.

Please see more details in the *Modbus TCP/RTU application note*.³

Open the Radio QoS Settings.

Quality	of Service											?
QoS Image: Constraint of the second												
		Source			Destination		DS fie	d	Assigned			
Prot.	IP	Mask	Port	IP	Mask	Port	Туре	Precedence	priority	Active	Note	
UDP			MBTCP (8902)			COM1 (8881)	Off		1 (Highest)	•		Delete Add
												Add

Fig. 1.5: RipEX-Base QoS

Turn on the QoS. Keep the Default priority to 8 (Lowest) and Queue size to 5 packets.

Add one QoS rule:

Protocol	UDP
Source port	MBTCP (8902)
Destination port	COM1 (8881)

³ http://www.racom.eu/eng/products/m/ripex/app/modbus/index.html

Assigned priority 1 (Highest)

As described above, the Protocol must be set to "UDP", the Source port to 8902 and the Destination port to 8881. Assign the highest priority (1) for this traffic.

The current configuration ensures all the packets matching the defined filters are inserted to the highest priority queue and dispatched first.

1.1.2. Remote RipEX Units Configurations

All remote RipEX units have the same configuration except:

- Unit name
- Radio IP address



Fig. 1.6: Remote RipEX Settings

Common parameters for all remote units (blue):

Operating mode	Router
Radio protocol	Base driven
Station type	Remote
Radio Mask	255.255.255.0 (default)
ETH IP/Mask	192.168.169.169 / 255.255.255.0 (default)
COM Protocol	Modbus

Unique parameters for particular RipEX unit (red):

Unit name RipEX2

Radio IP 10.10.10.2

The network is configured using Base driven Radio protocol. Set the Unit name, select the Router mode and configure correct IP addresses.

Open the Radio protocol menu and configure the protocol details.

Radio protocol	
 Radio protocol Station type 	Base driven 💌 Remote 💌
• Mode	CE
 Modulation type Protocol address mode 	QAM Y
Protocol address	2
Retries [No]	3

Fig. 1.7: Remote RipEX BDP Details

All remote units share completely the same BDP configuration.

Parameters:

Radio protocol	Base driven
Station type	Remote
Protocol address mode:	Automatic

The Protocol address is automatically set based on the last Radio IP digit.

Open the COM1 Protocol menu.

Protocol		
Protocol	Modbus	¥
Mode of Connected device	Slave	-
Broadcast accept	Off	-
Advanced parameters	-	

Fig. 1.8: Remote RipEX COM1 settings

Configure all remote RipEX units – select the Modbus protocol and the "Slave" mode.

Open the Radio QoS configuration.

Quality	of Service											?
QoS Default pri Queue siz Priority ass	ority e [pkts/queue] signment	On 💌 8 (Lowest) 💌 5										
		Source			Destination	n	DS f	ïeld	Assigned			
Prot.	IP	Mask	Port	IP	Mask	Port	Туре	Precedence	priority	Active	Note	
UDP			COM1 (8881)			MBTCP (8902)	Off		1 (Highest)	~		Delete Add
												Add

Fig. 1.9: Remote RipEX QoS

Turn on the QoS. Keep the Default priority to 8 (Lowest) and Queue size to 5 packets.

Add one QoS rule:

Protocol	UDP
Source port	COM1 (8881)
Destination port	MBTCP (8902)
Assigned priority	1 (Highest)

As described above, the Protocol must be set to "UDP", the Source port to 8881 and the Destination port to 8902. Assign the highest priority for this traffic.

The current configuration assures all the packets matching the defined filters are inserted to the highest priority queue and dispatched first.

No routing rules are required in this example.



1.2. TCP application Prioritization

Fig. 1.10: IEC104 TCP traffic prioritization diagram

TCP's typical behaviour is, simply stated, to use as much of the link capacity as possible. To control TCP's behaviour, RipEX can be configured in Base driven Protocol to handleTCP efficiently and control channel utilization. QoS can improve the behaviour in the case of more than one TCP application being used in a network (or any other such as SNMP, NTP, remote configuration, ...).

QoS can prioritize one or more traffic types over others. In our example, it is IEC104 traffic prioritization over other traffic. BDP controls TCP flows in a general way and QoS goes "deeper" and filters traffic according to given rules (particular ports, protocols, TOS fields, ...) so that a primary IEC104 application runs smoothly.

This example requires modification of configuration settings in RipEX units. We need to change the remote Ethernet subnets – the IEC104 remote devices are connected via Ethernet and the SCADA Center needs to reach a remote device IP address. Default Ethernet IP address cannot be used (see Note below). Various options are possible; this method requires "only" IP address changes and Routing configuration.

NOTE:

Remote IEC104 slave devices could be configured with the same (default) IP address, but NAT functionality would be required. Please see the *NAT application notes*⁴ for more details to find out whether it suits your requirements, or not.

⁴ http://www.racom.eu/eng/products/m/ripex/app/nat/index.html

1.2.1. RipEX-Base Configuration

Status	Values from: RipEX-B	ase					Fast remote	access	
Wizards									
Settings	Device								?
Routing	Unit name RipEX-	Base	Time	NTP	Alarm management	Default	Neighbours&Statistics	Default	
Routing	Operating mode Route	r •	SNMP	Off	Power management	Always On	Graphs	Default	
Nomadic mode	Hot Standby Off		Firewall & NAT	Ott	WiFi	On	Management	Default	
VPN	Radio		?	ETH	?	сом			?
IDsec							COM 1	COM 2	
	 Radio protocol 	Base drive	en	IP	192.168.254.1	Туре	RS232 🔻	RS232	-
GRE	Station type	Base		Mask	255.255.255.0	Baud rate [ops] 19200 👻	19200	-
Diagnostic	IP	10.10.10.2	254	DHCP	Off	Data bits	8	8	*
Neighboure	Mask	255.255.2	55.0	Shaping	Off	Parity	None 💌	None	-
Neighbours	 TX frequency 	444.400.0	00	Speed	Auto 🔻	Stop bits	1 💌	1	-
Statistic	RX frequency	444.400.0	00	Modbus TCP	Off	Idle [bytes]	5	5	
Graphs	Channel spacing [kHz]	25.0	•	Terminal servers	Off	MRU [bytes	1600	1600	
Ding	Modulation rate [kbps]	83.33 16	DEQAM	TCP proxy	Off	Flow contro	None 🔻	None	-
Ping	RF power [W]	0.5	Ŧ	ARP proxy & VLAN	Off	Protocol	None	None	
Monitoring	 Optimization 	Off	w						
Maintenance	 Encryption 	Off							
	QoS	On							
	MTU [bytes]	1500							

Fig. 1.11: RipEX-Base Settings

RipEX-Base configuration is almost the same as described in the previous Chapter 2.1 Serial (COM) SCADA Traffic Prioritization. The only difference is the QoS configuration.

NOTE:

You could, but do not have to turn off the Modbus TCP functionality.

Quality	of Service											?
QoS Default pri Queue siz Priority ass	ority 8 e [pkts/queue] 1 signment	Dn v 3 (Lowest) v 6										
		Source			Destinatio	n	DS f	field	Assigned			
Prot.	IP	Mask	Po	rt IP	Mask	Port	Туре	Precedence	priority	Active	Note	
тср			AI			Manual (2404)	Off		1 (Highest)	~		Delete Add
												Add

Fig. 1.12: RipEX-Base QoS settings

IEC104 uses the TCP port 2404 by default:

Protocol TCP

Source port All

Destination port Manual (2404)

Note that the Source port should be "All", because the IEC104 centre uses TCP port 2404 only as a Destination port, but the Source port is usually dynamically chosen.

The Queue size is increased to 16. A TCP mechanism usually requires higher queue size than UDP. Optimize the value for your particular application in an interval 2-31 - Values higher than 12 are recommended.

Status	Values from: RipEX-E	Base				Fa	ast remo	te access ?
Wizards								
Settings	Interfaces							?
Routing	Radio MAC ETH MAC	00:02:A9:BA:54:2B 00:02:A9:BA:50:43			Mask 255.255.255.0 Mask 255.255.255.0			
Nomadic mode	Routes							?
VPN	Destination	Mask	Mode	Gateway		Note	Active	Modify
	192.168.1.0/24	255.255.255.0	Static	10.10.10.1			~	Delete Add
IPsec	192.168.2.0/24	255.255.255.0	Static	10.10.10.2			v	▲ ▼ Delete Add
GRE	192.168.3.0/24	255.255.255.0	Static	10.10.10.3			~	▲ ▼ Delete Add
	192.168.4.0/24	255.255.255.0	Static	10.10.10.4			~	Delete Add
Diagnostic	192.168.5.0/24	255.255.255.0	Static	10.10.10.5			~	Delete Add
Neighbours	Default		Static	0.0.0.0				Add
Statistic	Backup							?
Graphs					Altern	ative paths		
· · ·	Name Peer IP	Hysteresis [s]	SNMP Notification	HW Alarm Output	Gateway	Policy Active	Note	Modify
Ping								Add

Fig. 1.13: RipEX-Base Routing

Add 5 routing rules, one rule for each remote RipEX.

- 192.168.1.0/24 via 10.10.10.1
- 192.168.2.0/24 via 10.10.10.2
- 192.168.3.0/24 via 10.10.10.3
- 192.168.4.0/24 via 10.10.10.4
- 192.168.5.0/24 via 10.10.10.5

NOTE:

The network utilizes BDP and thus, gateways are set to particular remote RipEX and not repeater IP (if it is behind that repeater). This knowledge/control is set in the BDP details (Settings menu).

1.2.2. Remote RipEX Units Configurations

Wizards Settings Routing Unit name RipEX2 Time NTP Alarm management Default Neighbours&Statistics Manual Routing Operating mode Router SNMP Off Power management Default Neighbours&Statistics Manual Nomadic mode VPN IPsec Radio protocol Base driven ETH ? COM COM 1 COM 20 IPsec Radio protocol Base driven Statistic P 192.168.2.1 P Mask 255.255.0 DHCP Off Data bits 8 9 9 9 9 9 9 9 9 9	Status	Values from: RipEX	X2					Remote IP 10.	10.10.	.2	Cor	nnect	Disc	onnect	
Settings Device Routing Unit name RipEX2 Time NTP Alarm management Default Neighbours&Statistics Manual Nomadic mode Operating mode Router SNMP Off Power management Always On Graphs Default Neighbours&Statistics Manual Nomadic mode VPN Radio Off Firewall & NAT Off WiFi On Management Default Default Neighbours GRE Station type Remote IP 192.168.2.1 Mask 255.255.255.0 DHCP Off Type R5232	Wizards														
Routing Unit name RipEX2 Time NTP Alarm management Default Neighbours&Statistics Manual Nomadic mode • Operating mode Router SNMP Off Power management Always On Graphs Default Neighbours&Statistics Manual Nomadic mode VPN IP Firewall & NAT Off WiFi On Management Default Neighbours& GRE Radio protocol Base driven IP 192.168.2.1 IP Rs232 Rs33 Rs3 Statistic None	Settings	Device													?
Routing Operating mode Router SNMP Off Power management Always On Graphs Default Nomadic mode VPN Off Firewall & NAT Off WiFi On Management Default IPsec Radio protocol Base driven ETH ? IP 192.168.2.1 Type RS232 RS33 RS3 <	Routing	Unit name Rip	ipEX2		Time		NTP	Alarm management	Defa	ault	Ne	ighbours&S	tatistics	Manual	
Nomadic mode Nome None Non	Routing	Operating mode Ro	outer	~	SNMP	11 & NAT	Off Off	Power management	Alw	ays On	Gr	aphs		Default Default	
VPN Radio ? ETH ? IPsec - Radio protocol Base driven IP 192.168.2.1 Type RS232 RS232 GRE Station type Remote Mask 255.255.255.0 DHCP Off Data bits 8<	Nomadic mode	not standby			TICWA		0.11				me	inagement		Doridan	
IPsec Radio protocol Base driven IP 192.168.2.1 Type RS232 RS232 GRE Station type Remote Mask 255.255.255.0 DHCP Off Data bits 8 8 Neighbours TX frequency 444.400.000 Speed Auto Stop bits 1 1 Statistic RX frequency 444.400.000 Speed Auto Stop bits 1 1 Graphs Channel spacing [kHz] 25.0 Terminal servers Off MRU [bytes] 1600 1600 1600 Monitoring Optimization Off ARP proxy & VLAN Off None None Maintenance Encryption Off Off None None None	VPN	Radio			?		ETH	?		сом					?
Instruction Radio protocol Base driven IP 192.168.2.1 Type RS232 RS232 GRE Station type Remote Mask 255.255.05 DHCP Off Data bits 8 8 Diagnostic IP 10.10.10.2 DHCP Off Data bits 8 8 Neighbours • TX frequency 444.400.000 Speed Auto Stop bits 1 1 Statistic • RX frequency 444.400.000 Modulus TCP Off Mole [bytes] 5 5 Graphs • Channel spacing [kHz] 25.0 • TCP proxy Off None None None Ping · Modulation type QAM CP proxy Off None None None Maintenance • Optimization Off ARP proxy & VLAN Off None None	IDsoc											COM 1		COM 2	
GRE Station type Remote Mask 255.255.0 Baud rate [pbs] 19200 19200 Diagnostic IP 10.10.10.2 DHCP Off Meighbours Mask 255.255.05 Shaping Off Neighbours TX frequency 444.400.000 Speed Auto Statistic RX frequency 444.400.000 Speed Auto Graphs Channel spacing [kHz] 25.0 Terminal servers Off Ping Modulation type QAM TCP proxy Off RF power [W] 0.5 ARP proxy & VLAN Off None Monitoring Optimization Off None Maintenance Encryption Off	11360	Radio protocol	E	Base drive	en		IP	192.168.2.1		Туре		RS232	-	RS232	
Diagnostic IP 10.10.10.2 DHCP Off Data bits 8 8 Neighbours Mask 255.255.05 Shaping Off Data bits 8 8 8 Neighbours TX frequency 444.400.000 Speed Auto Stop bits 1 1 Statistic RX frequency 444.400.000 Modulus TCP Off Molulus TCP Off Idle [bytes] 5 5 Graphs Channel spacing [kHz] 25.0 Terminal servers Off MRU [bytes] 1600 1600 1600 Ping RF power [W] 0.5 ARP proxy & VLAN Off None None None Monitoring Optimization Off ARP proxy & VLAN Off None None None Maintenance Encryption Off Off Off None None	GRE	Station type	F	Remote			Mask	255.255.255.0		Baud rate [t	ops]	19200	-	19200	
Neighbours Mask 255.255.255.0 Shaping Off Parity None None Statistic •TX frequency 444.400.000 Speed Auto Stop bits 1 1 Statistic •RX frequency 444.400.000 Modbus TCP Off Stop bits 1 1 Graphs •Channel spacing [kHz] 25.0 Terminal servers Off MRU [bytes] 1600 1600 Ping •Modulation type 0.4M TCP proxy Off None None None Monitoring •Optimization Off off Off None None None	Diagnostic	IP	1	10.10.10.2	2		DHCP	Off		Data bits		8	-	8	
Integration of the second o	Neighbours	Mask	2	255.255.25	55.0		Shaping	Off		Parity		None	-	None	
Statistic • RX frequency 444.400.000 Modbus TCP Off Graphs • Channel spacing [kHz] 25.0 Terminal servers Off Ping • Modulation type QAM TCP proxy Off RF power [W] 0.5 • ARP proxy & VLAN Off Monitoring • Optimization Off • None Maintenance • Encryption Off	Heighbours	 TX frequency 	g 4	444.400.00	00		Speed	Auto 💌		Stop bits		1	-	1	
Graphs • Channel spacing [kHz] 25.0 Terminal servers Off MRU [bytes] 1600 1600 Ping • Modulation type QAM TCP proxy Off Flow control None None Monitoring • Optimization Off • ARP proxy & VLAN Off Protocol None Maintenance • Encryption Off • • • • •	Statistic	RX frequency	^U 4	444.400.00	00		Modbus TCP	Off		Idle [bytes]		5		5	
Ping • Modulation type QAM TCP proxy Off RF power [W] 0.5 ARP proxy & VLAN Off Protocol None Monitoring • Optimization Off • Maintenance • Encryption Off •	Graphs	Channel spacing [kH.	lz]	25.0	-		Terminal servers	Off		MRU [bytes]		1600		1600	
Monitoring Optimization Off Maintenance Encryption Off	Ding	 Modulation type 	C	QAM			TCP proxy	Off		Flow contro	d -	None	-	None	
Monitoring Optimization Off Maintenance Encryption Off	- mg	RF power [W]	(0.5	-		ARP proxy & VLAN	011		Protocol	[None		None	
Maintenance Encryption Off	Monitoring	 Optimization 	(Off	-										
	Maintenance	Encryption	C	Off											
QoS IOn		QoS	0	On											

Fig. 1.14: Remote RipEX Configuration

In each remote, change the IP address following the rule:

• Radio IP address: 10.10.10.X -> Ethernet IP 192.168.X.1

For RipEX2, Ethernet IP address is 192.168.2.1.

NOTE:

You can disable the Modbus protocol on COM1.

Change the QoS configuration.

Quality	of Service											?
QoS Default pr Queue siz Priority as	riority ze [pkts/queue]	Dn 💌 B (Lowest) 💌 6										
		Source			Destination	I Contraction of the second	DS f	ield	Assigned			
Prot.	IP	Mask	Port	IP	Mask	Port	Туре	Precedence	priority	Active	Note	
тср			Manual (2404)			All	Off		1 (Highest)	~		Delete Add
												Add

Fig. 1.15: Remote RipEX QoS settings

Increase the Queue size to 16 (the same value as in the Base unit).

Configure one QoS rule:

Protocol TCP

Source port Manual (2404)

Destination port All

The ports are just swapped compared to Base unit.

1.3. Fast Remote Access (remote unit management) Prioritization

Fast Remote Access is a very helpful feature allowing remote units to be managed with minimum data being transmitted over the Radio channel. Only the effective data are transferred from remote RipEX over the Radio channel. The large amount of data needed to display full web interface is downloaded from the local unit which is usually connected via fast Ethernet interface.

A customer can have two different scenarios when controlling the unit management priority might be beneficial.

- 1.3.1. Ordinary network traffic must not be affected by unit management (i.e. Fast Remote Access). QoS protects user application traffic against unwanted effects of management traffic.
- 1.3.2. Remote unit management is important to work fluently under all circumstances. QoS is used to prioritize the management traffic, although it might even limit/disable running user application for a short period of time.

Applying QoS on management traffic might be useful especially in situations when a technical support package from a remote RipEX unit needs to be downloaded or a new firmware to a remote RipEX unit needs to be uploaded.

1.3.1. Fast Remote Access – The Lowest Priority

One approach is to change the default QoS priority and then configure a new QoS rule for Fast Remote Access traffic to lower its priority compared to other traffic.

Qualit	y of Service											?
QoS On Default priority 5 Queue size [pkts/queue] 16												
		Source			Destination	1	DS fie	eld	Assigned			
Prot.	IP	Mask	Port	IP	Mask	Port	Туре	Precedence	priority	Active	Note	
TCP			All			Manual (2404)	Off		1 (Highest)	~		Telete Add
UDP			All			rem.access (8889)	Off		8 (Lowest)	~		Delete Add
												Add

Fig. 1.16: RipEX-Base Fast Remote Access prioritization (Lowest)

Set the Default priority to 5. Any traffic going to the Radio channel which does not meet the QoS rules' filters, is handled with priority 5.

Create a new QoS rule:

Protocol	TCP
Source port	All
Destination port	rem.access (8889)
Assigned Priority	8 (Lowest)

Swap the Source and Destination ports in all remote RipEX units so that the opposite traffic is prioritized in remote RipEX as well. I.e. Source port = rem.access (8889), Destination port (All).

1.3.2. Fast Remote Access – The Highest Priority

Qualit	y of Service											?
QoS On Default priority 8 (Lowest) Queue size [pkts/queue] 16												
		Source			Destination	ı	DS f	ïeld	Assigned			
Prot.	IP	Mask	Port	IP	Mask	Port	Туре	Precedence	priority	Active	Note	
UDP			All			rem.access (8889)	Off		1 (Highest)	•		Telete Add
тср			All			Manual (2404)	Off		2	~		Delete Add

Fig. 1.17: RipEX-Base Fast Remote access prioritization (Highest)

The default priority can remain as the default value (8).

Add a new rule

and put it on the first line (to be evaluated first).

Protocol	TCP
Source port	All
Destination port	rem.access (8889)
Assigned Priority	1 (Highest)

Swap the Source and Destination ports in all remote RipEX units so that the opposite traffic is prioritized in remote RipEX as well. I.e. Source port = rem.access (8889), Destination port (All).

2. Functionality Verification and Troubleshooting

Monitoring does not display the QoS queues usage in its output. Neither does the Statistics menu show any information regarding any particular priority queue.

The only way to check the actual QoS functionality is via CLI.

NOTE:

CLI interface (Command Line Interface) is an alternative to web access. You can work with the CLI interface in text mode using an appropriate client, either SSH (putty) or Telnet.

Once logged in to the CLI environment, "cli_tcpdump" with "-v" parameter can be used to see the DS (TOS) field. Each QoS rule in RipEX can also be configured to filter based on this field in IP packet.

In this example, only two commands are helpful for troubleshooting.

• tc -s qdisc show dev radio

This command displays the QoS queues with statistics. Example:

```
CLI(admin):~$ tc -s qdisc show dev radio
qdisc prio 1: bands 9 priomap 1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
 Sent 2714 bytes 57 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
qdisc sfq 10: parent 1:1 limit 3p quantum 1514b perturb 10sec
 Sent 1344 bytes 32 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
gdisc sfg 20: parent 1:2 limit 5p guantum 1514b perturb 10sec
 Sent 1296 bytes 24 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
qdisc sfq 30: parent 1:3 limit 5p quantum 1514b perturb 10sec
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
qdisc sfq 40: parent 1:4 limit 5p quantum 1514b perturb 10sec
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
qdisc sfq 50: parent 1:5 limit 5p quantum 1514b perturb 10sec
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
qdisc sfq 60: parent 1:6 limit 5p quantum 1514b perturb 10sec
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
gdisc sfg 70: parent 1:7 limit 5p guantum 1514b perturb 10sec
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
qdisc sfq 80: parent 1:8 limit 5p quantum 1514b perturb 10sec
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
qdisc sfq 90: parent 1:9 limit 5p quantum 1514b perturb 10sec
 Sent 74 bytes 1 pkt (dropped 0, overlimits 0 requeues 0)
 rate Obit Opps backlog Ob Op requeues O
```

CLI(admin):~\$ tc -s qdisc show dev radio | grep -A1 "sfq 20" qdisc sfq 20: parent 1:2 limit 5p quantum 1514b perturb 10sec Sent 1296 bytes 24 pkt (dropped 0, overlimits 0 requeues 0)

The first paragraph starting with "qdisc prio" represents these queues as a whole. Its statistics output displays the total packets sent and dropped in QoS system.

Paragraphs starting by "qdisc sfq" represent particular priority queues (each priority level is assigned to separate queue) and their statistics output.

The queue for ARP packets is "qdisc sfq 10" and has the highest possible priority (this level is not configurable, neither is it displayed in the web interface, for simplicity). The other queues representing priorities 1-8 are listed in paragraphs labeled from "qdisc sfq 20" to "qdisc sfq 90".

The priority for our Modbus data example (UDP, 8881/8902) are displayed in "qdisc sfq 20" paragraph. Other traffic has the default (lowest) priority 8 and is displayed in paragraph "qdisc sfq 90".

• tc -s filter show dev radio

The second command displays the rules for placing packets to priority queues and their statistics. Example:

```
CLI(admin):~tc -s filter show dev radio
filter parent 1: protocol arp pref 1 u32
filter parent 1: protocol arp pref 1 u32 fh 800: ht divisor 1
filter parent 1: protocol arp pref 1 u32 fh 800::800 order 2048 key ht 800 bkt 0 flowid ►
1:1 (rule hit 33 success 33)
 match 0000000/0000000 at 0 (success 33 )
filter parent 1: protocol ip pref 2 u32
filter parent 1: protocol ip pref 2 u32 fh 1: ht divisor 1
filter parent 1: protocol ip pref 2 u32 fh 1::800 order 2048 key ht 1 bkt 0 flowid 1:2 ▶
(rule hit 24 success 24)
 match 22c622b1/fffffff at nexthdr+0 (success 24 )
filter parent 1: protocol ip pref 2 u32 fh 801: ht divisor 1
filter parent 1: protocol ip pref 2 u32 fh 801::800 order 2048 key ht 801 bkt 0 link 1: ▶
(rule hit 25 success 0)
 match 00110000/00ff0000 at 8 (success 24 )
 match 0000000/00001fff at 4 (success 24 )
   offset 0f00>>6 at 0 eat
filter parent 1: protocol all pref 3 u32
filter parent 1: protocol all pref 3 u32 fh 802: ht divisor 1
filter parent 1: protocol all pref 3 u32 fh 802::800 order 2048 key ht 802 bkt 0 flowid ►
1:9 (rule hit 1 success 1)
 match 0000000/0000000 at 0 (success 1 )
```

Output code starting with "**filter parent 1: protocol arp**" is the internal priority 0 (flowid 1:1 – corresponds to "sfq 10" in previous command) – used only for ARP, having the highest priority.

Output code starting with "**filter parent 1: protocol all**" is the table with the lowest priority 8 (flowid 1:9 – corresponds to "sfq 90" in previous command). In this example, this is the default priority.

Output code starting with "**filter parent 1: protocol ip**" are the user rules. In our example, the flowid is 1:2 (i.e. the highest user priority possible, corresponding to "sfq 20" in previous command).

If you need any further explanation and debugging help, contact our Technical support group at ${\scriptstyle <{\tt support@racom.eu}>}.$

NOTE:

The QoS state is stored in Technical support package.

Appendix A. Revision History

Revision 1.0 First issue 2018-04-03