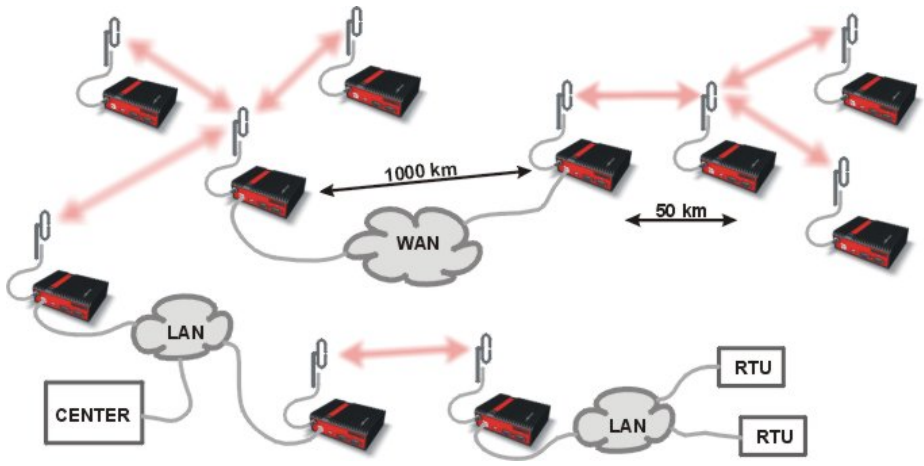
RACOM
RADIO DATA NETWORKS

Application notes



RipEX
Backup Routes

- **Backup Routes**
- Nomadic Mode
- Base Driven Protocol

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Table of Contents

1. Introduction 5
2. Backup Routing Management Protocol 6
    2.1. Protocol Procedure 6
3. Configuration Examples 7
    3.1. Radio/Radio – End Devices Connected via Serial Interface 7
    3.2. Radio/Radio – End Devices Connected via Ethernet Interface 12
    3.3. Ethernet/Radio 18
4. Summary 20
A. Revision History 21

1. Introduction

RipEX provides **Backup routes** functionality to increase reachability in networks through redundant paths.

See the following example, where we have three possible paths between RipEX A and RipEX C. The direct radio link is set as the primary path (because it is direct). The path over RipEX B is the first backup option (two hops) and if this path also fails, GPRS backup path is ready in case of radio failure. In cellular networks, data transfer is charged and so it is used as the last option here.

Path priorities can be changed according to our requirements. The path with the highest priority is always the primary one (the direct radio link in our example) and the path with the lowest priority is the last option (GPRS in our example).

Thanks to the Backup routes functionality, RipEX can handle various network problems without interrupting the desired network communication.

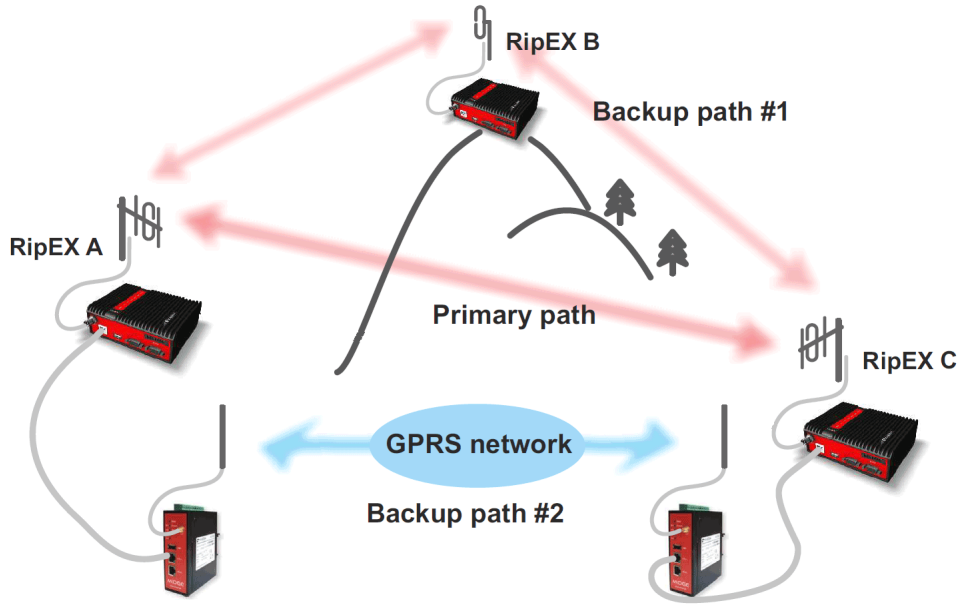

Fig. 1.1: Backup routes functionality example

Note

The Backup routes functionality can be used in the Router mode only.

The Backup routes functionality is supported by the SNMP, see SNMP Application Note for further details.

2. Backup Routing Management Protocol

BRMP is the proprietary protocol developed by RACOM. It handles the Backup routing functionality in RipEX networks with respect to radio network requirements.

The protocol

- does not overload the radio network,
- enables more than one backup path,
- deals with a random packet loss and
- enables very fast path switching in cases of network failure.

The protocol always works between two particular RipEX units. Each RipEX network can contain various backup routes and each backup route consists of several alternative paths. We can even configure nested backup paths.

2.1. Protocol Procedure

1. RipEX A sends out “Hello” packets (UDP) via all possible paths to RipEX B.
2. RipEX B receives these packets and records them according to the received path.
3. RipEX B sends the list of received “Hello” packets within its own “Hello” packet back to RipEX A.
4. RipEX A receives this packet and evaluates the conditions of individual paths.

Individual alternative paths can obtain the following states:

Up	the path is functional and can be used.
Down	the path is not functional and cannot be used.
Unknown	the path's state cannot be evaluated due to lack of information. This state is active immediately after the RipEX power-up or its state is not being evaluated, because a higher priority path is being used.

The route is chosen in the following way:

1. The first available route in the table Routing / Backup is used.
2. In case of a lost connection, the route on the next row of the Backup table is used (Policy / Default mode).
3. In situations of RSS deterioration, the route on the next row in Backup table is used (Policy / Manual mode).

Note

See the respective help for detailed parameter descriptions in RipEX web interface.

3. Configuration Examples

In this chapter, we will go through several examples in order to explain Backup routes in practice.

Please follow the examples one by one to fully understand the configuration differences and benefits of various solutions.

Note

The examples are configured similarly to the examples used in the RipEX Application note, see Address Planning in Application Notes

3.1. Radio/Radio – End Devices Connected via Serial Interface

In the first example, there are five RipEX units in a network. All end devices are connected to the RipEX units via a serial interface. It is helpful to use only the radio IP addresses for translation and data routing. Ethernet IP addresses may be assigned randomly (you can keep their defaults, however we recommend setting Ethernet addresses similar to radio IP addresses to keep things organized).

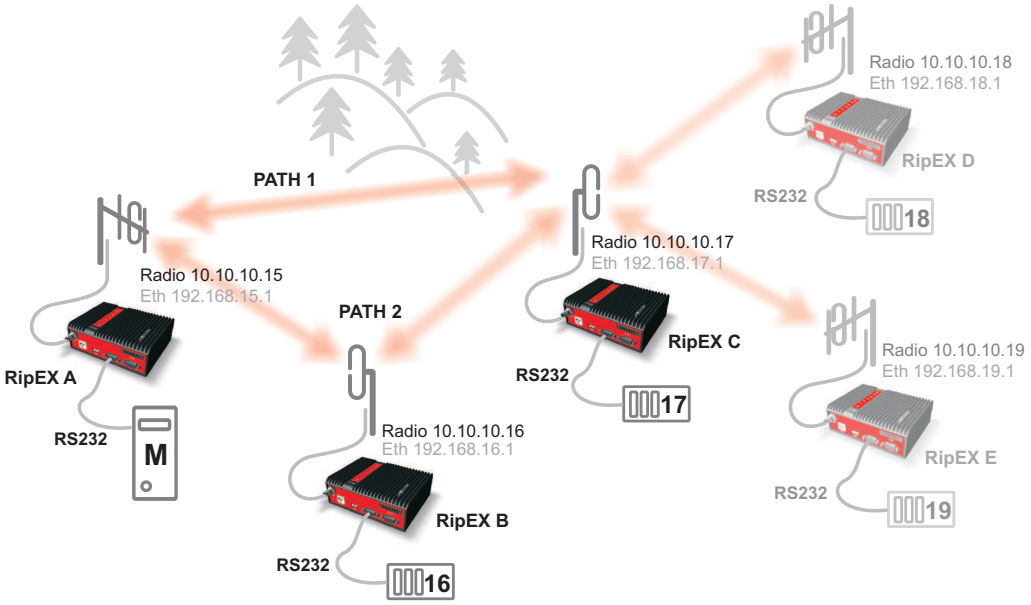

Fig. 3.1: Network topology 1

The device connected to RipEX A (10.10.10.15) is the Master station, others are slaves.

Note

We will not configure RS232 devices in this Application note

The Backup routes system can be used between RipEX A (.15) and RipEX C (.17), packets can be transmitted via:

- the primary (direct) radio link between RipEX A and RipEX C, or
- the backup (indirect) radio link over RipEX B.

See the following RipEX A routing configuration:

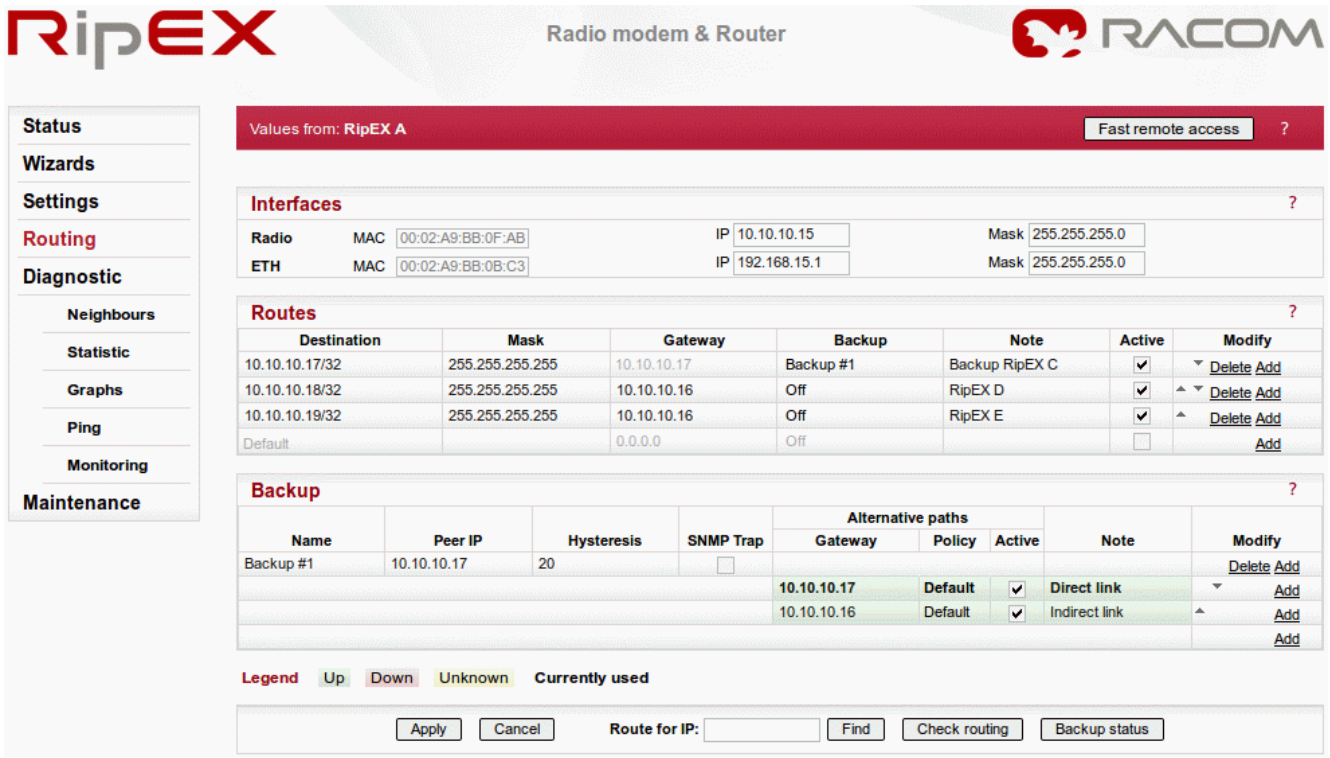

Fig. 3.2: RipEX A Routing menu – example #1

In RipEX A, we have one route which uses the backup configuration and two simple routes to other RipEX units.

The backup route is named “Backup #1” and it checks its health against the RipEX C radio IP address. The highest priority is set to the direct link and the second possibility is to use RipEX B as a repeater. Both paths are now checked by default and both are Up.

Note

Only the remote RipEX radio or the main Ethernet interface IP addresses can be used (no subnet IP addresses on RipEX Ethernet or IP of connected device behind RipEX).

See the respective configurations from RipEX B and C.

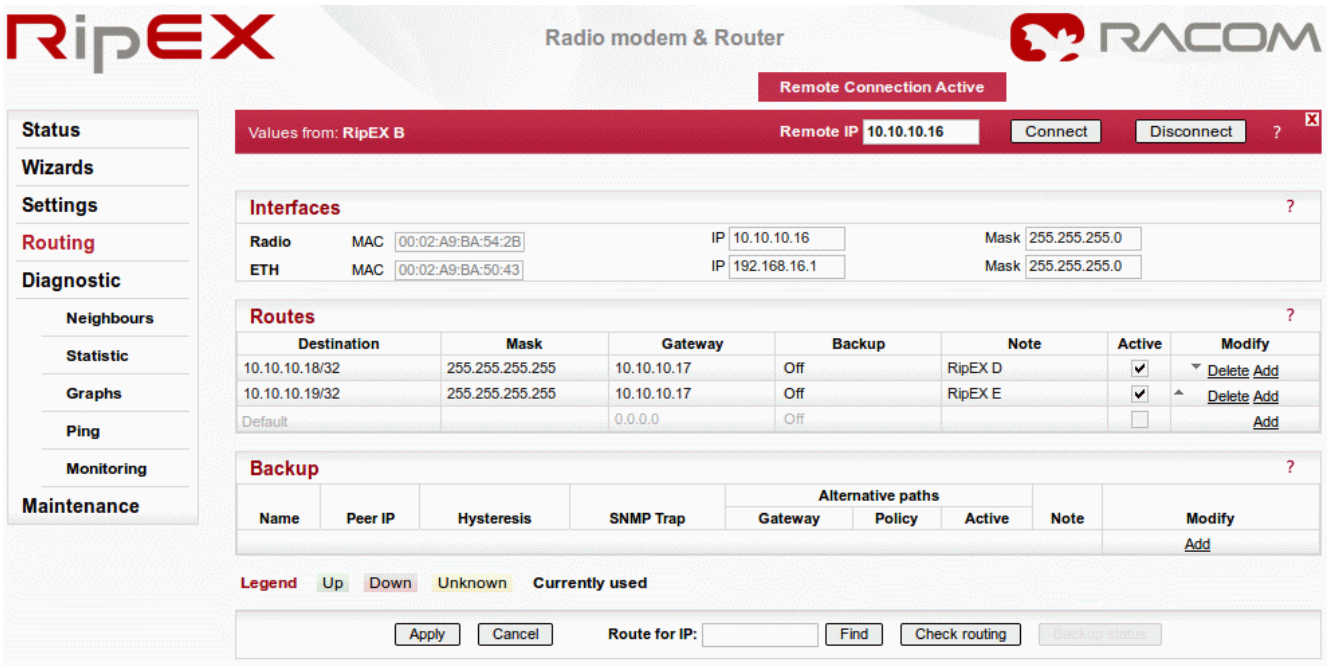

Fig. 3.3: RipEX B Routing menu – example #1

Note

RipEX B is not the end point (Peer IP) of the Backup routes system and so there is no backup route defined.

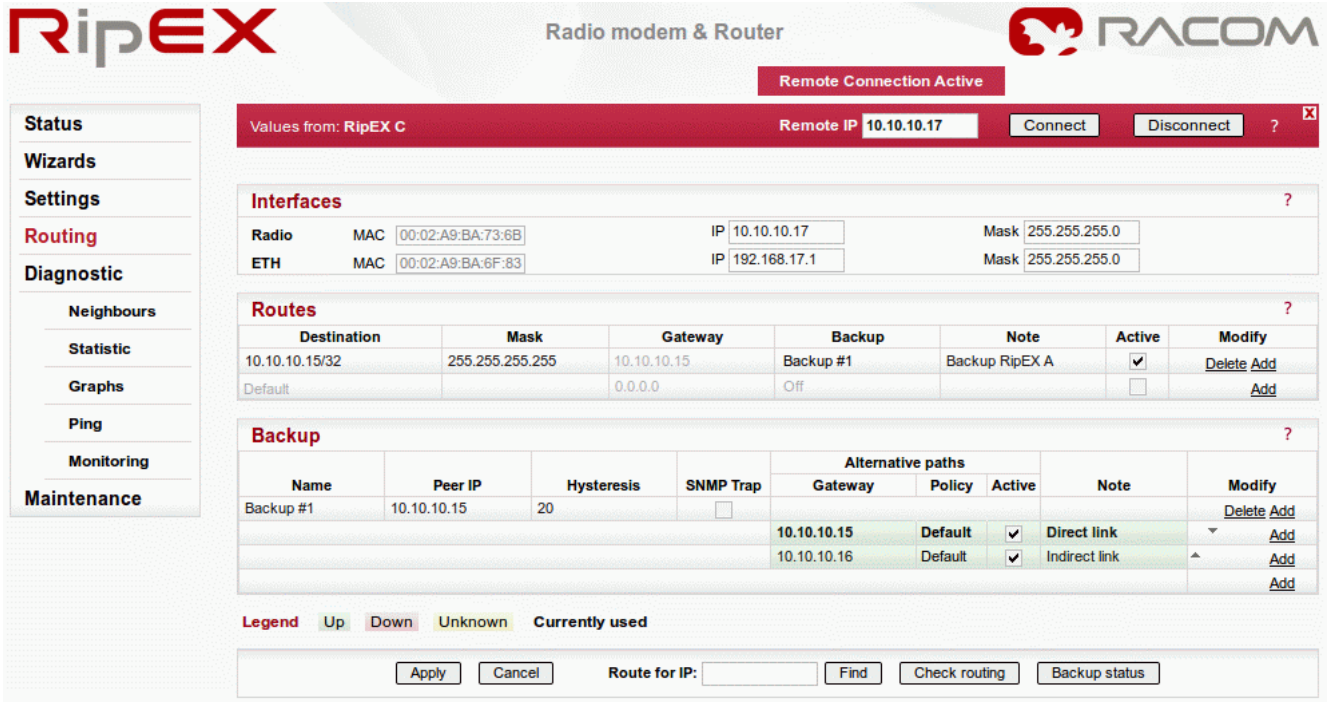

Fig. 3.4: RipEX C Routing menu – example #3

Note

See the configuration of RipEX D and E in the Application Note, see Address Planning in Application Notes

3.1.1. Practical Test

In this scenario, we will switch to the backup path due to a low RSS value. We must change the policy for the primary path to enable RSS checks. Click on the respective “Default” button in the **Policy** column.

Note

You can check the connectivity with a Ping feature (**Diagnostic** → **Ping**).

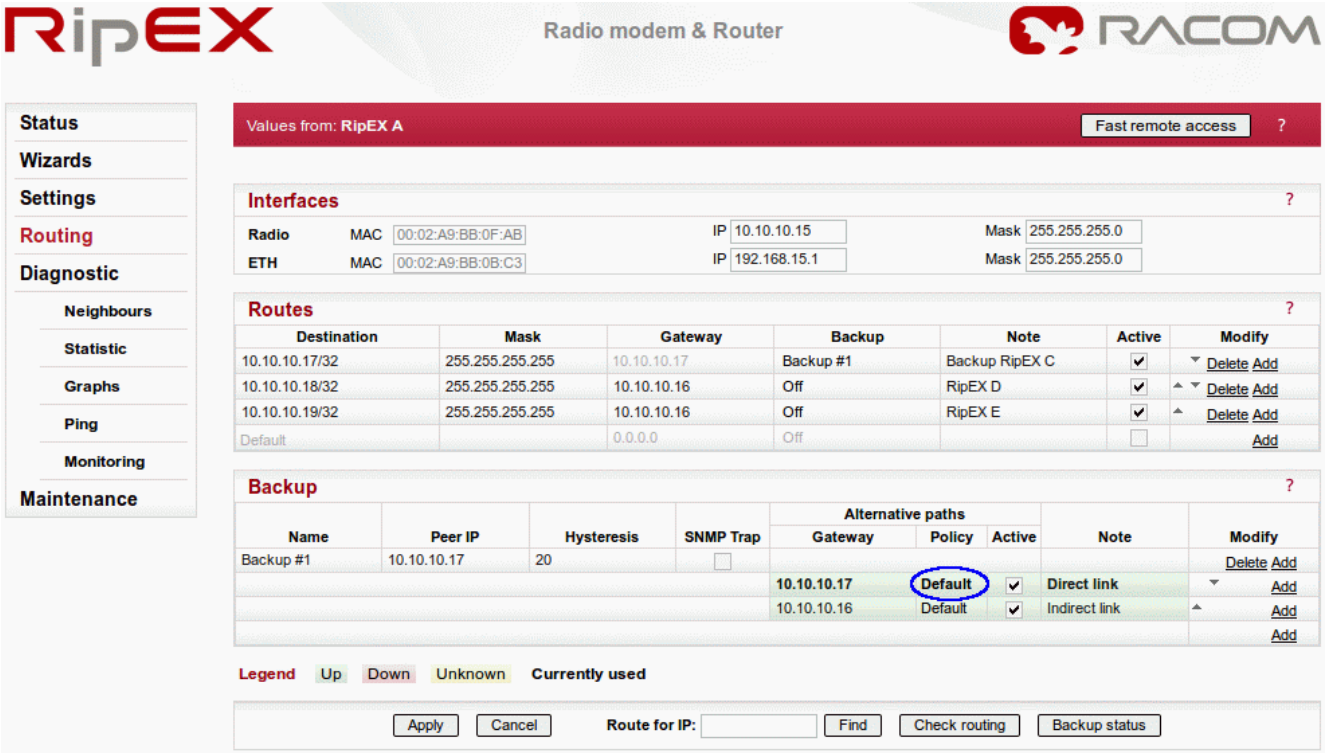

Fig. 3.5: RipEX A – Policy button

The new pop-up window appears. Change the Parameters to “Manual” and fill in the RSS [-dBm] value according to the current RSS value (see the Neighbours menu). The value needs to be higher than the current value, e.g. in the example, the current RSS value is -56 dBm. The condition for switching to the backup (indirect) path is set to -50 dBm.

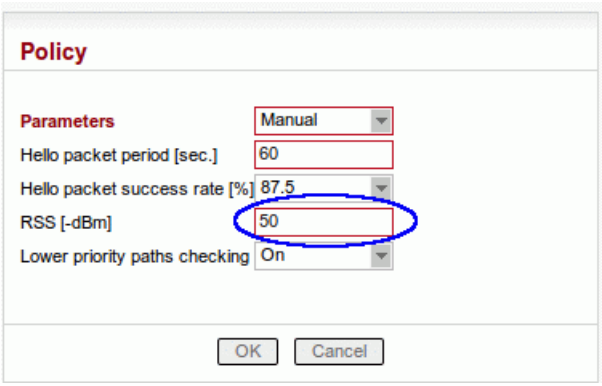

Fig. 3.6: RipEX A – Alternative path RSS change

Apply the changes and click on the Backup status button to see the changes. The policy is set to “Manual” and the backup (indirect) path is being used.

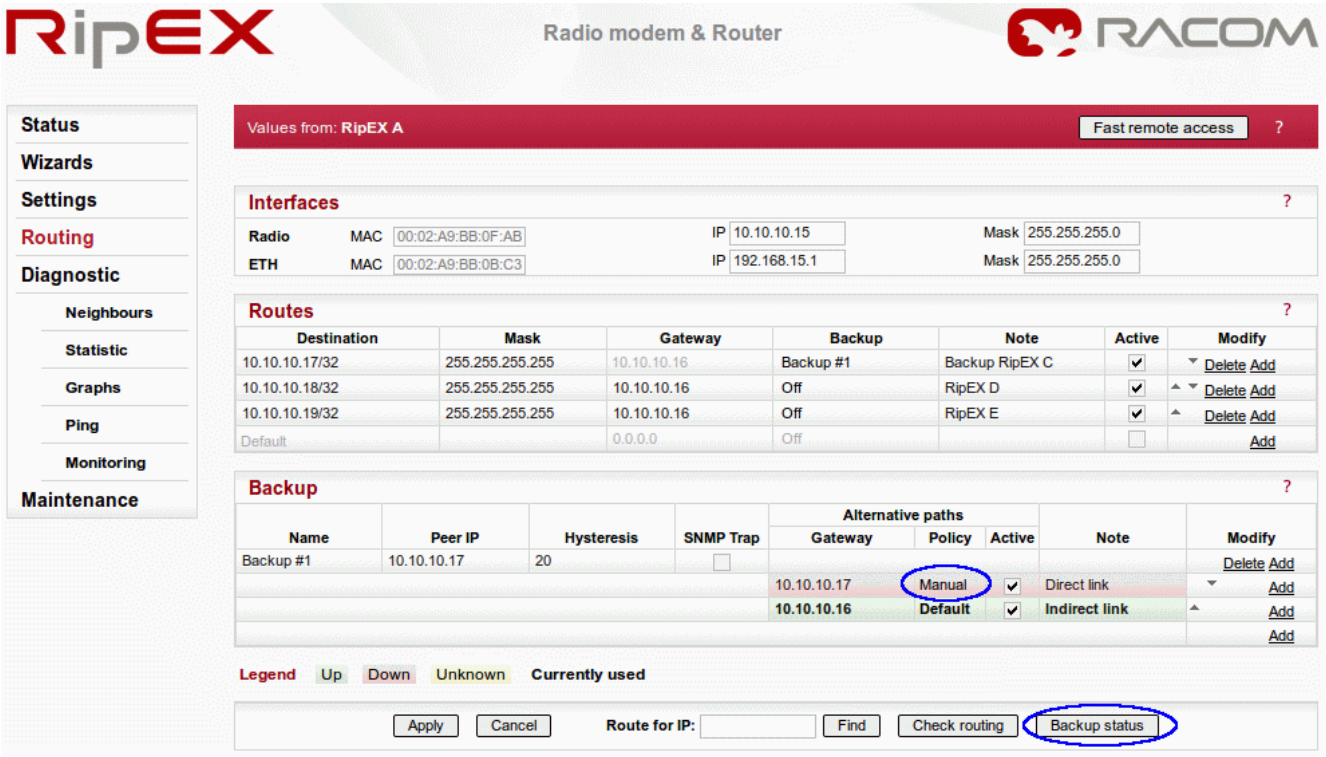

Fig. 3.7: RipEX A – Backup path is Up

Note

For proper functioning, do not forget to repeat these steps on the partner RipEX C unit. If not set on both units, RipEX A can communicate with RipEX C via the primary path in one direction and via the backup path in the other direction (asymmetric routing).

To revert to using the primary path again, disable RSS checks or improve the RSS signal between the RipEX units.

3.2. Radio/Radio – End Devices Connected via Ethernet Interface

In the second example, we use the same configuration except that the RTU devices are connected via the Ethernet interface. See the following diagram:

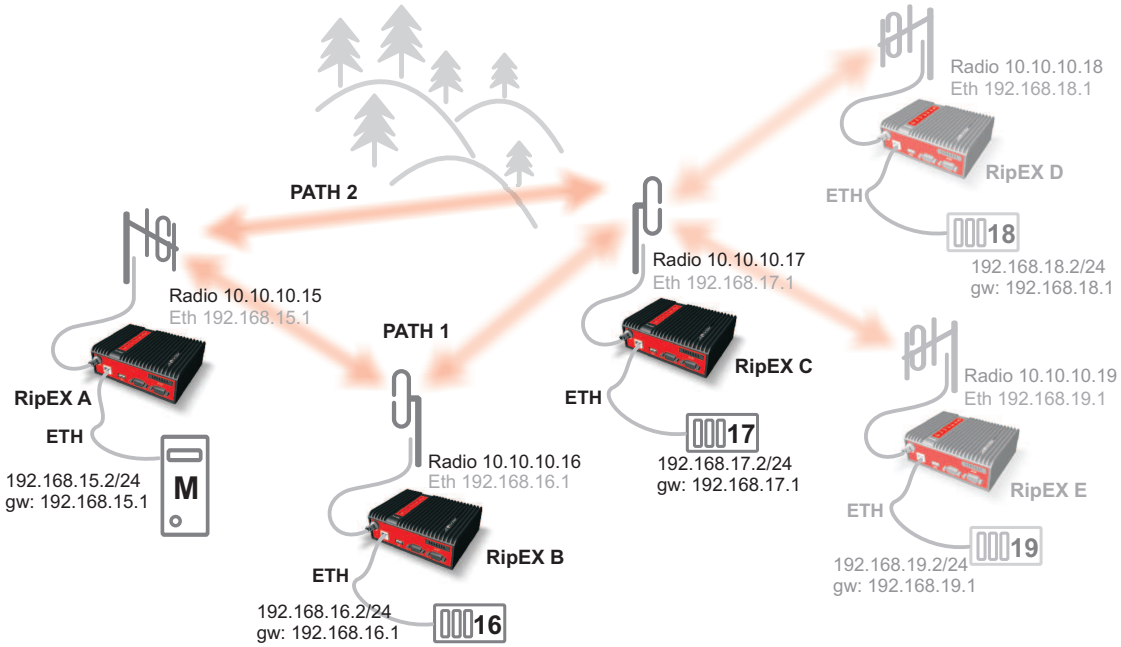

Fig. 3.8: Network topology 2

Note

In this example, we switched the priorities for the alternative paths.

RTU units are now connected via the Ethernet ports, which means we need to add the correct IP addresses and routing into the appropriate RipEX units.

If not already set, change the Ethernet IP addresses according to this topology:

- RipEX A – 192.168.15.1/24
- RipEX B – 192.168.16.1/24
- RipEX C – 192.168.17.1/24
- ...

Now we need to add the correct routing. To make the example simple, we will ignore RipEX D and RipEX E in our configuration.

See the following RipEX A routing settings:

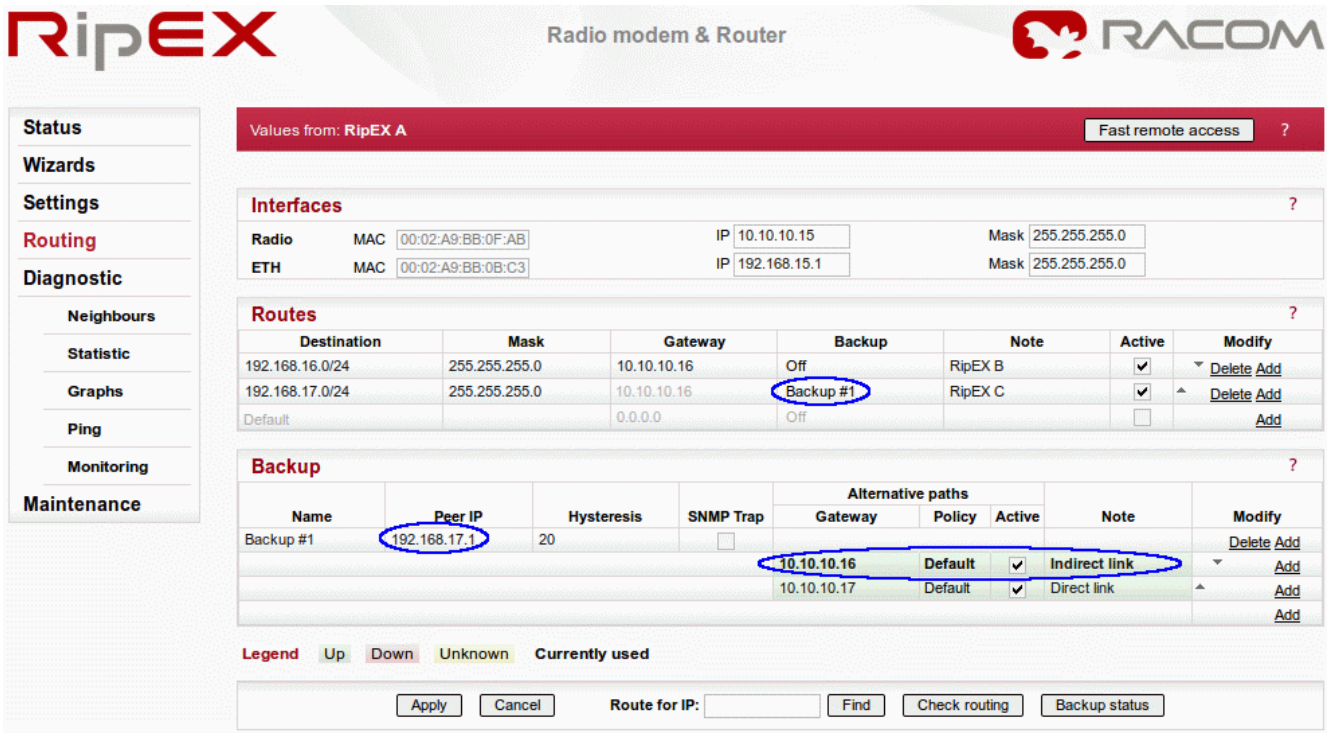

Fig. 3.9: RipEX A Routing menu – example #2

Notice that we are using the Backup routes system for the devices on the 192.168.17.0/24 network. Also notice that we filled the Peer IP with the remote RipEX Ethernet IP address. The path used currently is the primary (indirect) one, but both paths are marked in color “Up”.

Note

Only the remote RipEX radio or the main Ethernet interface IP addresses can be used (no subnet IP addresses on RipEX Ethernet or IP of connected device behind RipEX).

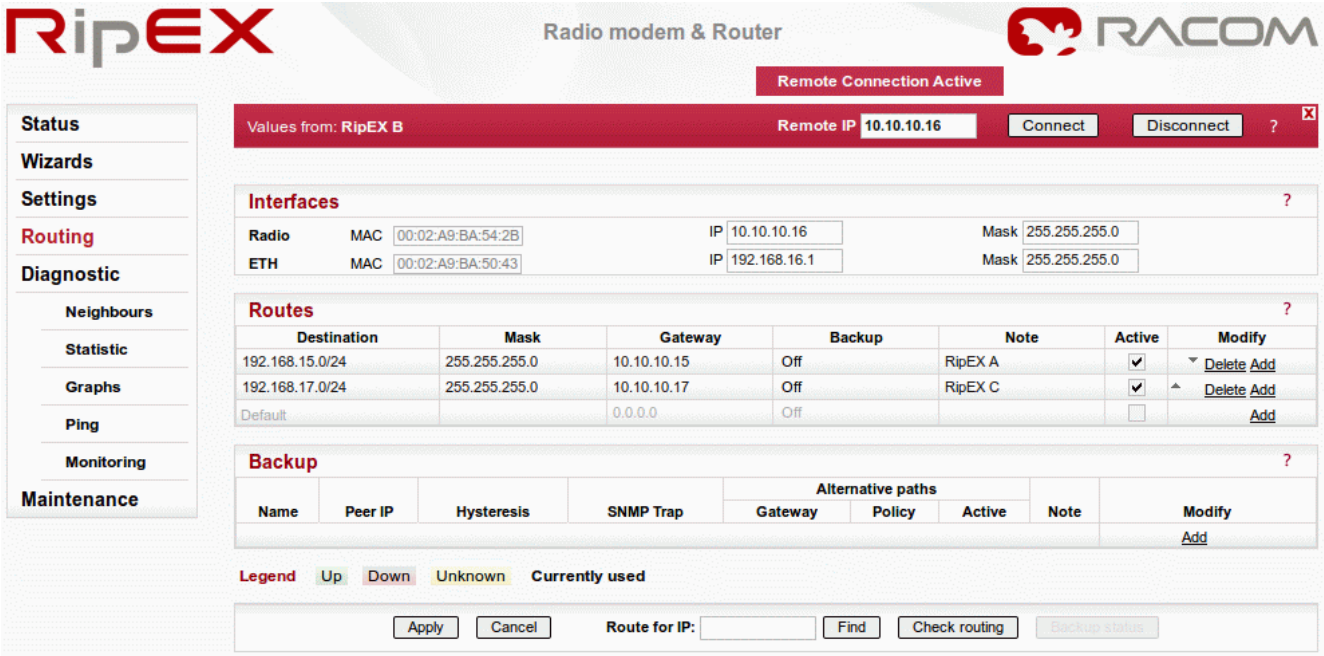

Fig. 3.10: RipEX B Routing menu – example #2

We also added paths in RipEX B for the Ethernet networks located behind other RipEX units.

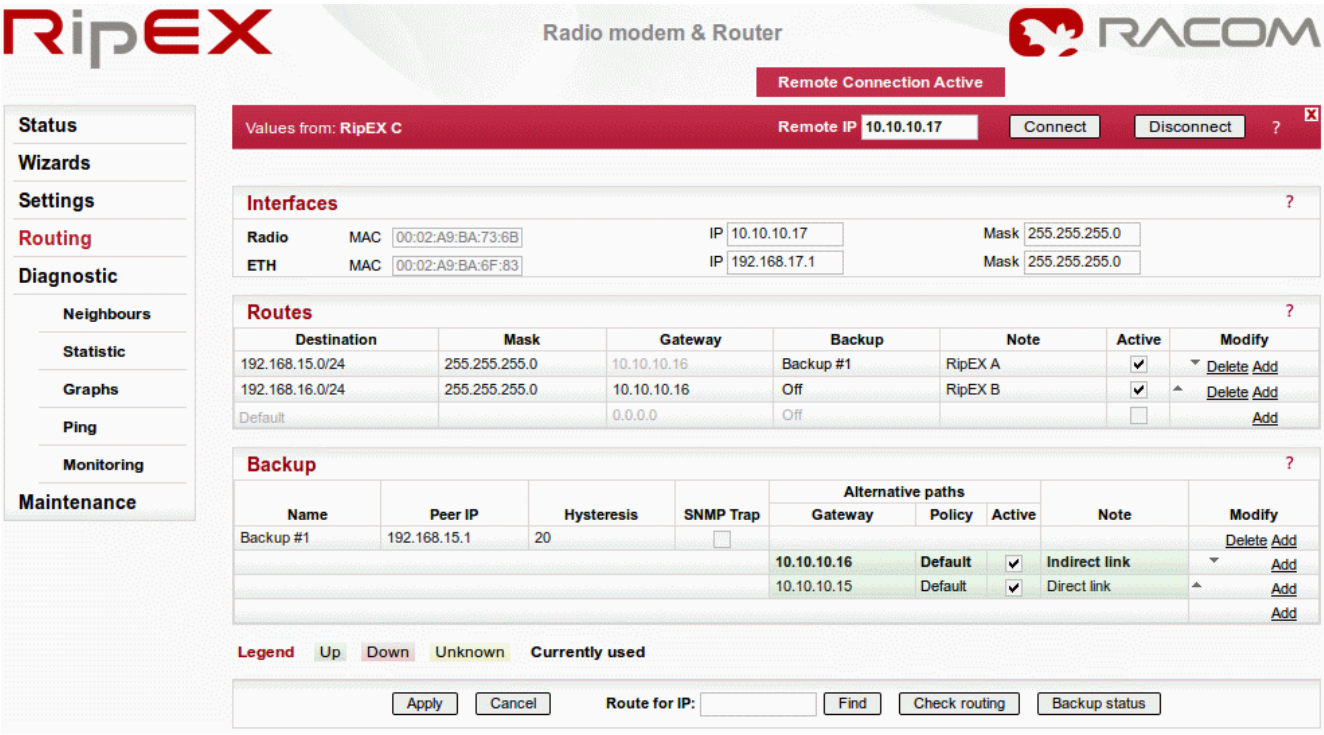

Fig. 3.11: RipEX C Routing menu – example #2

In RipEX C we have a very similar configuration to RipEX A, just in the opposite direction.

3.2.1. Practical Test

In this example, we will use a different method to switch between the primary and backup paths. We have set the highest priority for the indirect link (our backup path in the previous example). Whenever RipEX B is switched off, the Backup routes system will use the direct path instead.

The RipEX failure detection time is based on the Policy settings.

Note: If you set the “Hello” **packet period** to a low value (e.g. 10 seconds) and “**Hello packet success rate [%]**” to 100 %, the procedure will be very fast. But with these settings you are wasting the radio bandwidth with quite a lot of traffic and whenever a single “Hello” packet is lost, the active path is labeled as “Down”.

In the example, **we will not alter the default values**.

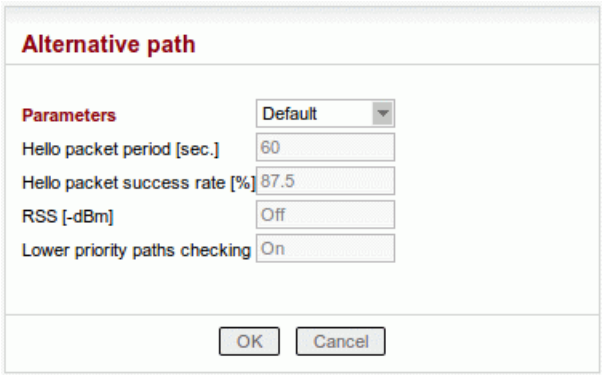

Fig. 3.12: Default Policy values

Note

“Hello packet success rate” evaluation is based on last 8 “Hello” packets.

To see the whole procedure, you can start with issuing ping packets. Go to the RipEX A **Diagnostic** → **Ping** menu and fill in the destination IP address (192.168.17.1). At this stage, ping packets will be successful and will be transmitted via the primary (indirect) path (e.g. check the RipEX RX/TX led diodes).

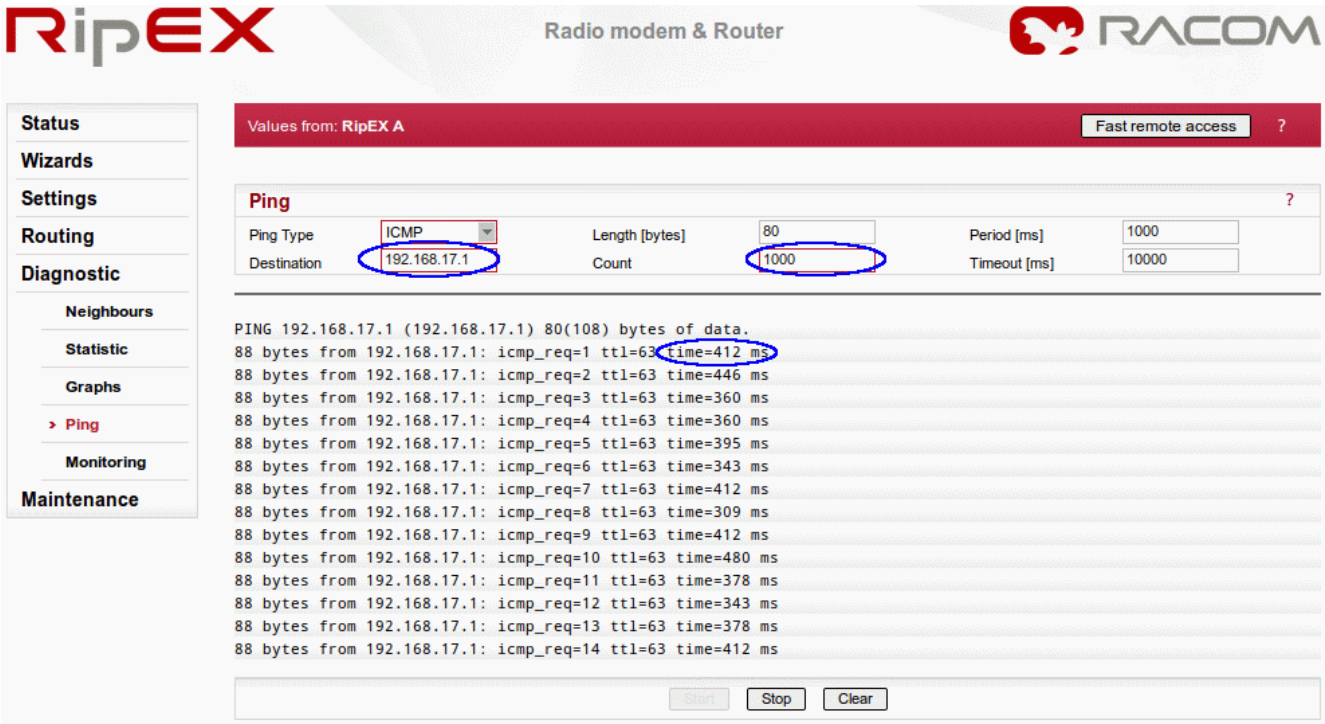

Fig. 3.13: Successful ping packets – primary (indirect) path

You can also turn on the radio interface monitoring. Go to the **Diagnostic** → **Monitoring** menu and check the radio interface. Leave other parameters at their defaults and click on the Start button. You can see all the packets in the radio network (ping packets, “Hello” packets, ARP, …).

Now turn RipEX B off, and see the differences. You can see that there are no replies to ping packets in **Ping** and **Monitoring** menu. Check the Routing menu (by pressing the Backup status button) to see when the active path is switched to the backup (direct) path.

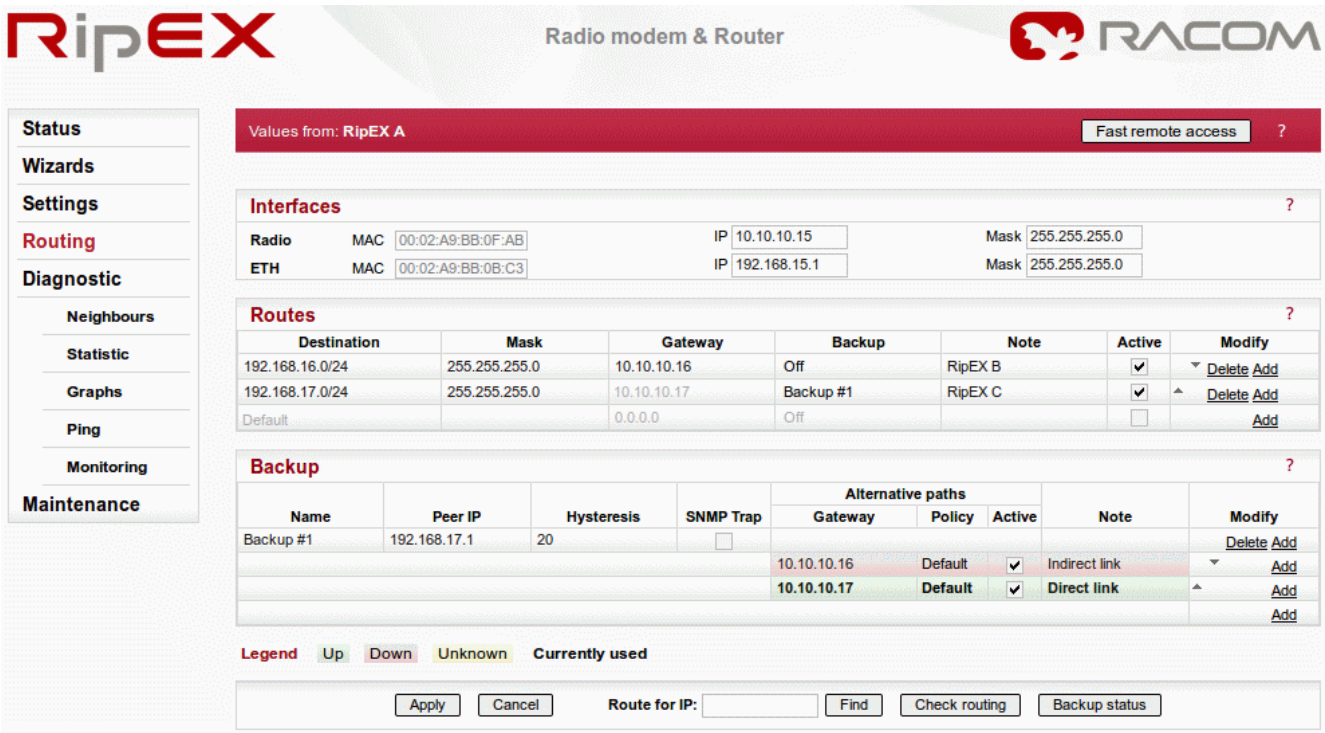

Fig. 3.14: RipEX A Routing menu – RipEX B switched off

As soon as the Backup routes system evaluates the situation correctly, the ping packets are successful again. Also notice the ping packets RTT value is lower than with the primary (indirect) path being used.

```
ping: recvmsg: No route to host
ping: recvmsg: No route to host
From 192.168.15.1: icmp_seq=558 Destination Host Unreachable
From 192.168.15.1: icmp_seq=559 Destination Host Unreachable
88 bytes from 192.168.17.1: icmp_req=563 ttl=64 time=174 ms
88 bytes from 192.168.17.1: icmp_req=564 ttl=64 time=157 ms
88 bytes from 192.168.17.1: icmp_req=565 ttl=64 time=174 ms
```

Fig. 3.15: RipEX A Ping packets – backup (direct) path

Now you can turn RipEX B back on again. Because RipEX checks the primary (indirect) path with “Hello” packets periodically, it will switch back to the primary path. This change will not cause any loss in ping packets.

3.3. Ethernet/Radio

In this test, the primary route is via the Ethernet link and it is backed up by the radio link.

See the following example:

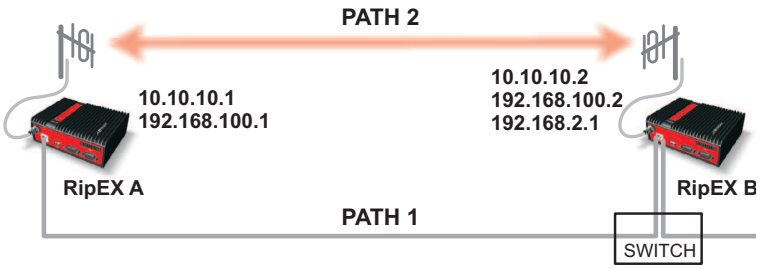

Fig. 3.16: Network topology 3

Note

This example will not be explained in as such detail as the previous ones and we will use different IP addresses.

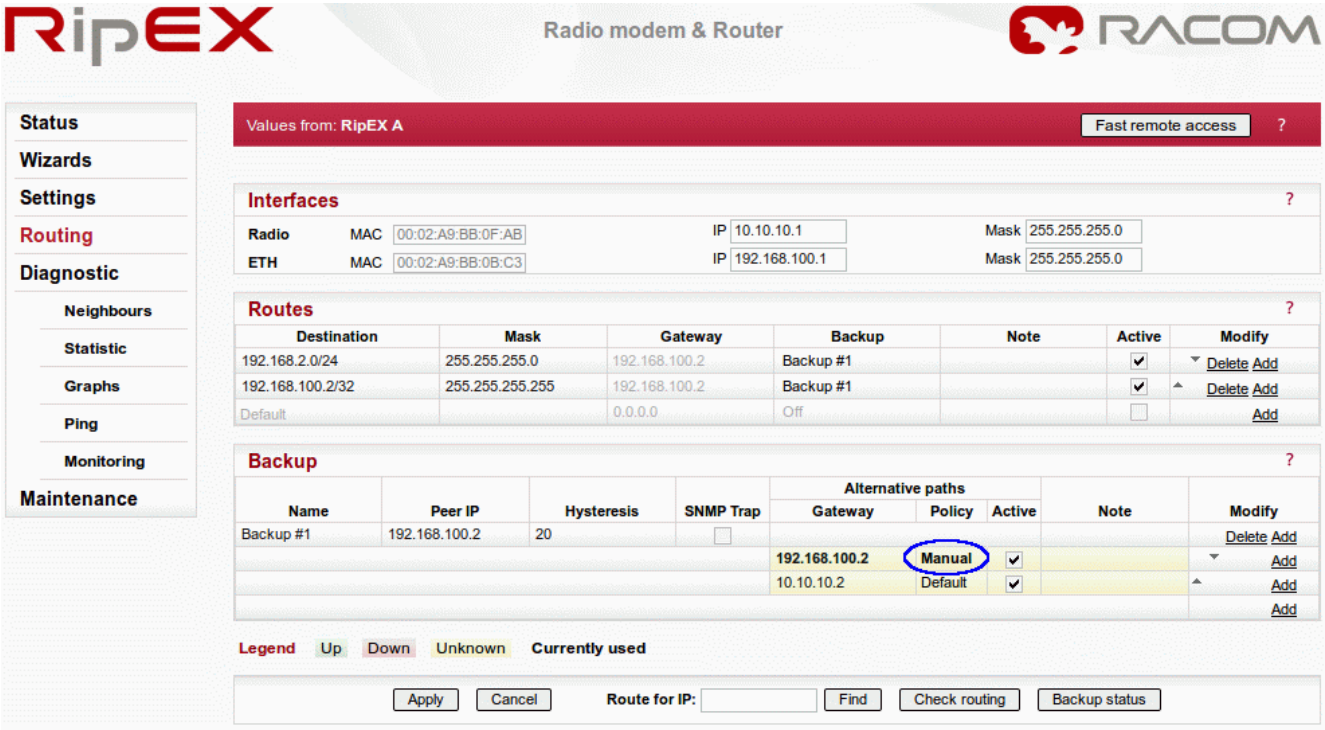

Fig. 3.17: RipEX A Routing menu – example #3

The primary Ethernet link provides a high bandwidth capacity. It is appropriate to send “Hello” packets every second. This will lead to a rapid switch over to the backup radio link in case of the Ethernet link failure.

```
ping: recvmsg: No route to host
ping: recvmsg: No route to host
From 192.168.15.1: icmp_seq=558 Destination Host Unreachable
From 192.168.15.1: icmp_seq=559 Destination Host Unreachable
88 bytes from 192.168.17.1: icmp_req=563 ttl=64 time=174 ms
88 bytes from 192.168.17.1: icmp_req=564 ttl=64 time=157 ms
88 bytes from 192.168.17.1: icmp_req=565 ttl=64 time=174 ms
```

Fig. 3.18: Hello packet period set to one second

RipEX B is configured with 192.168.100.2/24 IP address which is used only for communication between RipEX units. The additional subnet 192.168.2.0/24 is used for the rest of the Ethernet communication. See the details in ARP Proxy & VLAN Application note.

The “Hello” packet period for the Ethernet link is also set to one second on RipEX B.

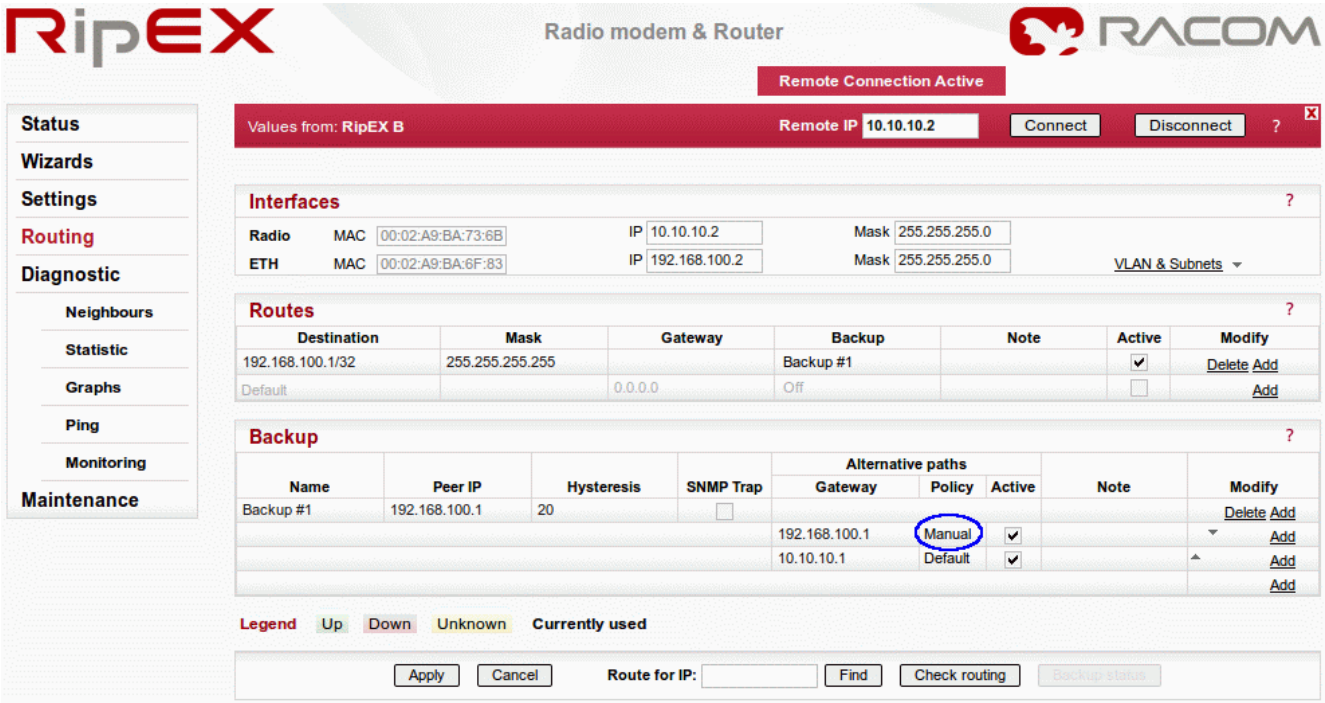

Fig. 3.19: RipEX B Routing menu – example #3

When you disconnect the primary Ethernet path, the system will automatically switch to its backup radio path. You can check this functionality using the same tools as in the previous examples.

4. Summary

We have described just a few basic examples of Backup routes usage. Feel free to download the RipEX User manual from http://www.racom.eu/download/hw/ripex/free/eng/ripex-m-en.pdf or the Application notes from http://www.racom.eu/download/hw/ripex/free/eng/ripex-app-en.pdf to conduct further tests.

Do not hesitate to contact us if you have any questions:

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Appendix A. Revision History

Revision 1.0 2017-11-23

First issue