

Hybrid Wireless Mesh Protocol+

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Introduction

- ▶ Bartłomiej Rodek
- ▶ **Inter Projekt S.A.**
 - ▶ wireless networking equipment distributor
 - ▶ engaged in trainings since 2008 (four MikroTik Certified Trainers)
 - ▶ <http://www.interprojekt.com.pl/>
 - ▶ <http://szkolenia.interprojekt.pl/>
- ▶ **IDEA4PRO Sp. z o.o.**
 - ▶ consulting and integration services
 - ▶ training services
 - ▶ info@idea4pro.com

Outline

Wireless mesh networks

STP/RSTP protocol

HWMP+ protocol

- HWMP+ concepts

- HWMP+ configuration

- HWMP+ scenario

What's a mesh network?

It's a network topology where all nodes/routers are connected to each other (full mesh) or, more usuall, almost each other (partial mesh). The main features of mesh topology are high scalability, adaptivity and reliability.

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Why layer 2?

- ▶ Wireless networks are usually bridged

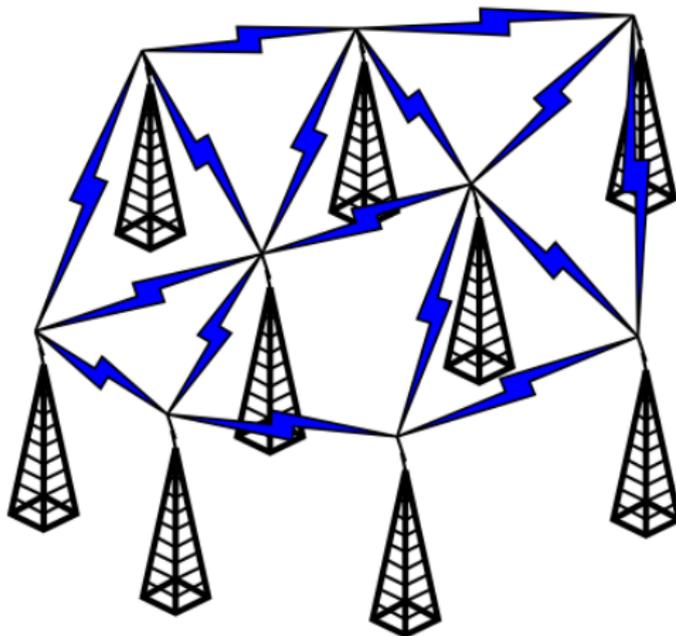
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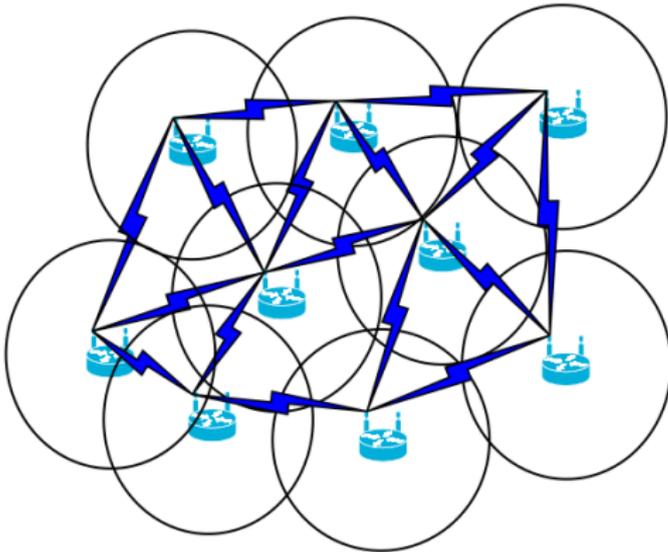
Why layer 2?

- ▶ Wireless networks are usually bridged
- ▶ Performance

Mesh topology



Mesh topology - Dual-band



The most common type of configuration: 2.4GHz access points for client connectivity and 5GHz for mesh interconnection.

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(R)STP Solution

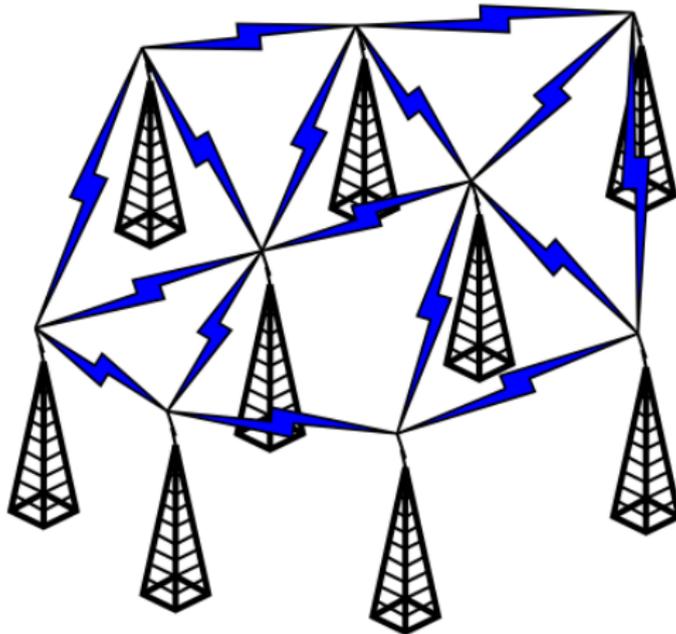
The solution can be (*Rapid Spanning Tree Protocol*):

STP¹ or its newer, faster version RSTP² is a OSI layer 2 protocol that ensures the loop free topology in bridged networks. RSTP allows to build networks with redundant links without danger of bridge loops, but... let see how it works:

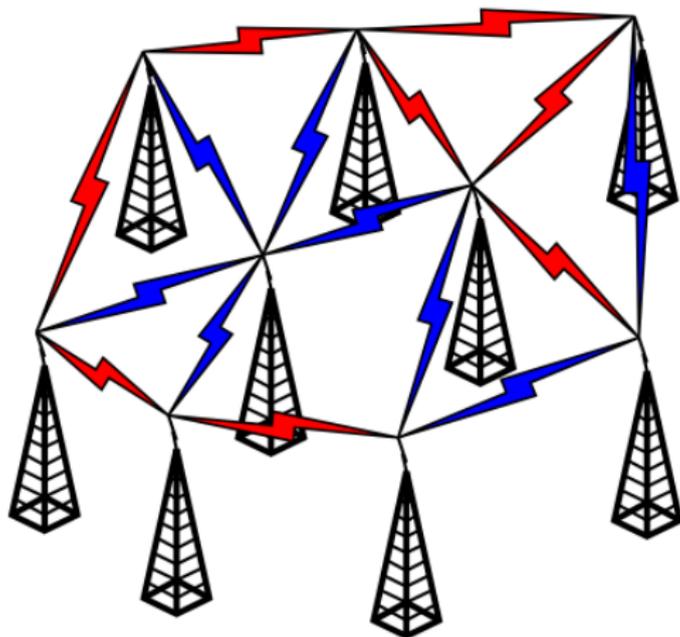
¹ANSI/IEEE 802.1d-1998 standard

²ANSI/IEEE 802.1w-2004 standard

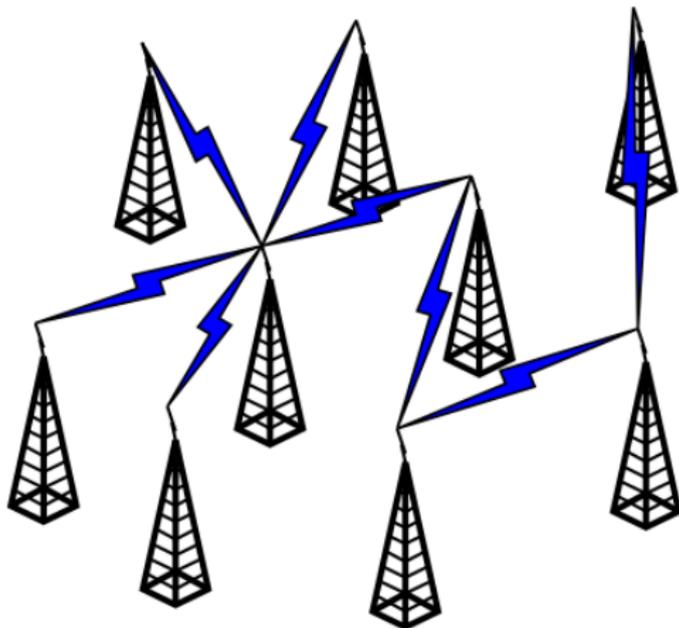
Before RSTP



RSTP select some links (based on path cost)...



And disable it



The result

What we get?

The result

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- ▶ Loop free topology

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- ▶ More or less optimal topology

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What we get?

- ▶ Loop free topology
- ▶ Redundant links can be used in case of failure
- ▶ More or less optimal topology
- ▶ Redundant links are unusable in normal operation

Hybrid Wireless Mesh Protocol+

HWMP+ is a layer two routing protocol based on HWMP¹ but, because of Mikrotik modifications it's incompatible with the standard one. It's designed for wireless mesh networks but works as well in wired Ethernet networks.

Main advantages:

¹IEEE 802.11s draft

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Main advantages:

- ▶ Ensures loop free topology
- ▶ Optimized route selection based on path cost
- ▶ On wireless link the cost is automatically calculated based on actual link bandwidth
- ▶ On demand route selection or tree based topology

¹IEEE 802.11s draft

HWMP+ Modes

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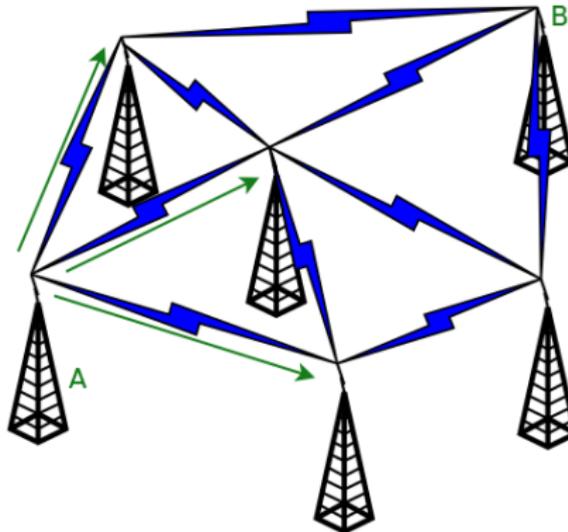
Which is more suitable for networks where most of the traffic does not leave the mesh network

- ▶ **Proactive mode**

We should use it in case when most of the traffic goes outside the mesh via few exit points. In this mode we have to define portals. The portals are routers connected to the other networks outside the mesh

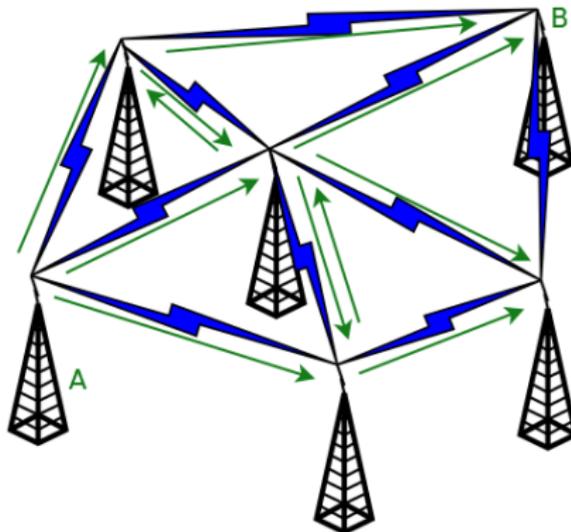
HWMP+ reactive mode

Let's assume bridge A wants to send a frame to bridge B
First it sends **PREQ** message out of all of its interfaces:



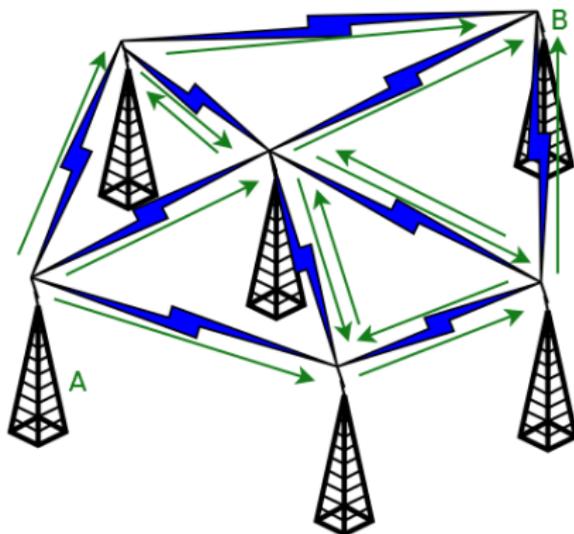
HWMP+ reactive mode

Which is flooded by all of the mesh devices:



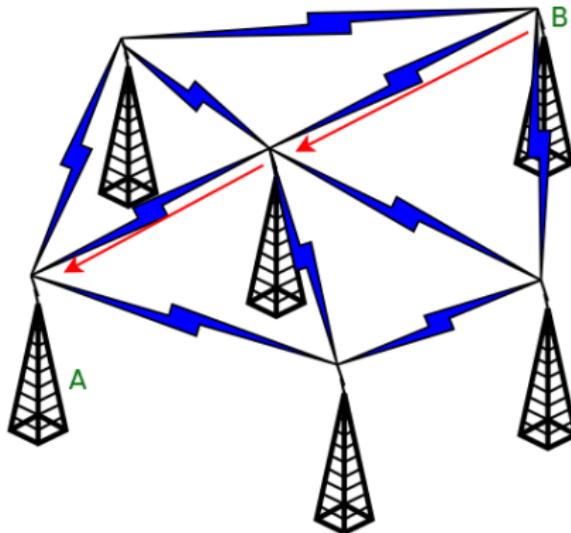
HWMP+ reactive mode

And finally it reaches the B device:



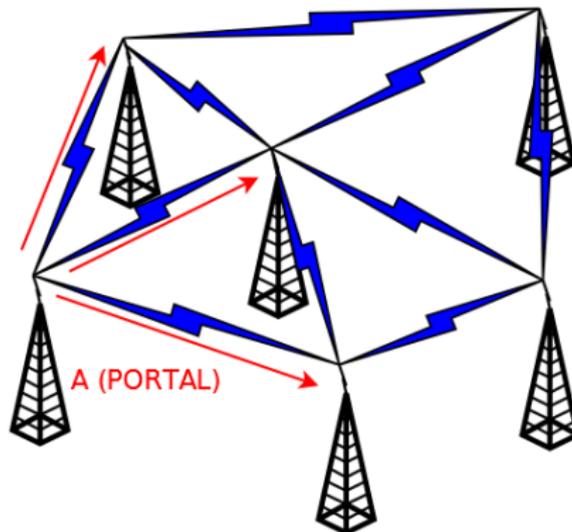
HWMP+ reactive mode

Now the B choses the route with lowest path cost and sends the **PREP** message to A.



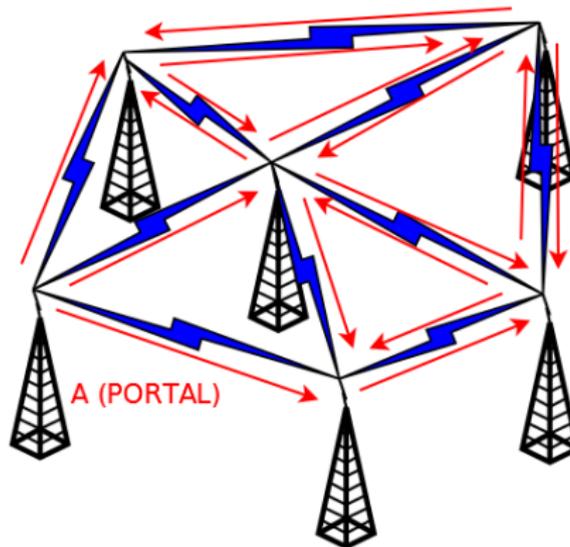
HWMP+ proactive mode

All *portal* nodes start to originate **RANN** messages



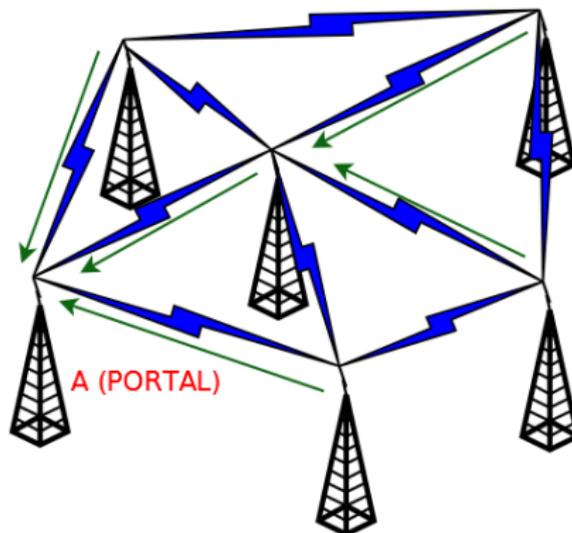
HWMP+ proactive mode

Which are flooded through the network



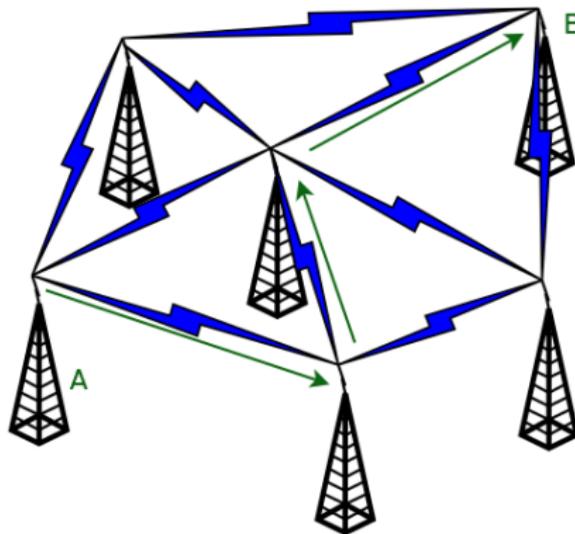
HWMP+ proactive mode - PREG message

Nodes register to the best (nearest) *portal* with **PREG** message



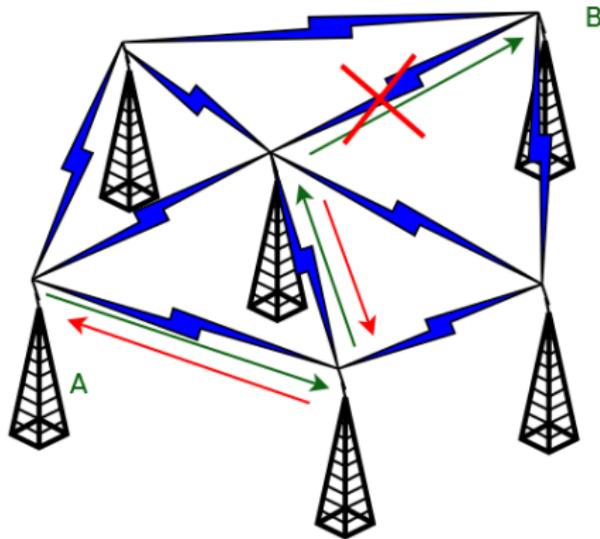
HWMP+ topology change detection

Let's assume that the registered path from A to B is like below

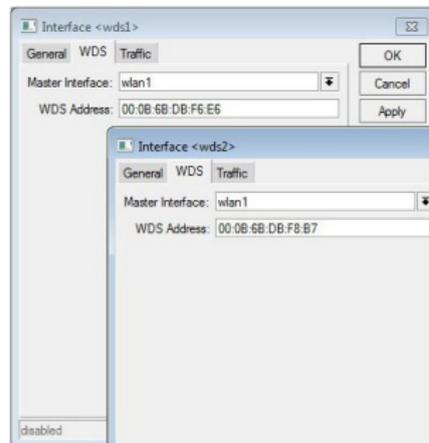
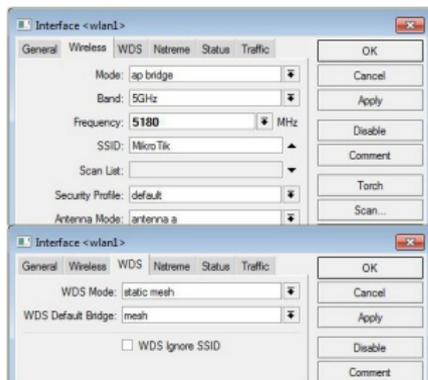


HWMP+ topology change detection

If link fails, the **PERR** message is propagated to all upstream nodes



WLAN and WDS configuration



WDS mode should be set to *static mesh* or *dynamic mesh* instead of static/dynamic WDS

Mesh interface parameters

The screenshot shows a configuration window titled "Interface <mesh>". It has three tabs: "General", "HWMP", and "Traffic". The "Traffic" tab is selected. The window contains several input fields and checkboxes:

- Mesh Portal
- Default Hoplimit: 32
- PREQ Waiting Time: 4 s
- PREQ Retries: 2
- PREQ Destination Only
- PREQ Reply and Forward
- PREP Lifetime: 00:05:00
- RANN Interval: 00:00:10
- RANN Propagation Delay: 500 ms
- RANN Lifetime: 00:00:22
- Reoptimize Paths

On the right side of the window, there is a vertical stack of buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove, and Torch. At the bottom of the window, there are three status indicators: "disabled", "running" (which is highlighted), and "slave".

Mesh interface parameters

Interface <mesh>

General HWMP Traffic

Mesh Portal

Default Hoplimit: 32

PREQ Waiting Time: 4 s

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PREQ Destination Only

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Reoptimize Paths

OK
Cancel
Apply
Disable
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disabled running slave

- ▶ **Mesh portal** - whether the interface is a portal in the mesh network, if it's set to yes protocol use tree based topology

Mesh interface parameters

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Copy

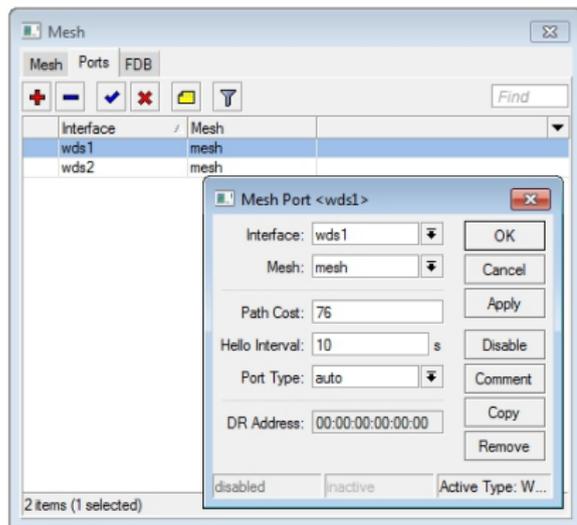
Remove

Torch

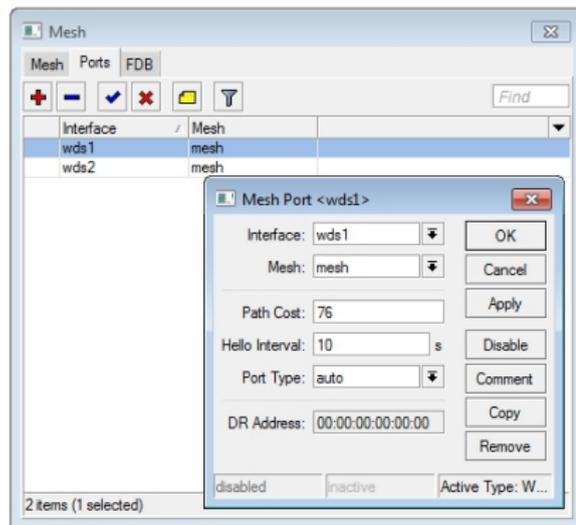
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- ▶ **Mesh portal** - whether the interface is a portal in the mesh network, if it's set to yes protocol use tree based topology
- ▶ **Default Hoplimit** - maximum hop limit of the HWMP messages
- ▶ **Reoptimize Paths** - enables periodical path reoptimization

Mesh port configuration

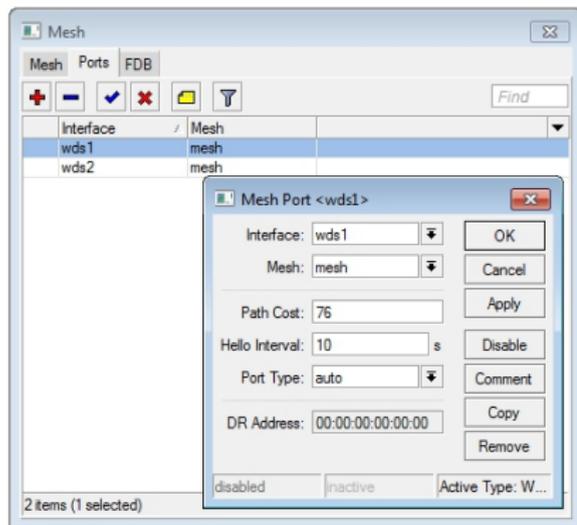


Mesh port configuration



- ▶ **Path cost** - cost of the path, for Ethernet default is 10

Mesh port configuration



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- ▶ **Port type** - type of the port. Possible value is *auto*, *WDS*, *Wireless* and *Ethernet*

Forwarding Database - device types

Me... /	Type	MAC Address	On In...	Lifeti...	Age	Metric	Seq...
A mesh	mesh	00:0C:42:07:D4:97	wds1	25	00:03:43	74	3
A mesh	local	00:0B:6B:DB:F8:BF			00:58:13	0	7
A mesh	neighbor	00:0B:6B:DB:F8:B7	wds2	197	00:41:56	83	1
A mesh	neighbor	00:0B:6B:DB:F6:E6	wds1		00:58:13	75	1
A mesh	mesh	00:0B:6B:DE:51:A1	wds1	285	00:48:25	154	1

5 items (1 selected)

Forwarding Database - device types

► **local** - local device

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Forwarding Database - device types

- ▶ **local** - local device
- ▶ **outsider** - device external to the mesh

Mesh

Mesh Ports FDB

Find

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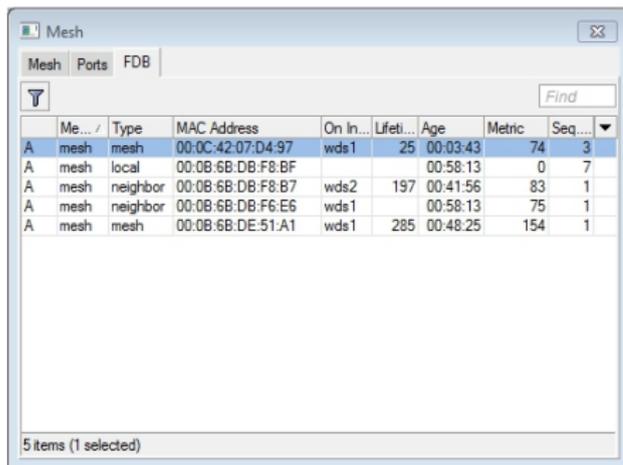
Forwarding Database - device types

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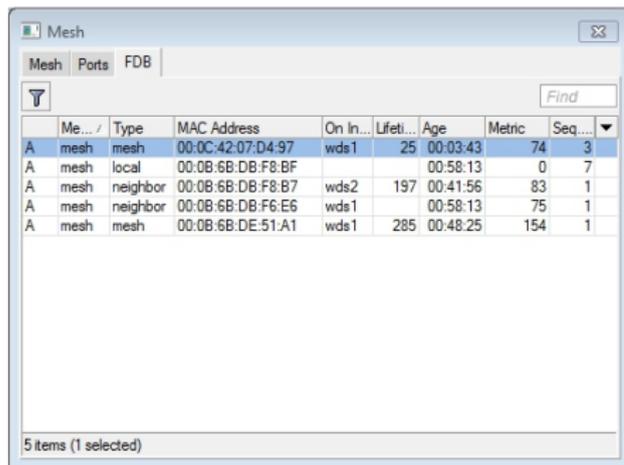
The screenshot shows a network device's Forwarding Database (FDB) window. The window has tabs for 'Mesh', 'Ports', and 'FDB', with 'FDB' selected. A search box labeled 'Find' is present. The table below lists five entries:

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At the bottom of the window, it says '5 items (1 selected)'.

- ▶ **local** - local device
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- ▶ **mesh** - device reachable over the mesh network

Forwarding Database - device types



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- ▶ **neighbor** - mesh device that is directly connected to this device

Forwarding Database - device types

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- ▶ **larval** - an unknown device which is reachable over the mesh network

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- ▶ **larval** - an unknown device which is reachable over the mesh network
- ▶ **unknown** - unknown device

FDB entry details

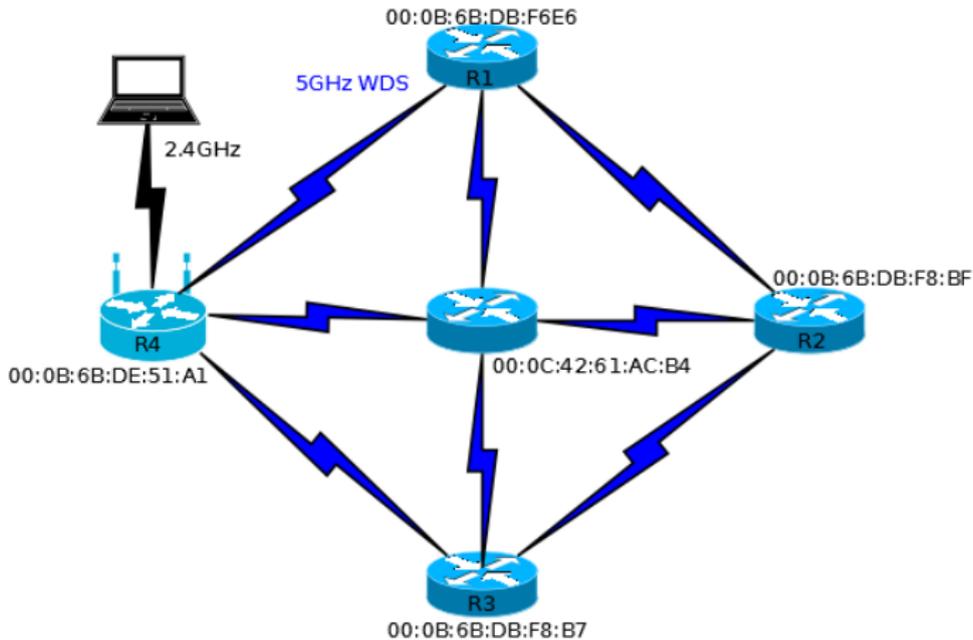
The screenshot displays a network management interface with a 'Mesh' window. The 'FDB' tab is active, showing a table of FDB entries. The first entry is selected, and its details are shown in a pop-up window titled 'Mesh FDB Entry <00:0C:42:07:D4:97>'. The details include:

- Mesh: mesh
- Type: mesh
- MAC Address: 00:0C:42:07:D4:97
- On Interface: wds1
- Lifetime: 205 s
- Age: 00:00:45
- Metric: 74
- Seq. Number: 3
- root: active

The table in the background has the following data:

Me...	Type	MAC Ad
A mesh	mesh	00:0C:4
A mesh	local	00:0B:6
A mesh	mesh	00:0C:4
A mesh	neighbor	00:0B:6
A mesh	neighbor	00:0B:6
A mesh	mesh	00:0B:6

6 items (1 selected)



Any questions?

Thank you.