Remote L2 management

Successfully pass the free certification exam at IW Academy and become an Infinet Certified Engineer.

To the certification exam

Abbreviations

The following abbreviations are used in this document:

- IP – Internet Protocol
- MAC – Media Access Control
- MINT - Mesh Interconnection Networking Technology
- PRF – Pseudo Radio interface
- RCMD – Remote Command

Purpose of this document

InfiNet Wireless is one of the leading manufacturers of Broadband Wireless Access equipment for carrier grade fixed installations. InfiNet Wireless uses its own proprietary transport protocol, MINT, which interconnects the units by wireless and wired (MINT-over-Ethernet technology provides MINT connectivity over wired Ethernet) links. Within MINT areas, it is possible to send any command for execution via the MINT protocol, to a specified unit (MAC addresses can be used for specific unit selection or broadcast MAC addresses can also be used).

This document shows how the unit management can be organized using the MINT protocol for the InfiLINK 2x2 and InfiMAN 2x2 families devices. The MINT protocol operates on both Layer 2 and Layer 3. However, in case of incorrect or missing IP settings on the units, the management of the InfiNet Wireless unit can be restored by issuing MINT RCMD (remote commands) from another InfiNet Wireless unit. MINT management only requires L2 communication and MINT connectivity between units.

Introduction to the MINT protocol

The MINT main purpose is to provide path selection with best quality for wireless (and wired) traffic at Layer 2 (switched traffic).

MINT highlights

Path quality check	MINT constantly checks the transmission quality for each link. In case of link degradation, MINT quickly changes some parameters in order to keep the packet loss value as low as possible automatically. In case of redundant links available, MINT will switch the main traffic through the link with the best transmission quality.
Predictive model	MINT supports a predictive model to select the best path in advance, in order to deliver data as quickly as possible.

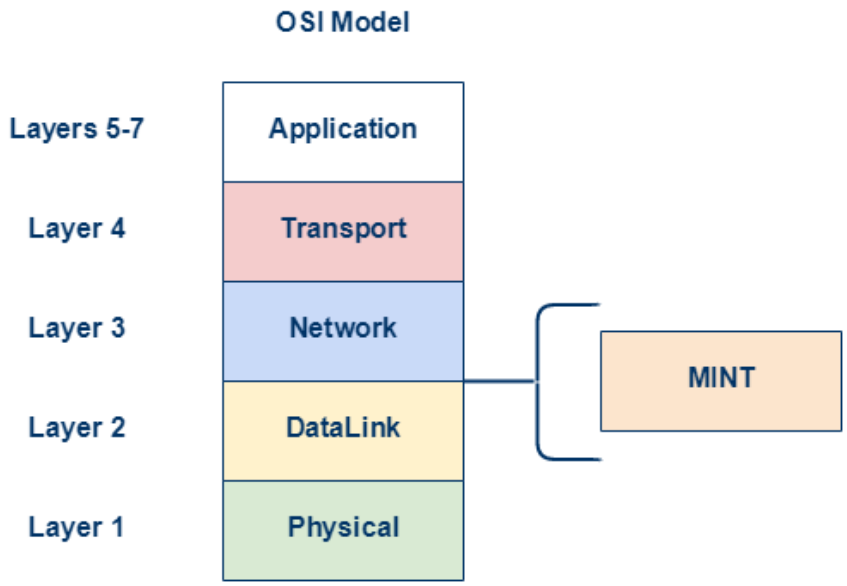
Redundancy and load balancing	MINT protocol was designed to work with multiple redundant paths. Moreover, redundant paths can be used to load balance the traffic from one customer point to another.
Minimum time for data delivery	MINT main criteria for optimal path selection is time (minimum packet delivery time).
MINT connections via wired Ethernet (MINT-over-Ethernet)	MINT-over-Ethernet is a unique feature of IW that allows to select the best path through a network that includes wired interfaces as well. Thus, both wireless and wired interfaces will be taken into account when selecting the best path. MINT-over-Ethernet can be enabled to provide backup and redundant paths, especially for mobile projects. Pseudo Radio Interfaces (PRF) are virtual interfaces created on top of the Ethernet interfaces, providing MINT-over-Ethernet capabilities.
Switching loop prevention	MINT has a built-in mechanism to prevent data loops within the MINT network (when redundant paths are present).

MINT related to the OSI model

A MINT link is the link between two units that use MINT as transport protocol.

MINT encapsulates and transports all types of traffic and all protocols. Thus, MINT is the only transport protocol for the InfiNet Wireless InfiLINK 2x2 and InfiMAN 2x2 families.

MINT operates between the DataLink and the Network layers of the OSI Model. Therefore MINT is capable to encapsulate and carry through the link Layer 2 traffic (Ethernet switched data) and Layer 3 traffic (IP routed data).



MINT technology overview

MINT and the physical interfaces

Only adjacent neighbor connectivity is needed to create MINT powered links:

- For radio interfaces, MINT is enabled by default, only the radio parameters should be configured;
- For Ethernet interfaces, MINT-over-Ethernet should be enabled manually (disabled by default). In this case, Pseudo-radio interface (PRF) should be created. Each BS sector and CPE supports such interfaces.

MINT path selection

In case of multiple MINT routes, the protocol will always choose a route for each single data frame and will have the possibility to re-select a new route for the next data frame, in case of any path characteristics changes. Path characteristics are described by MINT cost the aggregated parameter .

The MINT cost is calculated using the following parameters:

- Signal-to-Noise Ratio (for connectivity over radio interfaces);
- Throughput or Bitrate (for connectivity over radio interfaces);
- Percentage of retries ;
- Link load and throughput;
- Some other parameters.

Link quality assessment:

- Each MINT unit has a full MINT map with all MINT neighbors;
- Each MINT node constantly checks the MINT cost with all his neighbors;
- The update interval depends on the selected mode: for Fixed mode - 3s, for Nomadic - 1,5s, for Mobile - 1s;
- The MINT path can unpredictably change due to changes in the link quality (cost drop).

Loop free capability:

- The path for data is selected by the lowest overall cost;
- Predefined paths are calculated for every destination, unless any changes occur in the network, when a new calculation is performed;
- The path for each frame or packet can be different;

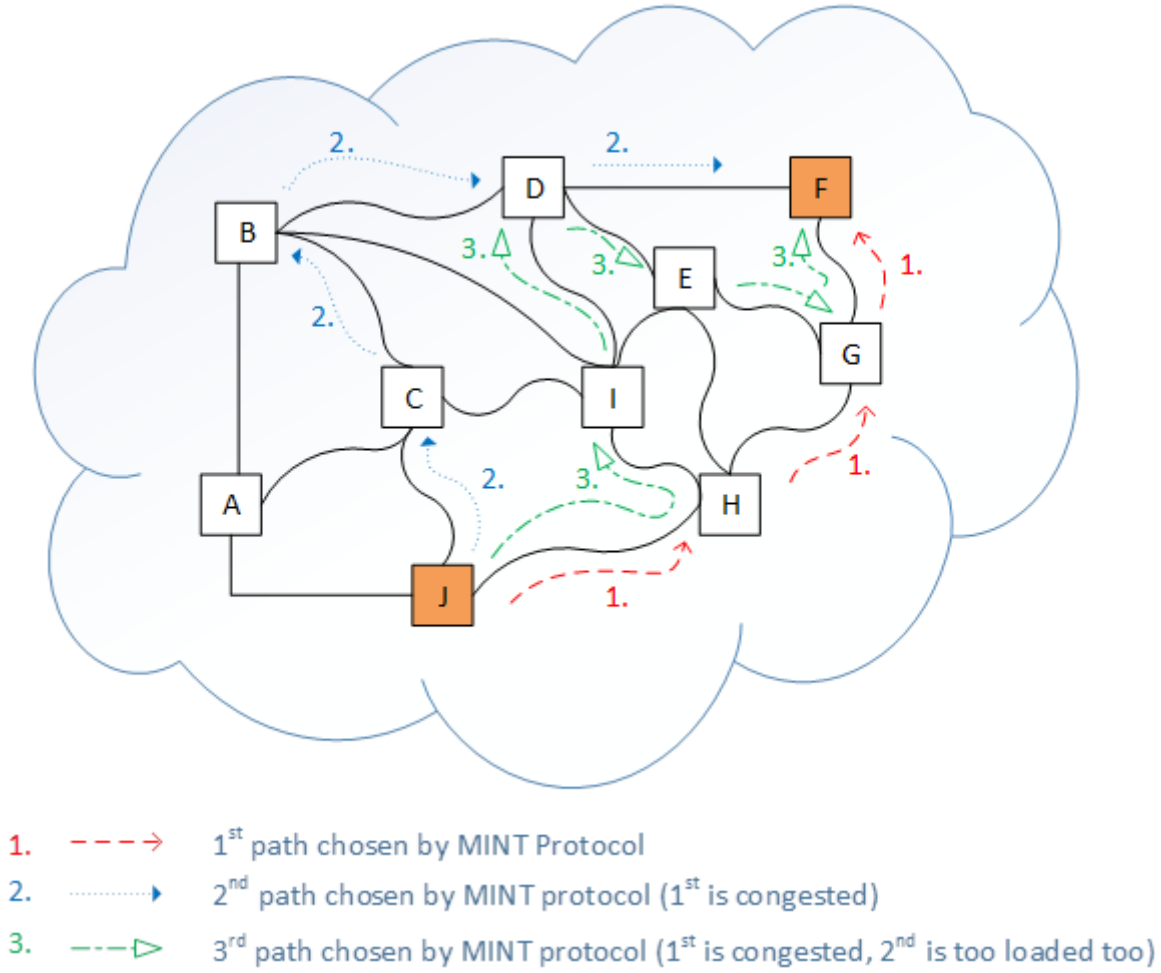
STP BPDU transmission can be blocked by configuration through any logical interfaces.

MINT path selection capabilities

The MINT protocol will quickly adjust to possible changes in critical parameters – re-calculates the MINT cost for each path and rebuilds the path accordingly. Moreover, due to the built-in capability to quickly adopt changes, even the data flow within the MINT network can change rapidly as well.

In the picture below a mesh topology is shown. All units run the MINT protocol for each interface, hence each connection is handled by the MINT protocol. In this case, node J has to send data to node F.

Title



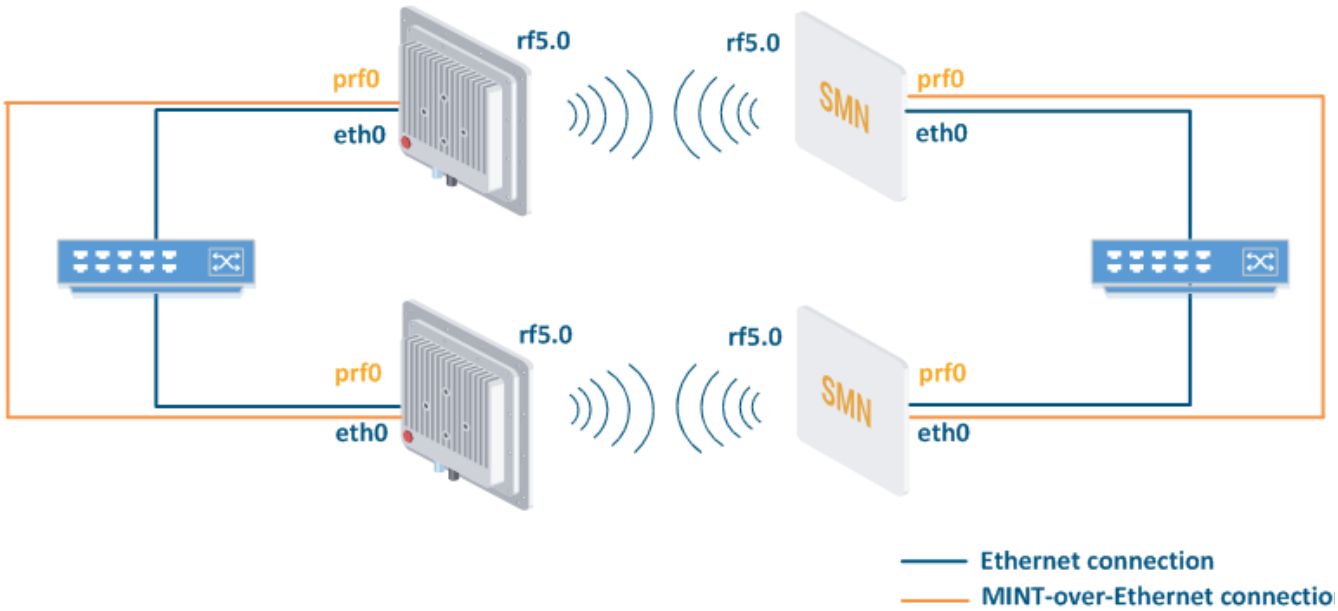
The path selection process is shown in detail in the video below:

Your browser does not support the HTML5 video element

MINT area

All the benefits of the MINT protocol mentioned above, are available only in a network where all the units support the MINT protocol as the only transport protocol. Such a MINT network is called a MINT area. Thus it is required to create a unified MINT area consisting of InfiNet Wireless units interconnected by wireless radio interfaces (RF) or by wired MINT-over-Ethernet (Pseudo Radio) interfaces.

Title



So, here we have a network where almost each unit has at least two connections via the MINT protocol. Therefore, it is possible to switch the traffic via one or another path (or even load balance using both paths). In case of a link failure, the traffic will flow through the remaining link. Eventually, under normal circumstances the units will always stay connected because both links being down is a situation very unlikely to happen. It doesn't really matter what type of physical connection is used (wired or wireless), MINT works with any connection, the only difference is the MINT cost value for each link. So the MINT area main purpose is to create a the network where all nodes are familiar with the link cost values between all nodes and to guarantee the fastest calculation of the best route by taking into account the radio parameters.

> **NOTE**
>
> For more information about traffic balancing proceed to article Link aggregation, balancing and redundancy.

MINT RCMD

Within a MINT area every MINT node can receive information about another MINT node through its MINT neighbors. Every MINT neighbor exchanges information about its adjacent links, their quality, load, issues and MAC address. The MAC address is used as an identification label for a MINT node.

List of MINT neighbors:

```
Master#>console>mint map detail

================================================================================
Interface rf5.0  TDM (5 ms DL/UL:Auto) (RSSI=-43 Dist=1) (Sync Off)
Node  00043513724F  "Master", Id 25871, Nid 0, (Master)
Freq 5470, Band 20, Sid 10101010, autoBitrate 130000 (min 13000), Noise -94

 ------- --------------------------- ------------ -----  ------- ----- -------
   Id         Name                        Node     Level  Bitrate Retry Options
 ------- --------------------------- ------------ rx/tx   rx/tx  rx/tx -------
   60755 Slave                       00043523FA93 14/14  104/104  0/0  /S/
         load 0/4, pps 0/1, cost 51
          pwr 25/27, rssi -57/-53, snr 33/36
          dist 0.14
          H11v2.1.11, IP=10.10.10.2, up 18 days
   60756 Slave 2                     00043523FA94 18/30  117/130  0/0  /S/
         load 5/2, pps 2/0, cost 51
          pwr 12.5/27, rssi -50/-21, snr 41/63
          dist 0.18
          H11v2.1.11, IP=192.168.103.37, up 14 days
 ------- --------------------------- ------------ -----  ------- ----- -------
 2 active neighbors
 Total load: 5/6 (rx/tx), 11 (sum) Kbps
 Total nodes in area: 3
```

So, a MINT neighbor is designated by its MAC address.

A unique feature of the MINT protocol is the possibility to send any command for execution to any MINT neighbor from a MINT neighbor unit. It is called MINT Remote Command execution (RCMD). MINT RCMD could be helpful in lots of cases, such as: lost password, ip address settings cleared, no possibility to login to the remote MINT neighbor directly, or when it is required to execute some commands on all MINT neighbors.

Examples

Force reboot on remote MINT neighbor

```
Master#>mint rf5.0 rcmd -n 00043523FA93 "restart yes"
```

Set new IP address and Default Gateway on remote MINT neighbor

```
Master#>mint rf5.0 rcmd -n 00043523FA93 "ifc svi1 172.12.77.2/27; route add 0.0.0.0/0 172.12.77.1;"
```

> **NOTE**
>
> The full syntax of the MINT remote commands with different options is described in the WANFleX command reference guide - Layer 2 commands set - PHY and MAC.

MINT area prerequisites

In the default configuration, the MINT protocol is enabled and used only between wireless radio interfaces. However, in order to create an interconnected MINT area, MINT-over-Ethernet interfaces (PRF) are required.

In order to enable MINT-over-Ethernet, proceed with the following:

- Create a virtual Pseudo Radio Interface (PRF). PRF can be created as logical sub-interface for physical Ethernet interface (parent interface), or as logical sub-interface for another logical interface;
- Enable the MINT protocol for the PRF interface;
- Use the JOIN option to create an internal connection between the Radio interface and the PRF interface.

Within the same Ethernet broadcast domain (LAN) two (or more) InfiNet Wireless units with PRF interfaces created, can find each other and establish connections via MINT by sending and receiving Ethernet broadcast frames. Thereafter, InfiNet Wireless units will use Ethernet unicast data transfer.

VLAN considerations

In case that two InfiNet Wireless devices are placed within certain VLANs, then the configuration of PRF should be performed within a specific VLAN tag .

MINT-over-Ethernet & VLANs

MINT-over-Ethernet generates broadcast traffic to find other MINT neighbors. Sometimes, such broadcast traffic could be treated as abnormal by the network, especially for enterprise networks using a comprehensive network security policy.

> **NOTE**
>
> It is recommended to put MINT-over-Ethernet connections into dedicated VLAN zones, thus keeping all broadcast traffic within a unique VLAN

Moreover, in an entirely MINT-over-Ethernet network, different MINT-over-Ethernet areas should be isolated from each other in order to provide complex traffic engineering or prevent undesired traffic path selection. Hence, VLAN separation should be used in such cases.

Configuration part

The steps to configure MINT-over-Ethernet are shown below. Only step 4 is different for the untagged approach (4b) versus the vlan based approach (4a).

CLI based configuration

1. Create Pseudo Radio (PRF) interface on all devices and set eth0 as parent:

Units

```
ifconfig prf0 up
prf0 link administratively up

Master#console>prf 0 parent eth0
OK.
```

2. Start the MINT protocol for the PRF interface:

Units

```
mint prf0 start
OK.
```

Check the connection between the devices:

Units

```
mint prf0 map detail

================================================================================
Interface prf0  (parent eth0)
Node  00043503724F  "Master", Id 25871, Nid 0, (Master)

 ------- --------------------------- ------------ -------
   Id         Name                        Node     Options
 ------- --------------------------- ------------ -------
   60756 Slave 2                     00043503FA94 prf
          load 64/0, pps 6/0, cost 51
           H11v2.1.11, up 00:00:24
 ------- --------------------------- ------------ -------
 1 active neighbors
 Total load: 64/0 (rx/tx), 64 (sum) Kbps
 Total nodes in area: 2
```

Right now we have created and enabled the radio link and the backup MINT-over-Ethernet paths. We have just created and enabled TWO independent instances of the MINT protocol. Both instances are completely independent and have no information of each other, no matter if they are started inside the same unit.

Therefore, the next step is to join these instances together.

3. Create a unified MINT interface using the join command:

Units

```
mint join prf0 rf5.0

Complete list of joined interfaces:
mint join rf5.0 prf0
```

Now, both MINT interfaces are treated by the unit as a single entity, hence MINT exchanges information using both ways (wireless and wired).

4. In order to allow the IP management traffic to reach the unit, switch groups need to be configured.

4a. In case of a VLAN based management, a VLAN interface is requiered with the eth0 interface as parent interface. Created a VLAN interface and add one of the joined interfaces (rf or prf) to the switch group. We strongly recommend you to configure a switch group number that matches with the VLAN ID in order to avoid any confusion.

Units

```
ifconfig vlan100 vlan 100 vlandev eth0 up

sw group 100 add vlan100 rf5.0
OK.

sw group 100 start
OK.
```

4b. If no VLAN is used for management, it is enough to add the eth0 interface and one of the joined interfaces (rf or prf) to the switch group.

Units

```
sw group 100 add eth0 rf5.0
OK.

sw group 100 start
OK.
```

5. Create the management svi interface, add it to the the group and set the IP address to the svi interface.

Units

```
ifc svi100 up
svi100 link administratively up

svi 100 group 100
OK.

ifc svi100 192.168.1.3/24
OK.
```

6. Don't forget to save the configuration.

Units

```
config save
```