

## ePMP Point-to-Point Configuration Primer

Providing step-by-step instructions for configuring and verifying ePMP point-to-point or bridge networks (Software version 3.0)

### Pre-installation considerations

As the user of the radio equipment, it is your responsibility to ensure that your system complies with any regulatory guidelines imposed by the local regulator.

We recommend that you complete a site survey to identify the many considerations critical for successful site selection such as the availability of tower or rooftop space, the location of the grounding system, best positioning of the devices, aesthetics and other permission-based issues, and maximum cable lengths required for your deployment.

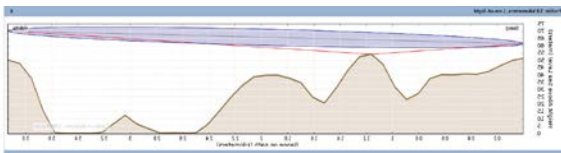
Structures, equipment and people must be protected against power surges (typically caused by lightning) by conducting the surge current to ground via a separate preferential solid path. The actual degree of protection required depends on local conditions and applicable local regulations. If the Ethernet connection of the radio is to be operated in 10/100 Mbps mode, then the 600SSH Surge suppressor can be utilized. Otherwise a 3<sup>rd</sup>-party Gigabit Ethernet-compatible surge suppressor should be used (for example, L-Com models AL-CAT6JW and AL-CAT6HPJW).

### ePMP PTP Terminology Overview

The ePMP device can operate in two types of point-to-point modes:

**TDD (PTP):** The AP operates in Point-To-Point mode using TDD scheduling. In this mode Quality of Service configuration (rate-limiting and traffic prioritization) is available, and TDD mode is recommended for CCTV applications so that link symmetry (adjustment of downlink / uplink ratio) can be controlled to meet the deployment's high uplink bandwidth requirements.

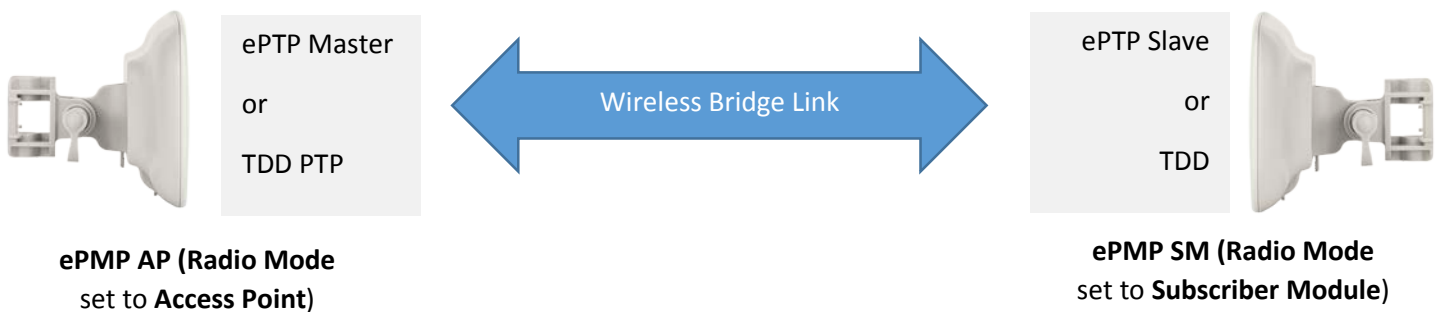
**ePTP:** In this mode, the PTP device is able to provide significantly lower latency than other modes. Quality of Service (rate-limiting and traffic prioritization) capability and Link Quality/Capacity indicators are not available in this mode.



Determine link and sector-planning factors such as path obstructions, risk of interference, path and link loss, maximum power levels permitted, and coverage requirements. Cambium Networks' [LINKPlanner](#) allows you to model "what if" scenarios - based on geography, distance, antenna height, transmit power, and other

factors - to optimize system performance before purchase.

One of the most important elements in your planning process is the analysis of spectrum usage and signal strength needed to occupy the spectrum you are planning to use. For PTP links you need to determine whether there is available spectrum to accomplish your desired goal.



## Log into the web interface

Use this procedure to log into the device web interface as a system administrator.

### Procedure

1. Start the web browser from the management PC
2. Type the IP address of the unit into the address bar. The factory default IP address is either 192.168.0.1 (AP mode) or 192.168.0.2 (SM mode). Press **ENTER**. The web interface dashboard and login input is displayed.



### Note

If **Device IP address Mode** is set to **DHCP** and the device is unable to retrieve IP address information via DHCP, the device management IP is set to fallback IP 192.168.0.1 (AP mode), 192.168.0.2 (SM mode), 192.168.0.3 (Spectrum Analyzer mode) or the previously-configured static Device IP Address. Units may always be accessed via the Ethernet port. With Release 2.1, the fallback IP address has changed from 10.1.1.254 to 169.254.1.1.

3. Enter **Username** (default: admin) and **Password** (default: admin).
4. Click Login. New ePMP devices all contain default username and password configurations. It is recommended to change these password configurations immediately. These passwords may be configured in the management GUI in section **Configuration => System => Account Management**.

### Equipment and tools

- Connectorized or integrated device connected to power supply by Ethernet cable.
- PC connected to power supply by Ethernet cable.
- Power Supply powered up.
- Supported browser – Chrome v29, Firefox v24, Internet Explorer 10, Safari v5.

## Check / upgrade the software version – Important!

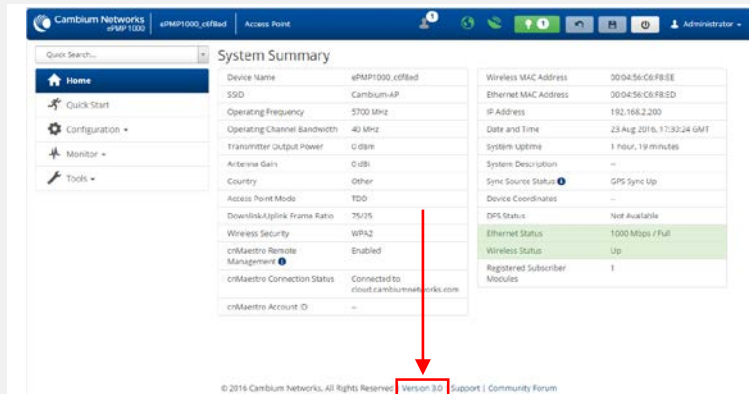
Use this procedure to verify the device software version and upgrade if necessary.

### Procedure

1. At the device web interface home screen, check the software version listed at the bottom of the browser window.
2. Compare this version with the latest software listed here:  
<https://support.cambiumnetworks.com/files/epmp/>
3. If necessary, download the latest software from the Cambium Networks support site listed in step 2.

*ePMP radios running System Release 2.1 or earlier cannot be directly upgraded to System Release 2.6.1 or later. Please upgrade to System Release 2.6 first, then upgrade to System Release 2.6.1 or later. Stepping through System Release 2.6 is not required if the ePMP radio is running System Release 2.2 or later.*

4. On the device, navigate to **Tools -> Software Upgrade**.
5. Click **Browse...** and select the downloaded software package.
6. Click **Upgrade**.
7. When the upgrade has completed, reset the device by clicking the **Reboot Device** button in the upper-right-hand corner.



## Configuring ePMP Access Point (AP) devices to operate as ePTP Master or TDD PTP devices

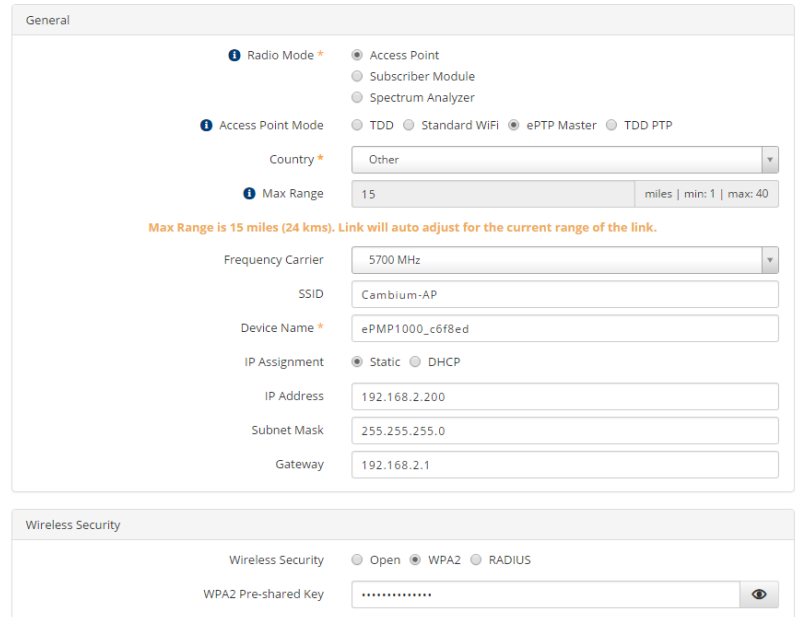
The **Quick Start** tab contains a listing of parameters required to configure a simple radio link and to configure requisite networking parameters.

To configure the device to operate in **ePTP Master** or **TDD PTP** mode via the **Quick Start** menu, follow the procedure below:

### Procedure:

1. Start the web browser from the management PC.
2. Navigate to the **Quick Start** menu.
3. Configure the parameter **Radio Mode** to **Access Point**.

Quick Start > Quick Start



The screenshot shows the 'Quick Start' configuration page. The 'General' tab is active, displaying the following settings:

- Radio Mode:** Access Point (selected), Subscriber Module, Spectrum Analyzer
- Access Point Mode:** TDD, Standard WiFi, ePTP Master (selected), TDD PTP
- Country:** Other (dropdown menu)
- Max Range:** 15 miles (min: 1, max: 40). A note below states: "Max Range is 15 miles (24 kms). Link will auto adjust for the current range of the link."
- Frequency Carrier:** 5700 MHz (dropdown menu)
- SSID:** Cambium-AP
- Device Name:** ePMP1000\_c6f8ed
- IP Assignment:** Static (selected), DHCP
- IP Address:** 192.168.2.200
- Subnet Mask:** 255.255.255.0
- Gateway:** 192.168.2.1

The 'Wireless Security' tab is also visible, showing:

- Wireless Security:** Open, WPA2 (selected), RADIUS
- WPA2 Pre-shared Key:** [Redacted]

4. Configure the parameter **Access Point Mode** to **ePTP Master** or **TDD PTP** based on your deployment's requirements. See page 1 for information about **ePTP Master** and **TDD PTP** modes.
5. Configure the parameter **Country**:

Country settings affect the radios in the following ways:

- Maximum transmit power limiting (based on radio transmitter power plus configured antenna gain)
- DFS operation is enabled based on the configured country code, if applicable
- Frequency selection limiting (based on valid frequencies for the configured country)

Select the country in which your network will be operating. Please note that setting **Country** to **Other** allows unrestricted configuration of the unit's **Transmitter Output Power** and **Frequency Carrier** – ensure that the transmit power plus applicable antenna gain and frequency setting is within your country's EIRP and spectral limits.

6. (If using **TDD PTP** mode) Configure the parameter **Max Range**:

Enter a number of miles or kilometers for the furthest distance from which a slave PTP device is allowed to register to this master PTP device. Do not set the distance to any greater number of miles. A greater distance:

- does not increase the power of transmission from the master device.
- can reduce aggregate throughput.

Regardless of this distance, the slave device must meet the minimum requirements for an acceptable link. The master device will reject any slave device network entry attempts from outside the configured maximum range. Verify that the **Max Range** setting is configured to a distance slightly greater than the distance of the PTP link to maximize link throughput and decrease latency.

7. *Simple frequency configuration option* - (If using **TDD PTP** mode) Configure the parameter **Automatic Channel Selection**:

If **Automatic Channel Selection** is enabled, then after a reboot or when a user selects the **Run ACS** button the device will scan all valid channels for the configured **Country** code and selects the channel with the least amount of noise to operate on. The unit will continue to look for the best channel upon every reboot until this parameter is disabled. Typically, PTP links are deployed using one static, well-surveyed frequency.

8. *Advanced frequency configuration option* - Configure the parameter **Frequency Carrier** (if not utilizing Automatic Channel Selection):

Configure the frequency carrier for RF transmission. This list is dynamically adjusted to the regional restrictions based on the setting of the **Country** parameter. Ensure that a thorough spectrum analysis has been completed prior to configuring this parameter.

9. Configure parameter **SSID**:

The **SSID** is used to identify the device and is used to configure the opposite end of the link with the appropriate device with which to register. Ensure that this parameter is configured uniquely for each ePTP Master in the network.

10. Configure the parameter **Device Name**:

The **Device Name** is used to identify the device on the network. This parameter may be modified or left at the default value of **Cambium-AP**.

11. (If using **TDD PTP** mode) Configure the parameter **Downlink/Uplink Ratio**:

Configure the schedule of downlink traffic to uplink traffic on the radio link. The first three options, **75/25**, **50/50** and **30/70**, allow the radio to operate in a fixed ratio on every frame. In other words, this ratio represents the amount of the total radio link's aggregate throughput that will be used for downlink resources, and the amount of the total radio link's aggregate throughput that will be used for uplink resources.

*For CCTV applications, it is recommended to set **Downlink/Uplink Ratio** to **30/70** to maximize the amount of uplink resources available for transmission of video data on the uplink.*

The fourth option, **Flexible**, allows the radio to dynamically choose the amount of the total radio's aggregate throughput that is used for downlink and uplink resources, every frame. This option does not allow synchronization of transmission or frequency reuse between in-range deployments.

12. (If using **TDD PTP** mode) Configure the parameter **Synchronization Source** to **Internal**:

When **Synchronization Source** is set to **Internal**, synchronization timing is generated by the AP (TDD PTP device) and the timing is not based on GPS pulses.

Radio devices using **Synchronization Source** of **Internal** will not transmit and receive in sync with other co-located or in-range devices. See section [A note on GPS synchronization in PTP deployments](#) on page 8 for more information about GPS synchronization and its uses.

13. Configure the parameter **IP Assignment**:

If **DHCP** is selected, the DHCP server automatically assigns the IP configuration (Ethernet (LAN) IP Address, Ethernet (LAN) IP Subnet Mask, Gateway IP Address (LAN)) and the values of those individual parameters (below) are not used. To configure a simple test network, select mode **Static**.

14. Configure the parameter **IP Address**:

Internet Protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. To configure a simple test network, this field may be left at default (**192.168.0.1**).

15. Configure the parameter **Subnet Mask**:

The Subnet Mask defines the address range of the connected IP network. To configure a simple test network, this field may be left at default (**255.255.255.0**).

16. Configure the parameter **Gateway**:

The IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks. To configure a simple test network, this parameter may be left at default (**blank**).

17. Configure the parameter **Wireless Security**:

**Open**: All ePTP Slave devices requesting network entry are allowed registration.

**WPA2:** The WPA2 mechanism provides AES radio link encryption and ePTP Slave network entry authentication. When enabled, the ePTP Slave must register using the **Authentication Pre-shared Key** configured on the ePTP Master

18. Click the **Save** icon, then click the **Reboot** icon.

### Configuring ePMP Subscriber Module (SM) devices to operate as ePTP Slave or TDD PTP devices

The **Quick Start** tab contains a listing of parameters required to configure a simple radio link and to configure requisite networking parameters.

To configure the device to operate in **ePTP Slave** or **TDD** mode via the **Quick Start** menu, follow the procedure below:

**Procedure:**

1. Start the web browser from the management PC.
2. Navigate to the **Quick Start** menu.
3. Configure the parameter **Radio Mode** to **Subscriber Module**
4. Configure the parameter **Subscriber Module Mode** to **ePTP Slave** or **TDD** based on your deployment’s requirements. See page 1 for information about **ePTP Slave** and **TDD PTP** modes.

5. Configure the parameter **Device Name**:  
The Device Name is used to identify the device on the network. This parameter may be modified or left at the default value of **Cambium-SM**.

6. Configure the **Network Mode** parameter:  
This parameter defines how the network interface at the ePTP Slave/TDD module will function. Three options are available:

**NAT:** The ePTP Slave/TDD module acts as a router and packets are forwarded or filtered based on their IP header (source or destination). The device translates IP addresses between the Wireless and Ethernet interfaces.

**Bridge:** The device acts as a switch, and packets are forwarded or filtered based on their MAC destination address.

**Router:** The device acts as a router and packets are forwarded or filtered based on their IP header (source or destination) using specific Static Routes and IP Aliases configured by the operator.

7. Configure the parameter **IP Assignment**:

Quick Start > Quick Start



If **DHCP** is selected, the DHCP server automatically assigns the IP configuration (**Ethernet (LAN) IP Address, Ethernet (LAN) IP Subnet Mask, Gateway IP Address (LAN)**) and the values of those individual parameters (below) are not used. To configure a simple test network, select mode **Static**.

8. Configure the parameter **IP Address**:

Internet Protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. To configure a simple test network, this field may be left at default (**192.168.0.2**).


9. Configure the parameter **Subnet Mask**:

The Subnet Mask defines the address range of the connected IP network. To configure a simple test network, this field may be left at default (**255.255.255.0**).

10. Configure the parameter **Gateway**:

The IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks. To configure a simple test network, this parameter may be left at default (blank).

11. If applicable, configure the parameter **WPA2 Pre-shared Key**:

Configure the device with this key (matching the ePTP Master/TDD PTP Master configured key) to complete the authentication configuration. This key must be between 8 to 128 symbols. Click the visibility icon  to toggle the display of the key's contents.

12. Configure the **Preferred APs** list:

The **Preferred APs** list is comprised of a list of up to 16 Access Points (ePTP Masters or TDD PTP devices, in this case) to which the ePTP Slave/TDD device sequentially attempts registration. For each AP (ePTP Master/TDD PTP device) configured, if authentication is required, enter a **Pre-shared Key** associated with the configured SSID. If this list is empty or if none of the configured APs (ePTP Masters/TDD PTP devices) are found, the ePTP Slave/TDD PTP device scans and registers to the best AP (ePTP Master/TDD PTP device) signal found with matching radio and/or authentication settings.

13. Configure the section **Subscriber Module Scanning**:

For a simple radio network setup, click **Select All** to scan all frequencies. The **Radio Scan List** determines the frequencies and channel bandwidths for which the device scans for ePTP Master/TDD PTP device signaling. For each channel bandwidth selected, an associated tab is displayed with applicable frequencies available for scanning.

14. Click the **Save** icon, then click the **Reboot** icon.

### Verifying the ePMP Point-to-Point link

The **Home** tab contains a **System Summary** displaying important system parameters and statistics.

To quickly verify that the ePTP Slave or TDD PTP device has registered, reference **Registered Subscriber Modules**. To verify that the correct device has registered, navigate to **Monitor -> Wireless** and validate the **Registered Subscriber Modules** list.

For further verification of the link, navigate to **Tools -> Wireless** and run a wireless link test to determine the capacity of the link.

The screenshot shows the 'System Summary' page with two columns of data. The left column lists system parameters, and the right column shows wireless-related status. A red box highlights the 'Registered Subscriber Modules' row, which shows a value of '1'. A red arrow points to the 'Wireless Status' row, which shows 'Up'.

System Summary	
Device Name	ePMP1000_c8f8ed
SSID	Cambium-AP
Operating Frequency	5690 MHz
Operating Channel Bandwidth	40 MHz
Transmitter Output Power	0 dBm
Antenna Gain	0 dBi
Country	Other
Access Point Mode	ePTP Master
Downlink/Uplink Frame Ratio	--
Wireless Security	WPA2
cnMaestro Remote Management	Enabled
cnMaestro Connection Status	Resolving URL
cnMaestro Account ID	--
Wireless MAC Address	00:04:56:C6:F8:EE
Ethernet MAC Address	00:04:56:C6:F8:ED
IP Address	192.168.2.200
Date and Time	01 Sep 2015, 01:18:25 GMT
System Uptime	1 hour, 18 minutes
System Description	--
Sync Source Status	Sync Down
Device Coordinates	--
DFS Status	Not Available
Ethernet Status	1000 Mbps / Full
Wireless Status	Up
Registered Subscriber Modules	1

## Quality of Service considerations

The ePMP platform supports three QoS priority levels (not available in ePTP Slave mode) using an air-fairness, priority-based starvation avoidance scheduling algorithm.

Ordering of traffic amongst the priority levels is based on a percentage of total link throughput. In other words, all priorities receive *some* throughput so that low priority traffic is not starved from transmission. In effect, the greatest amount of throughput is guaranteed to the VOIP priority level, then High, then Low.

ePMP Traffic Priority Label	Priority Level	Priority 
VOIP	Highest Priority	
High	Medium Priority	
Low	Lowest Priority	

By default, all traffic passed over the air interface is low priority. The **Quality of Service** page may be utilized to map traffic to certain priority levels using QoS classification rules. The rules included in the table are enforced starting with the first row of the table.



### Caution

*Each additional traffic classification rule increases device CPU utilization. Careful network planning is required to efficiently use the device processor.*

The ePMP platform supports prioritization based on the following traffic types and identifiers, many of which are supported on modern video surveillance and transmission systems:

**DSCP:** Differentiated Services Code Point; traffic prioritization is based on the 6-bit Differentiated Services field in the IP header present in the packet entering the Ethernet port.

**CoS:** Class of Service; traffic prioritization is based on the 3-bit header present in the 802.1Q VLAN-tagged Ethernet frame header in the packet entering the device Ethernet port.

**VLAN ID:** Traffic prioritization is based on the VLAN ID of the packet entering the device Ethernet port.

**EtherType:** Traffic prioritization is based on 2 octet Ethertype field in the Ethernet frame entering the device Ethernet port. The Ethertype is used to identify the protocol of the data in the payload of the Ethernet frame.

**IP:** Traffic prioritization is based on the source and/or destination IP addresses of the packet entering the device Ethernet port. A subnet mask may be included to define a range of IP addresses to match.

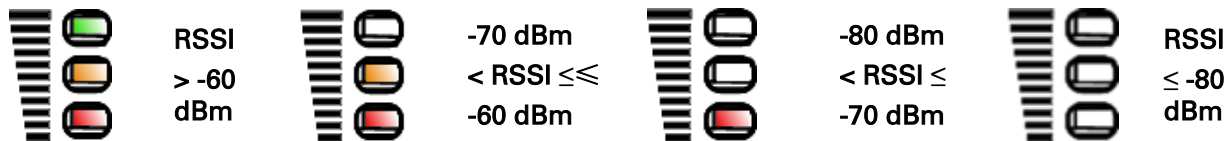
**MAC:** Traffic prioritization is based on the source and/or destination MAC addresses of the packet entering the device Ethernet port. A mask may be included to define a range of MAC addresses to match.

### Optimizing the radio link using coarse and fine alignment

Once a link is established between the two ePMP modules, it is important to align the devices to achieve the highest possible RSSI (Received Signal Strength Indicator) readings. By maximizing RSSI, the radio link's dependability and speed is also optimized.

#### Coarse alignment

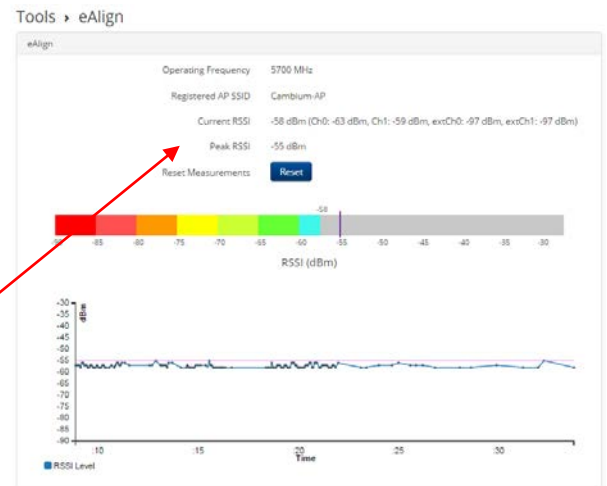
To begin coarse alignment, observe the slave device's signal level LED indicators until the maximum number of LEDs are lit. For reference, see the table below of LED states for the slave device:



#### Fine Alignment

To complete the alignment, final fine adjustments may be made by navigating to **Tools -> eAlign** and monitoring the **Current RSSI** and **Peak RSSI** statistics. Incrementally adjust the radio's positioning to maximize RSSI.

Maximize the device RSSI for best link performance. Use the line graph to reference the quality of recent alignment attempts.



### A note on GPS synchronization in PTP deployments



ePMP 1000 and ePMP 2000 devices feature a fixed TDD (GPS-Synchronized) mode which organizes the TDD data frames into TDD sub-frames based on fixed DL to UL ratios, thereby enabling synchronization across multiple networks.

The DL/UL cycles are configured in the AP (TDD PTP device) and are controlled by the GPS timer mechanism, which sends a pulse to the radios for synchronization amongst them. This periodic DL/UL cycle creates a predictable communication model that reduces self-interference and improves both performance and reliability. Taken together with transmit power control, these features enable co-located and non-co-located frequency reuse, maximize spectral efficiency in congested areas (where spectrum is crowded) and offer an opportunity to increase installation density with improved quality of service.

While GPS synchronization is not typically required for a simple Point-to-Point link, operators with requirements for multiple in-range deployments or installations in crowded radio spectrum may consider taking advantage of using ePMP 1000 or ePMP 2000 GPS-Synchronized radios.