

Pharos AP Solution 2

CPE&WBS Outdoor Wi-Fi Solutions for P2MP Applications

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Background

Connecting multiple sites to a central location wirelessly can be beneficial in a range of business scenarios, such as transmitting the video data of an IP Camera back to a monitoring center, or connecting a server room to multiple teaching buildings in a college campus. Point-to-multipoint (P2MP) solutions like these can be achieved using TP-Link's Pharos series outdoor Wi-Fi products.

Application Scenarios

- Remote data acquisition and operation such as a traffic monitoring system, outdoor electronic billboards/street lighting control, chemical production data collection and more
- Network convergence, for example connecting the server room to multiple teaching buildings in a campus, or connecting the headquarters to multiple subsidiaries
- Other scenarios where a wired network connection is not possible

Benefits

- 1) Cost-effective solution with a rich array of features
- 2) Simple deployment, management and maintenance, as well as high stability and reliability
- 3) Experienced and reliable technical support

Solutions

In the network topology for P2MP, we deploy a Base Station AP (access point) at the center of the network to provide wireless network coverage, and deploy Station APs (Client APs) in multiple sites to connect to the Base Station AP. This article will introduce such P2MP wireless networking solutions based on TP-Link Pharos CPE and WBS products.

The solutions include three parts:

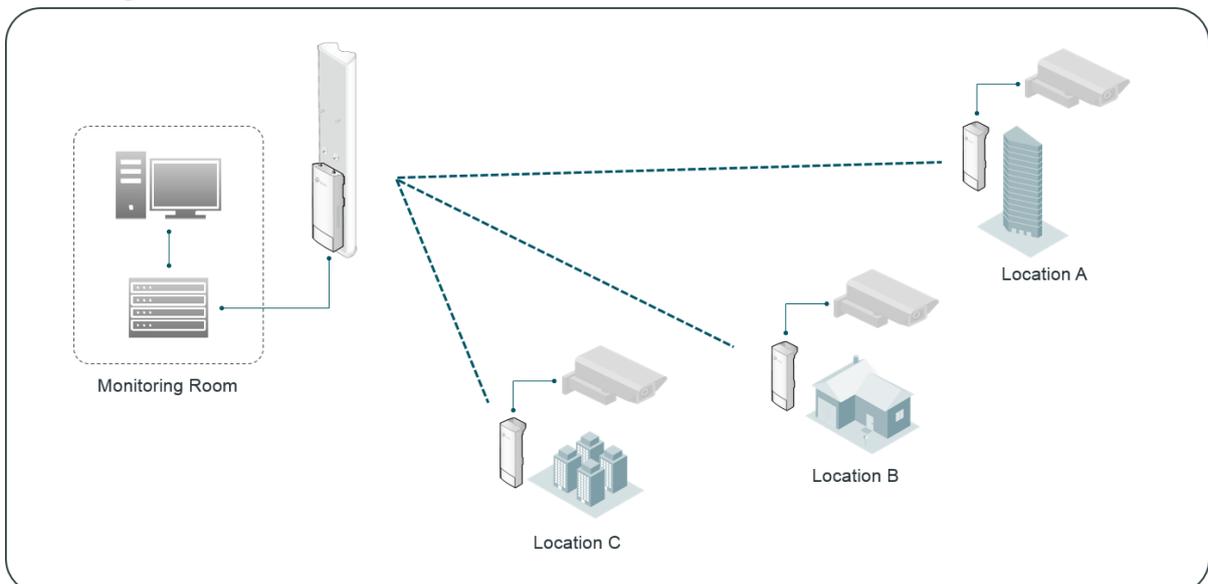
A. Solution Overview and Network Topology Description.

B. Network Deployment and Configuration Guide.

C. Wireless Network Optimization.

A. Solutions Overview and Network Topology Description

Networking Solutions — Outdoor Wi-Fi Solutions for P2MP Based on CPE and WBS



As shown above:

1. Deploy WBS (Base Station AP) on a signal tower at the center point, and use Sector Antenna to provide 120° wireless coverage
2. Deploy CPEs (Client AP) in multiple sites, and connect them to the center network in long distances
3. Connect IP Cameras to CPEs. Monitoring data will be transmitted to the central monitoring room via the wireless network

B. Network Deployment and Configuration Guide

1. Network Deployment and Configuration Guide 1: Solution Selection

TP-Link provides two sets of networking solutions for P2MP Wi-Fi based on Pharos products: Economic solution (based on CPE) and Enhanced solution (based on WBS).

Solution	Economic	Enhanced
Product on AP Side	CPE	WBS + Sector Antenna
Product on Client Side	CPE	CPE
Horizontal Coverage Angle	45°-65°	120°
Recommended Distance	0-15km	0-15km

In general, it is recommended to adopt the Enhanced solution based on WBS + Sector Antenna with the following advantages:

- 1) Wider coverage, longer distance communication and better performance
- 2) Simpler antenna alignment since the Enhanced Solution has a wider angle of coverage than the Economic solution

2. Network Deployment and Configuration Guide 2: Introduction to Pharos

TP-Link Pharos series includes three types of products: CPE, WBS, and MIMO Antenna. This article will make a brief introduction to them. For more detailed information, please refer to the [CPE&WBS](#) and [MIMO Antenna](#) pages on our official website.

CPE is an access point device and has built-in directional antennas. So far there are four models of CPE: CPE210, CPE220, CPE510 and CPE520. The specifications are as follows:

Model	CPE210	CPE220	CPE510	CPE520
Wireless Speed	2.4G 300Mbps	2.4G 300Mbps	5G 300Mbps	5G 300Mbps
Transmit Power	27dBm	30dBm	23dBm	27dBm
Antenna Gain	9dBi	12dBi	13dBi	16dBi
HPBW Angle	65°	60°	45°	45°
Interface	10/100Mbps Ethernet port *1	10/100Mbps Ethernet port *2	10/100Mbps Ethernet port *1	10/100Mbps Ethernet port *2
Power Supply	24V Passive PoE	24V Passive PoE	24V Passive PoE	24V Passive PoE
Recommended Distances	3km	8km	15km	20km

WBS is another access point device and works together with external antennas (2*2 MIMO Antenna). So far we have two models of WBS: WBS210 and WBS520. The specifications are as follows:

Model	WBS210	WBS510
Wireless Speed	2.4GHz 300Mbps	5GHz 300Mbps
Transmit Power	27dBm	27dBm
Interface	2*10/100Mbps Ethernet Port 2*RP-SMA Male	2*10/100Mbps Ethernet Port 2*RP-SMA Male
Power Supply	24V Passive PoE	24V Passive PoE
Recommended Distances	Dish Antenna: 30km Sector Antenna: 5km Omni Antenna: 2km	Dish Antenna: 40km Sector Antenna: 15km

Pharos MIMO Antenna includes three types of antenna: Sector Antenna, Dish Antenna and Omni Antenna. They are able to provide wireless coverage for different scenarios and requirements. So far we have five models of MIMO Antennas: TL-ANT2424MD, TL-ANT2415MS, TL-2410MO, TL-5830MD and TL-ANT5819MS. The specifications are as follows:

Model	TL-ANT2424MD	TL-ANT2415MS	TL-ANT2410MO	TL-ANT5830MD	TL-ANT5819MS
Type	Dish	Sector	Omni	Dish	Sector
Frequency	2.4GHz	2.4GHz	2.4GHz	5GHz	5GHz
Gain	24dBi	15dBi	10dBi	30dBi	19dBi
HPBW Angle	<5°	120°(6dB) 90°(3dB)	360°	<5°	120°(6dB) 90°(3dB)
Interface	2*RP-SMA Female	2*RP-SMA Female	2*RP-SMA Female	2*RP-SMA Female	2*RP-SMA Female
Scenario	P2P	P2MP	Hotspot	P2P	P2MP

3. Network Deployment and Configuration Guide 3: Production Selection

- AP Selection

Pharos contains a variety of models that can work together flexibly. Therefore, you should deploy products for your wireless network depending on your requirements. We recommend the following Pharos CPE&WBS solutions for P2MP networks:

Solution	Enhanced				Economic	
AP side	WBS210 + TL-ANT2415MS		WBS510 + TL-ANT5819MS		CPE210/ CPE220	CPE510/ CPE520
Frequency	2.4GHz		5GHz		2.4GHz	5GHz
Angle	120°(6dB) & 90°(3dB)		120°(6dB) & 90°(3dB)		<65°	<45°
Client side	CPE210	CPE220	CPE510	CPE520	CPE210/ CPE220	CPE510/ CPE520
Distance	3km	5km	10km	15km	<3/5km	<10/15km

Note: The wireless throughput performance may be decreased since CE/FCC regulations limit wireless transmission power in outdoor areas.

Generally, outdoor Wi-Fi networking cases for P2MP require a Base Station AP that has a wide range of wireless coverage. It is recommended to adopt a solution based on the WBS + Sector Antenna (Enhanced). If there are few clients concentrated in a small area, you can also deploy a CPE product as a Base Station AP. A detailed description of that solution is not provided here.

Note: This document for outdoor Wi-Fi networking solutions for P2MP will mainly introduce the remote monitoring solution of WBS + Sector Antenna as Base Station AP and CPE as Client AP + IP Camera.

TP-Link provides CPE and WBS outdoor Wi-Fi networking solutions for P2MP networks including 2.4GHz and 5GHz solutions. You may choose a suitable solution according to your own requirements. If the wireless interference is large, it is recommended to adopt the 5GHz solutions because of the abundance of available channels and lower wireless interference. There is no difference between the two solutions in terms of networking and deployment, so we will no longer differentiate them in the rest of the introduction.

- **Quantity Selection**

The number of Client APs (CPEs) is directly determined by the number of sub sites, which means that you need to install Client APs on every sub site. For the Base Station APs, you need to consider the capacity (how many WBS products are sufficient to serve all clients) and distribution (how many WBS you need to provide sufficient wireless coverage for all clients).

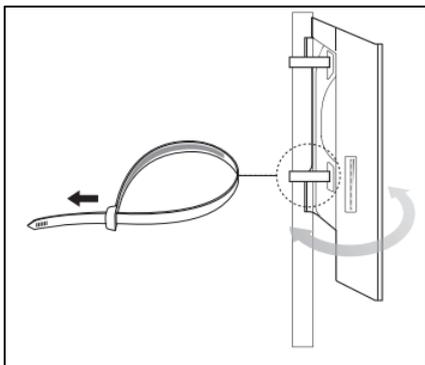
A WBS with MAXstream off is recommended to load less than 20 CPEs, and with MAXstream on it is recommended to load less than 50 CPEs; a WBS + Sector Antenna can cover an angle of 120° . In special circumstances, the Client APs are so highly concentrated that a single WBS cannot load them. In that case, you should deploy multiple WBS products that cover the same angles.

4. Network Deployment and Configuration Guide 4: Field Deployment

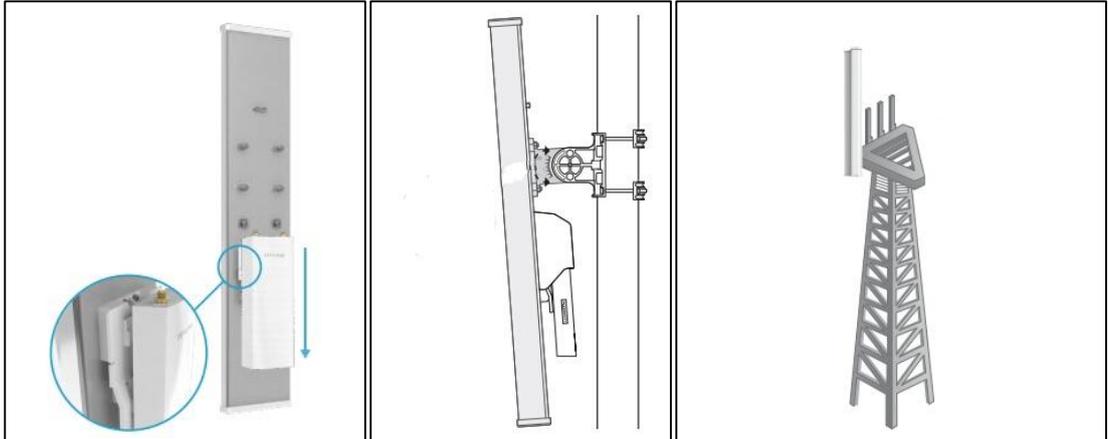
- **Field Deployment 1: AP Installation**

Note: Before installation, you should ensure the first Fresnel area between the installation sites is clear. If there are obstacles present that cannot be removed, you can increase your installation height to avoid them. For detailed information, please refer to [FAQ-907](#).

On the client side, generally the CPEs are installed through pole mounting and fixed in the same bracket as the IP Camera. The CPEs are designed with a binding slot, and the product comes with a special cable to fix it in place.

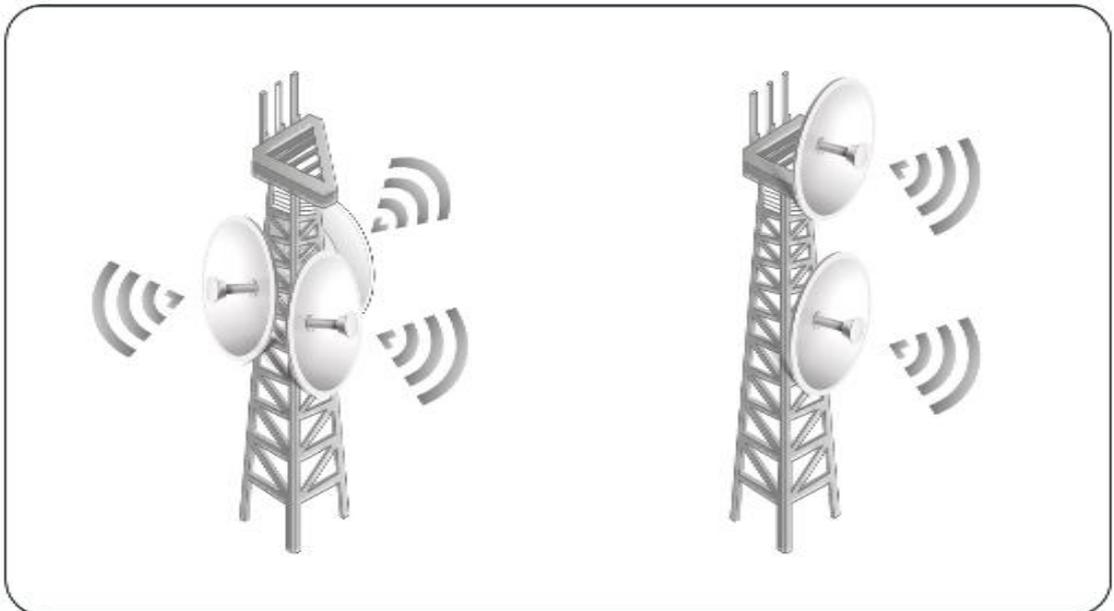


On base station side, a WBS is usually installed using a special bracket or signal tower due to the large size of the Sector Antenna. The Pharos Sector Antenna is designed with a dedicated slot to affix a WBS. You should fix the antenna to the signal tower with a metal bracket. For detailed information, please refer to the [TL-ANT5819MS Installation Guide](#).



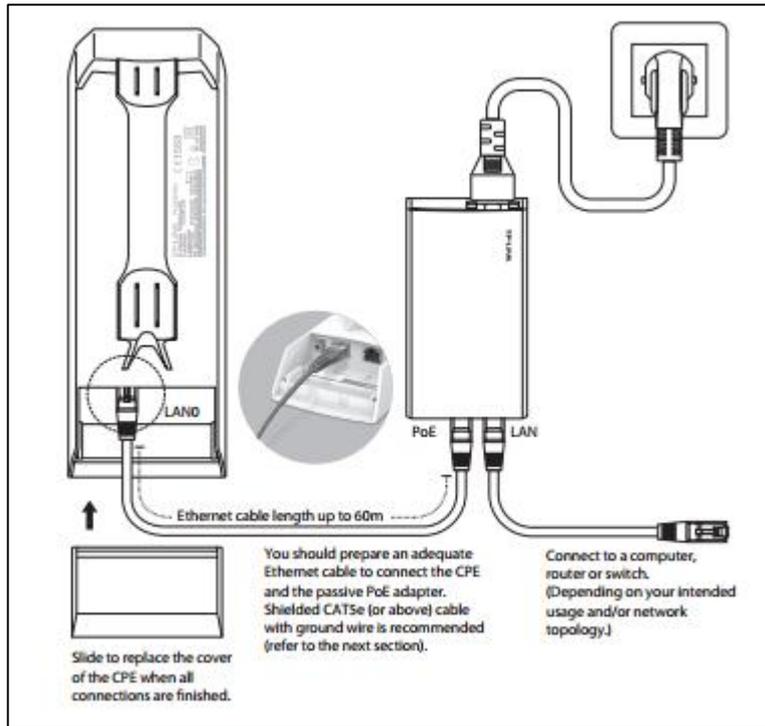
How can I to avoid collocation interference when multiple WBS products are deployed at the same site?

If you deploy multiple WBS products to provide wireless coverage in different directions, you could deploy them at different horizontal positions at the same height (as the left picture below shows); if you deploy multiple WBS products to provide wireless coverage in the same direction, you can deploy them with the same orientation but at different heights (as the right picture below shows). Please adjust the antenna's elevation angle too. The latter case is for when there is a high number of Client APs concentrated in one direction and a single AP is unable to serve them. Thus, you need to deploy multiple Base Station APs to share the load.



● **Field Deployment 2: Power Supply and Lightning Protection**

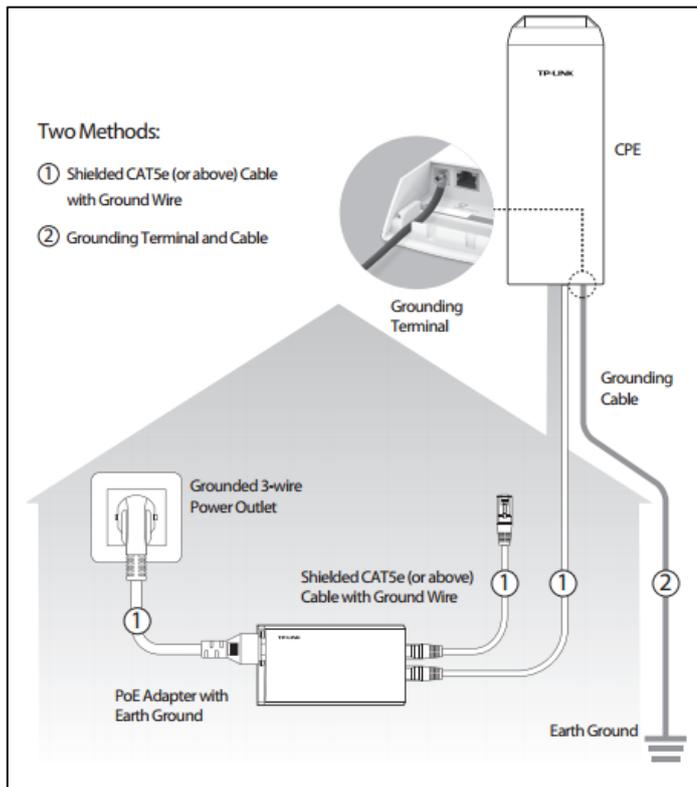
Pharos CPE/WBS products support 24V/1A Passive PoE power supply. The maximum distance from the power supply is 60m. Therefore, you can power the device with an indoor electric source.



Please note that Passive PoE is different to Standard PoE. You CANNOT supply power to CPE/WBS with PoE switches. For detailed information about PoE power supply, please refer to [FAQ-906](#).

If your project requires lightning protection:

- 1) Connect the ground electrode to the grounding terminal.
- 2) Use Cat5e (or above) Shielded twisted pair cables to work with the PoE Adapter (comes with product) for lightning protection.



- **Field Deployment 3: AP Configuration and Channel Optimization**

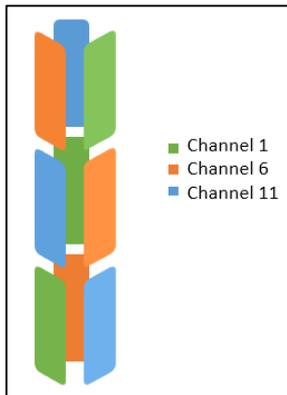
Log in to the web management UI and configure the Base Station AP (WBS) in AP mode. Note that the Distance option should be set to 1.1 times the distance of the farthest client from the WBS. For details about how to configure it, please refer to [FAQ-730](#).

When configuring the AP, you could choose a clean channel to help improve the throughput. Therefore, it is recommended that you perform spectrum analysis with the Spectrum Analysis tool in the web UI. You can then select a relatively clean channel manually.

Client APs (CPE) need to be configured in Client mode and connect to the Base Station AP. Note that the Distance option should be set to 1.1 times the distance from the Base Station EAP. For details about how to configure it, please refer to [FAQ-727](#).

- **How to avoid collocation interference when you configure channel optimization?**

Sometimes, you may need to deploy multiple Base Station APs in the same signal tower, to cover multiple directions, or to connect to multiple Client APs. In such cases, the APs sharing the same signal tower may wirelessly interfere with one another (collocation interference). Therefore, it is recommended to configure adjacent APs in non-overlapping channels. Take WBS210 as an example; if we need omnidirectional coverage, and three APs in each direction to serve multiple clients, you can refer to the following picture for deployment and channel planning.



- **Field Deployment 4: Antenna Alignment**

In the network topology for P2MP, Base Station APs generally work with Sector Antennas, covering a large area. Thus, the Antenna Alignment tends to be simpler than for P2P networks. For detailed information, please refer to [FAQ-1044](#).

- **Field Deployment 5: Wireless Performance Testing and Optimization**

You can test the wireless throughput with the Speed Test tool in the Pharos web management UI. Configure your WBS as a server and multiple CPEs as clients to test the wireless throughput. For detailed testing methods, please refer to the [Pharos User Guide](#), pages 97-98.

You can also test the wireless performance by simulating users' online behavior, such as multiple clients streaming videos, browsing webpages and making VoIP calls at the same time. If you find the test results do not satisfy your requirements, it could be that the APs are overloaded or the channel capacity is

insufficient. You could try deploying multiple WBS products and allocating clients by staggering the working channel of each base station to alleviate such problems.

C. Wireless Network Optimization

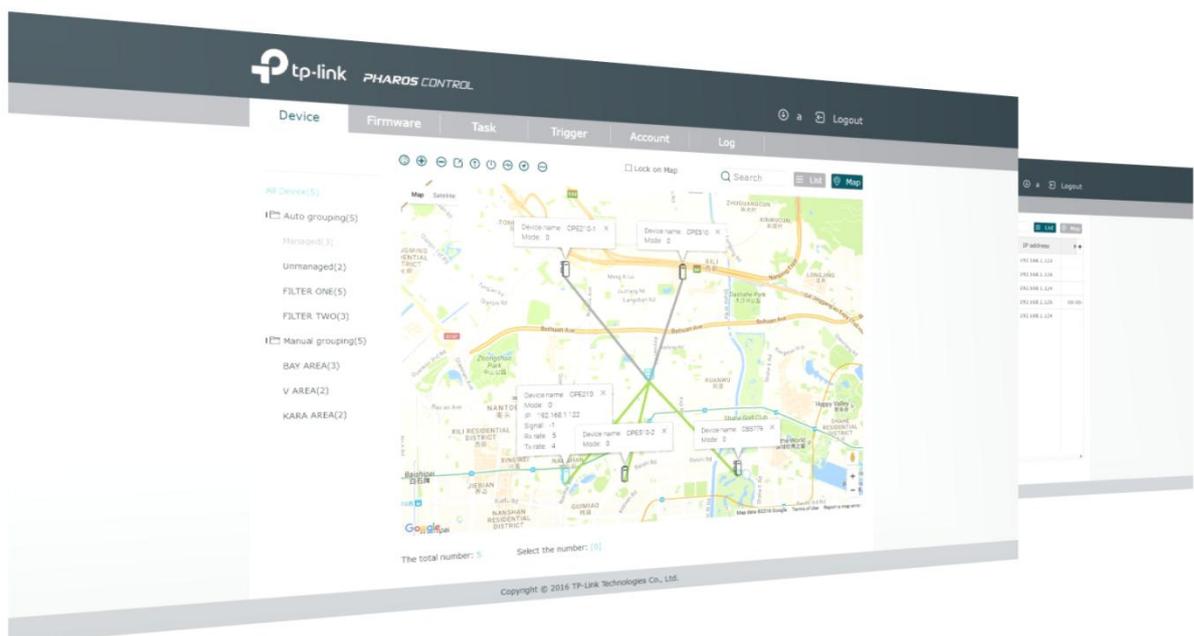
1. Wireless Network Optimization 1: Enable MAXstream to Improve Wireless Throughput

Traditional 802.11 WLAN is based on CSMA protocol. As the number of clients increase in the outdoor network topology for P2MP, the probability of wireless conflicts will gradually increase, which results in a reduction in wireless throughput. The MAXstream function can help to resolve this issue on Pharos APs, helping to improve wireless throughput for P2MP solutions.

With MAXstream enabled, the Base Station AP will allocate timeslots to each client. Clients can then only transmit data in the timeslot allocated, meaning they no longer have to compete for the right to use the channel. In this way wireless client conflicts are eliminated and the wireless throughput increased. For detailed information, please refer to [FAQ-694](#).

2. Wireless Network Optimization 2: Centralized Management and Maintenance by Pharos Control

For network management, the Pharos Control software allows centralized management and maintenance via an intuitive interface. With the help of Pharos Control, you can monitor the operating status and data traffic in real time, and perform common operations such as auto-upgrade, periodic reboot, exception notification and more.



3. Wireless Network Optimization 3: Enable Test Mode to Improve Wireless Throughput

Pharos series software includes Test Mode, which allows the access point to use higher transmission power and cleaner channels so as to avoid wireless interference and improve network performance.

IMPORTANT: Enabling Test Mode may violate local regulations regarding the transmission of radio waves in your country. Please ensure your product complies with local regulations in Test Mode before enabling it. The transmission statistics of Pharos products when operating in Test Mode are shown below.

Model	Frequency	Maximum Transmit Power	Antenna Gain
WBS210	2312-2572 MHz	27dBm/500mW	/
WBS 510	4920-6100 MHz	27dBm/500mW	/
CPE210	2312-2572 MHz	27dBm/500mW	9dBi
CPE220	2312-2572 MHz	30dBm/1000mW	12dBi
CPE510	4920-6100 MHz	23dBm/200mW	13dBi
CPE520	4920-6100 MHz	27dBm/500mW	16dBi