

Auranet CAP Solution 3

CAP Indoor Wi-Fi Solution for Large-Sized and Multi-Subnet Networks

Albert Hao

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Background

Free Wi-Fi can increasingly be found in shopping malls, hotels, airports and other large public spaces. The scale of such locations, with hundreds or even thousands of access points, brings its own logistical challenges for wireless network deployment, configuration and maintenance. Another consideration is that complex environments such as these, with heavy visitor traffic and a large number of connected clients, can be susceptible to wireless interference. A solution is required that can be deployed rapidly and managed centrally while also providing fast, stable Wi-Fi for large indoor expanses.

TP-Link's Auranet CAP Series products provide a range of cost-effective indoor solutions carefully engineered to meet the networking needs of indoor business environments. With over 20 years of networking experience behind us, TP-Link has an outstanding track record as a commercial wireless network solutions provider, owing to our dedicated technical support team and trusted partners.

Application Scenarios

The solution provided in this document applies to the following customers and application scenarios:

1. Large indoor wireless networks including shopping malls, airports, hotels, factories and more with a wireless client number of 500 to 1000+.
2. Sites that require business-class, high-speed and stable wireless access.

For enquiries about the selection or implementation of these solutions, please contact TP-Link Technical Support.

Why TP-Link?

1. 20 years of experience delivering quality products at an affordable price.
2. Over 1000 global professional and reliable partners.
3. Effective, economical and reliable wireless solutions.
4. Diverse range of products available for your business.
5. Outstanding technical support team with both pre-sales and post-sales support.
6. Free and professional global hotline support and warranty service available 24/7.

Solution

This document will demonstrate a solution suitable for large-sized wireless networks with a wireless client number of 500 to 1000+ and dozens or even hundreds of access points. If you just want to extend a wireless network with our CAP products based on your existing wired network, you need to make sure that your existing wired network meets the basic network requirements detailed in this article. If you need to build a brand new wired and wireless network, we will also recommend a set of indoor wired & wireless solutions based on TP-Link products for your reference. This solution includes the following three parts:

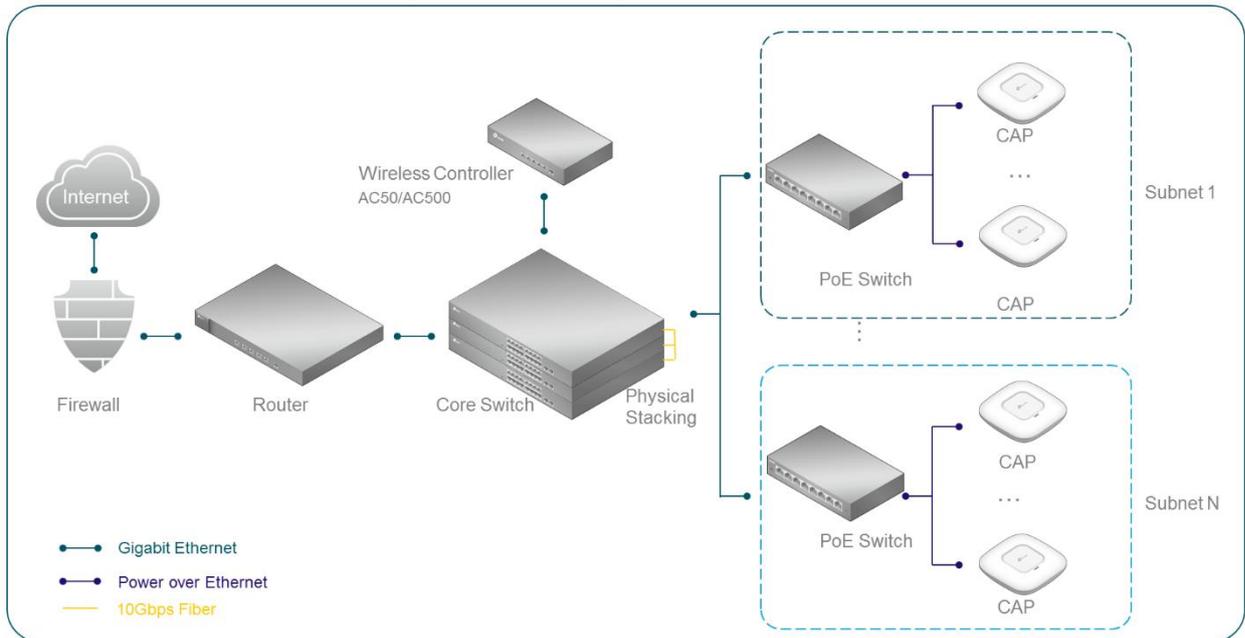
A. Solution Features and Topology Description

B. Wired Network Deployment and Configuration Guide

C. Wireless Network Deployment and Configuration Guide

A. Solution Overview and Network Topology Description

Solution --- Indoor Wi-Fi Networking Solutions for Large-Sized and Multi-Subnet based on CAP Products



As shown above:

- 1) In the wired network, we need to divide different departments or areas into different subnets. Dividing subnets can isolate broadcast domains and reduce broadcast traffic in the network. It can also improve network security and simplify management.
- 2) The AC Controller supports Layer 3 cross-subnet management. A single AC Controller can manage CAPs from different subnets. There's no need to change the existing wired network when extending a wireless network with CAPs.
- 3) An SMB router and firewall can act as the gateway and ensure network security. An L3 stackable switch is used as the core switch to divide subnets. Multiple core layer switches can be stacked to enhance the stability of the network. The AC Controller is deployed at the core layer and centrally manages CAPs in all subnets. PoE switches are installed to supply power to CAPs in the access layer.

You can deploy an appropriate number of CAPs for your indoor wireless network by considering the area where wireless coverage is needed and the number of clients during peak usage. The recommended number of wireless clients for each CAP is 25. (For dual-band CAPs the number is 50, or 25 for each band.) A single CAP has a range of 15 meters. For guidelines on the number of CAPs needed in an ideal environment, you can refer to the test report in Part C of this document, entitled "Wireless Network Deployment and Configuration Guide 3: CAP Product Deployment". However, please note the actual number of required CAPs will depend on the environment they are being deployed in, since wireless signal is affected by obstacles, RF interference and other factors.

B. Wired Network Deployment and Configuration Guide

1 Wired Network Deployment and Configuration Guide 1: Gateway Selection

There are multiple subnets in this solution, so the gateway router must support Multi-Nets NAT (Multiple Subnet NAT) and Static Routing. Different router manufacturers require different configuration steps to set up Multi-Nets NAT. For TP-Link routers, refer to [FAQ-887](#) for detailed instructions.

TP-Link provides a variety of SMB routers (Gateway Router Equipment). For this solution, we recommend the following TP-Link SafeStream routers as the gateway router:

Product Series	SafeStream VPN Router		SafeStream Load Balance Router
Model	TL-ER6120	TL-ER6020	TL-ER5120
Concurrent Session	60000	30000	120000
Recommended Client Number	300	150	600
NAT Throughput	350Mbps	180Mbps	350Mbps
Multi-nets NAT Subnet Number	16	8	16
Maximum Number of WAN Port	2	2	4

To learn more about our [SafeStream VPN Routers](#) and [SafeStream Load Balance Routers](#), please visit our official website.

2 Wired Network Deployment and Configuration Guide 2: Core/Convergence Layer Switch Selection

The core/convergence layer switch must have sufficient data forwarding and processing capabilities. Since we are dealing with an L3 multi-subnet network, stackable L2+/L3 switches are recommended as the core switch as these support subnetting and routing. In this solution, we recommend the following TP-Link switches. Further information about [TP-Link Switches](#) can be found on our official website.

Model	T1700G-28TQ	T2700G-28TQ	T3700G-28TQ	T2600G-28TS	T2600G-52TS
DHCP Relay	Supported	Supported	Supported	Supported	Supported
DHCP Server	Not Supported	Supported	Supported	Supported	Supported
Number of IP interfaces	16	128	128	16	16
Number of static routes	32	256	256	48	48
No. of Units Per Stack	6	8	8	No	No
Static/Dynamic LAG	Supported	Supported	Supported	Supported	Supported
Switching Capacity	128Gbps	128Gbps	128Gbps	56Gbps	104Gbps
Packet Forwarding Rate	95.2Mpps	95.2Mpps	95.2Mpps	41.67Mpps	77.4Mpps

Why choose L2+/L3 switches as the core layer switches?

Most L2 switches support 802.1q VLAN, which divides the network into different VLANs. However, after VLAN division not only are the broadcast and multicast traffic isolated, but the unicast communication between VLANs is also blocked. This is inconvenient for the network communication.

If L2+/L3 switches are used, it can not only reduce network load by isolating broadcast domains but can also achieve unicast communication between VLANs through data routing. At the same time, the high data forwarding capability can ensure your network runs smoothly. For this reason, it is recommended to use

L2+/L3 switches to divide VLAN and subnets for stability.

3 Wired Network Deployment and Configuration Guide 3: CAP Power Supply Selection (Access Layer Switch Must Support Standard 802.3af/at PoE)

PoE (Power over Ethernet) allows a single cable to provide both data connection and electric power. Using PoE switches can simplify network deployment and save costs since there's no need to install additional power cabling. TP-Link provides different levels of PoE switches with a variety of port numbers, which can meet the requirements of PoE power supply and network access in various scenarios. In this solution, we recommend using the following PoE switches:

Model	SG3424P	T1600G-52PS	T1600G-28PS	SG2210P	T1500-28PCT	SG1008PE	SG1008P
POE Standard	802.3at	802.3at	802.3at	802.3af	802.3at	802.3at	802.3af
Configuration	Rack mount	Rack mount	Rack mount	Desktop	Rack mount	Desktop	Desktop
POE Power Budget	320W	384W	192W	53W	180W	124W	55W
POE Ports	24	48	24	8	24(10/100Mbps)	8	Port1~4

In addition, different TP-Link CAP products support different PoE standards. PoE technologies adopted on the TP-Link Auranet series CAP are listed in the following table:

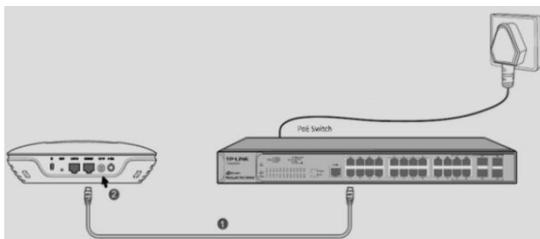
Model	CAP1750	CAP300
POE Standard	802.3at	802.3af

Find out more about [TP-Link PoE switches](#) by visiting our official website.

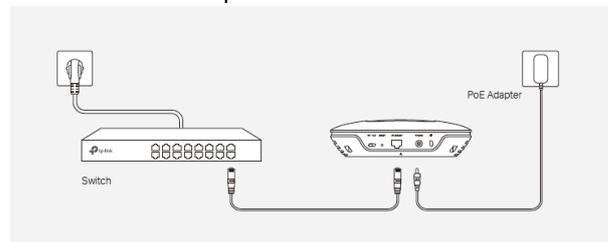
Why can't 802.3af standard PoE switches supply power for 802.3at standard CAPs?

The maximum output power per PoE port in IEEE 802.3af is 15.40W. A later specification, IEEE 802.3at, offers up to 30W on each port. And 802.3at PSE (power source equipment) is backward-compatible with 802.3af PD (powered device). The IEEE 802.3af PoE switch cannot provide power to the 802.3at standard CAPs such as CAP1750. However, the 802.3at standard PoE switch can power up 802.3af CAPs like CAP300.

Please note that external power adapters can be used instead for power supply. However, if you are using an external power adapter, you need to consider the number and location of power outlets.



Standard PoE Power Supply



External Adapter Power Supply

C. Wireless Network Deployment and Configuration Guide

1 Wireless Network Deployment and Configuration Guide 1: Solution Selection

Here we choose wireless networking solution with TP-Link CAP (FIT Mode) & AC Controller. It uses CAP

products to expand wireless network based on the existing wired network and AC Controller to manage the CAP centrally. The main benefits of the solution are:

- 1) Networking is convenient, with no need to change the existing wired network.
- 2) CAPs work in FIT Mode, and AC Controller supports L3 Management. So, AC Controller can discover and manage CAPs in different subnets and monitor the working status of each CAP in real time.
- 3) AC controller, as a hardware device, can run independently with high stability and performance.

2 Wireless Network Deployment and Configuration Guide 2: CAP Product Selection

TP-Link provides different levels of 11n/11ac CAP products to meet different requirements. See the table below for details.

Model	CAP1750	CAP300
Wireless Throughput	2.4GHz:450Mbps 5GHz:1300Mbps	2.4GHz: 300Mbps
Internal Antennas	2.4GHz:3*4dBi 5GHz:3*4dBi	2.4GHz: 2*3dBi
Captive Portal	√	√
Airtime Fairness	×	×
Band Steering	√	×
Load Balance	√	√

Why choose 5GHz CAP products?

- 1) The 2.4GHz band only has three available non-overlapping channels for transmission, namely 1, 6, and 11. The 5GHz band can provide a much larger number of channels. Please note that due to different local regulations, available 5GHz channels differ between countries and regions. For example, in the United States twenty-two 5GHz channels are supported, while in Europe nineteen 5GHz channels are supported.
- 2) The 5GHz channel is much cleaner, with less interference. The 2.4GHz wireless band uses the same channel signals as other devices such as Bluetooth and microwave ovens, so it is more likely to experience interference in a noisy environment. Compatibility with 5GHz band Wi-Fi is becoming widespread, with greater and greater numbers of devices now supporting it. Furthermore, it allows dual-band CAP products to handle larger numbers of simultaneous connections.

3 Wireless Network Deployment and Configuration Guide 3: AC Controller Selection

1) Why is centralized management necessary?

- Medium or large scale networks can contain a high number of CAPs. Hence, configuration and management is much more convenient if all CAPs can be managed at the same time using the AC controller. Managing each CAP individually in FAT mode would be time consuming and inefficient.
- It is difficult to monitor all CAPs and keep track of their working status in real time if they are in FAT mode.
- A single CAP in FAT mode is unable to perform advanced functions, while upgrades are limited by its hardware specifications.

2) The advantages of centralized management under AC Controller:

- The AC Controller can manage all CAP products at once. It supports unified configuration and

software upgrades, which is easy for network management and maintenance.

- It can monitor working status, network traffic and client information of all access points.
- Advanced functions such as flexible Portal Authentication, Load Balance and more are supported.

TP-Link has launched two AC hardware wireless controllers, AC50 and AC500, to meet the needs of centralized management in different sized networks. As the name implies, AC50 can manage up to 50 CAPs, and AC500 can manage up to 500 CAPs. If you have less than 50 CAPs in your network, you can choose AC50. If the number of CAPs is larger than 50, AC500 is recommended. The following table shows the specifications of AC50 and AC500:

The specifications of AC50 and AC500:

		AC500	AC50
Main Design	Processor	1GHz Dual-core MIPS64 Network Dedicated Processors	650MHz Network Dedicated Processor
	Memory	256MB DDR3*2, 32MB Flash*1	128MB DDR2*1, 16MB Flash*1
	Interfaces	Gigabit Ethernet Port*5 Console Port*1	10/100Mbps Ethernet Port*5
	Management Scale	Up to 500 Aps	Up to 50 Aps
	Dimensions (W × D × H)	17.3 × 8.7 × 1.7 in (440 × 220 × 44mm)	8.2 × 5.0 × 1.0 in (209 × 126 × 26 mm)
Software Feature	Support AP	TP-Link Auranet CAP Series AP	
	L3 Management	Yes	
	Multi-SSID	32 SSIDs	16 SSIDs
	Link Backup	Yes	
	Portal Authentication	Yes	

4 Wireless Network Deployment and Configuration Guide 4: CAP Product Deployment

1) CAP Product Installation

TP-Link CAP products can be ceiling-mounted, wall-mounted and ceiling-rail mounted. Installation methods are simple and fast. The installation procedure is the same for CAP300 and CAP1750. Please refer to the [CAP300 Installation Guide](#) for detailed instructions.

2) CAP Product Cabling

To ensure normal communication and power transmission, we recommend that you use Ethernet cables that are CAT 5E or above, with a maximum length of 100 meters. If you have a large network, then we recommend that you use a standard PoE switch if you have one. If you do not have a PoE switch, then external power adapters can also be used for power supply.

For every CAP product, you will need to decide the number of CAPs and where to install them based on your indoor environment. You should consider the following factors:

- Carpet Area: In theory, the wireless coverage of a CAP can reach up to 500 square meters. However, the actual coverage may be less than that value, due to the effects of signal interference and obstacles.
- Number of Connections and Internet Behaviors: A single band (2.4GHz or 5GHz) of an access point has a recommended number of connected devices of 30, and the connected capacity of the 5GHz band is slightly more than that of the 2.4GHz band. A series of tests carried out with a selection of CAP products produced the following results when users streamed 720P HD videos:

	2.4 GHz		5 GHz
	CAP1750	CAP300	CAP1750
Smooth Play*	26	25	38
Occasional Error*	30	30	42

*Smooth Play indicates the maximum number of connected devices when all clients are able to smoothly stream 720P HD videos.

*Occasional Error indicates the maximum number of connected devices when clients experience occasional buffering or pausing when streaming 720P HD videos.

- Obstacles: Obstacles can cause varying degrees of wireless signal attenuation. To ensure complete coverage, try to install the CAPs in the center of an open room, which reduces the interference between the CAPs and their surroundings. It is recommended to test the signal reception in the corner of the room.

3) Discover and Manage CAP Product

In an L3 network with multiple subnets, the AC Controller cannot discover CAPs in different subnets automatically. Instead, the CAPs must be informed of the AC Controller's IP address. The CAPs from different subnets then communicate with the AC Controller to achieve cross-subnet management (L3 management). There are two options for AC Controller cross-subnet management (L3 management) which are as follows:

- **Using DHCP Option 138 and Option 60**

If your DHCP Server supports DHCP Option 138 and Option 60, we can inform CAPs of the IP address of the AC Controller when the DHCP server is assigning IP addresses to CAPs. In this way, a connection is established between AC and CAP.

Different manufacturers require different configuration steps for DHCP Servers regarding Option 138 and Option 60. Please contact the manufacturer of your DHCP server for details. Here we take the TP-Link JetStream T2600 switch as an example. For detailed configuration steps regarding Option 138 and Option 60 on TP-link switches, please refer to [FAQ-1346](#).

- **Using AC Controller as DHCP Server**

If your DHCP Server doesn't support DHCP Option 138 and Option 60, you can set the AC Controller as a DHCP Server for your CAP products. The AC Controller will assign each CAP an IP address while at the same time inform them of its own IP address. For detailed configuration steps, please refer to [FAQ-1344](#).

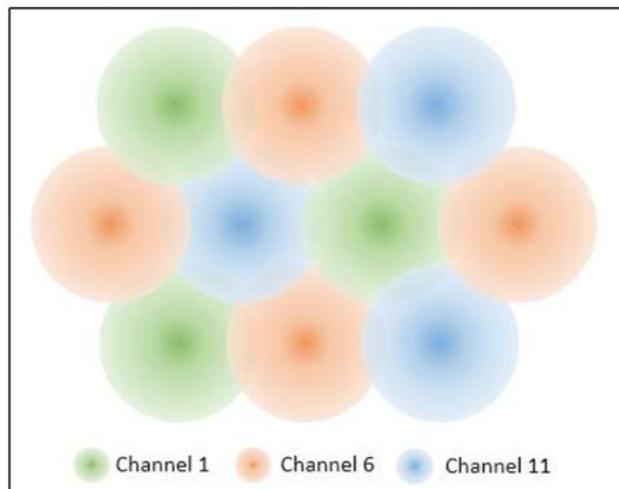
4) Wireless Network Optimization

Once the wireless network is set up, you can access the internet or configure features such as wireless authentication, VoIP and more.

The following features can help to build a more stable wireless network:

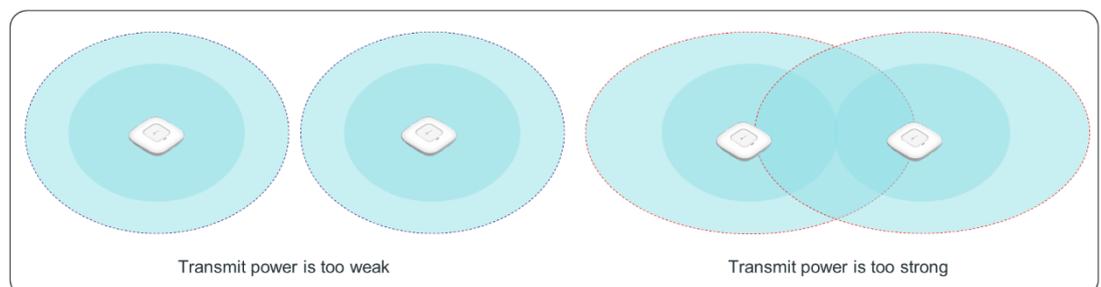
- **Channel Optimization**

No matter whether you select the 2.4GHz or 5GHz band when deploying your wireless network, it is important to ensure that wireless signals of adjacent CAPs do not interfere with each other. To achieve this, we can manually assign and fix channels for each access point. The following figure shows a possible channel assignment layout based on the three non-overlapping 2.4GHz wireless channels (1, 6 and 11).



- **Transmission Power Adjustment**

Generally, the higher the transmission power is, the larger the area that the wireless signal can cover. In places with a high density of clients, however, access points tend to be placed very close together, which may result in their wireless signals interfering. High transmission power is another factor that can result in interference between adjacent access points. Analyzing transmission power requires professional wireless signal analysis tools such as inSSIDer. When two access points are close together and there is no obstacle between them, it is recommended to reduce the transmission power. If there are many obstacles and access points are spread far away from one another, the transmission power may be increased.



- **Load Balance**

Load Balance attempts to distribute wireless clients evenly between access points. Clients with a

weak wireless signal can also be removed from the network, creating a smoother connection for users. To learn more about the working mechanism and configuration steps involved with Load Balance, please refer to [FAQ-1336](#).

- **Band Steering**

This feature is supported by 2.4GHz/5GHz dual band products such as CAP1750. When possible, dual-band clients will be connected to the cleaner and faster 5GHz network instead of the 2.4GHz band. This provides a better online experience for users on both bands since network traffic on the 2.4GHz band will also be reduced. To learn more about the detailed working mechanism and configuration steps involved with Band Steering, please refer to [FAQ-1337](#).

5 Wireless Network Deployment and Configuration Guide 5: Improve Wi-Fi Access Experience

TP-Link Auranet CAP products provide more than just Wi-Fi. They include software features such as Captive Portal, AP Isolation and an Accounting Service.

- 1) By using Captive Portal Authentication, you can advertise your business while providing authentication for the users. TP-Link Auranet CAPs support a variety of Captive Portal authentication modes. Users can select Captive Portal authentication modes according to their network size, application scenario and customers.
- 2) AP Isolation can ensure the customers' network security. By setting up AP Isolation, you can isolate communication between all wireless clients. This not only reduces broadcast traffic, but also enhances network security.
- 3) Both AC500 and AC50 support accounting service. Administrators can build their own CAP accounting system and charge guests according to their time online.