Auranet CAP Solution 4

CAP Indoor Wi-Fi Solutions for Large-Sized and Multi-Site Networks

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Background

For businesses spread out across multiple locations, such as supermarket or hotel chains, efficient network management can prove challenging. In traditional wireless networking solutions, the wireless network of each branch is separate from the others. There are two major disadvantages to this:

1. The first is that it's not possible to centrally manage the network. The wireless network of each site will require independent management and maintenance. Not only will this increase the cost of the wireless controller equipment, but the cost and efficiency of network management will also be affected.
2. The second is that LAN resources cannot be shared between the sites. This increases the operating cost because such networks cannot provide a unified business platform, causing some businesses to require different servers in different sites.

For these types of businesses, it is essential to provide a multi-site wireless networking solution which is economical, reliable, and able to support centralized management. 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 solutions provided here apply to the following customers and application scenarios:
1. Hotel chains, supermarket chains, chain stores and any other businesses with branches in multiple locations, and with a total client number of 500 -1000 or more
2. Businesses with high requirements for network stability and speed

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 to suit 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

Solutions

In this document, we will introduce two solutions based on the management of TP-Link CAPs across multiple sites using AC controllers. One is achieved through the use of VPN tunneling, and the other is achieved using NAT port forwarding. To build a site-to-site VPN between your headquarters and branches using the gateway routers, "Multi-Site Management via VPN Tunnel" is recommended. If it is impossible to build a site-to-site VPN tunnel between your headquarters and branches, please move to the second solution "Multi-Site Management via NAT Port Forwarding". These solutions include 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 1 --- Multi-Site Management and Deployment of CAP Wireless Network via VPN Tunnel
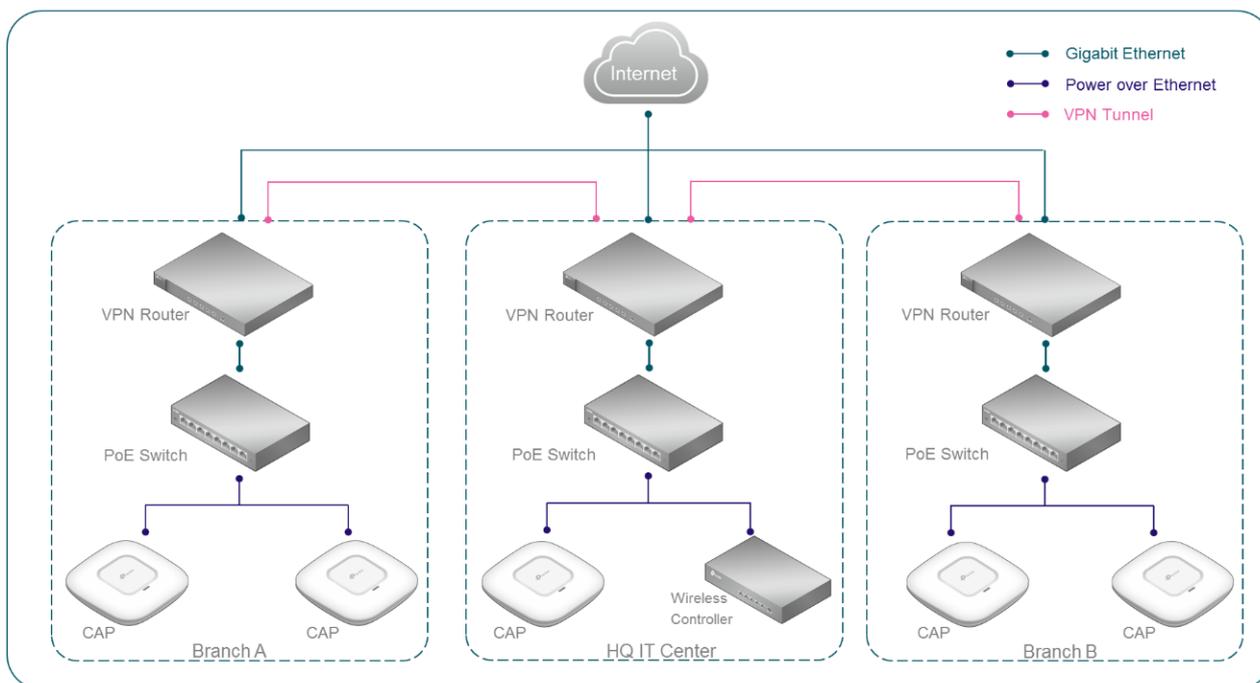
As shown above:

1) The LAN of the headquarters and branches are connected via VPN tunnels.

2) CAP products are used to extend the wireless network based on the existing wired network in the headquarters and branches.

3) CAPs from all branches are centrally managed with an AC Controller located in headquarters.

Solution 2 --- Multi-Site Management and Deployment of CAP Wireless Network via NAT Port Forwarding
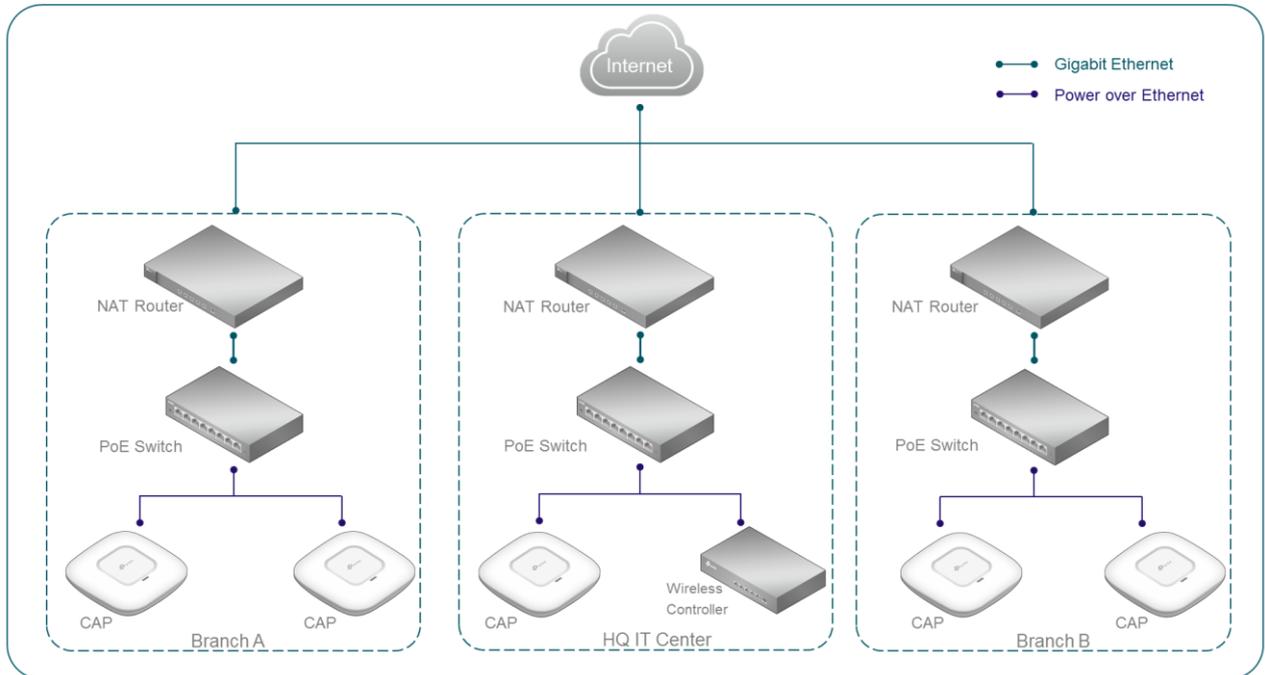
As shown above:

4) The relevant ports on the gateway router at the headquarters are opened to allow the wireless controller to manage CAPs in all branches.

5) CAP products are used to extend the wireless network based on the existing wired network in the headquarters and branches.

6) CAPs from all branches are centrally managed with an AC Controller located at headquarters.

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, titled "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

   1) Solution 1: Building a site-to-site VPN tunnel between the gateway routers of the headquarters and branches

      Different manufacturers have different methods for building site-to-site VPN tunnels. Please consult the manufacturer of your gateway router for information. Here we recommend TP-Link SafeStream VPN Router, and also IPSec site-to-site VPN. For detailed configuration steps for this product, please refer to FAQ-380. For questions regarding the configuration of VPN tunnels with TP-Link routers, please contact TP-Link Technical Support.

2) Solution 2: Opening the relevant ports on the gateway router of the headquarters

In this solution, you don't need to set a site-to-site VPN on the gateway routers. However, the gateway router must support NAT Port Forwarding features such as Virtual Server. Please be aware different manufacturers have different configuration methods. For detailed configuration instructions, please consult the support team of your gateway router manufacturer. In order for the AC Controller in headquarters to discover and manage CAPs from all branches, we need to open UDP port 5246 and 5247 on the gateway router at headquarters. Here, we take the TP-Link SafeStream Load Balance Router as an example. For the detailed configuration instructions of this product, please refer to FAQ-1347.

Please note that opening ports only achieves cross-NAT data communication between the AC Controller and CAPs. It cannot achieve site-to-site LAN information and resource sharing. In addition, multi-site management via port forwarding is insecure since the data exchange between different sites is not encrypted. It will also increase the risk that your local network gets attacked from external networks when you open ports on your NAT device. Solution 1 is recommended if you require a high level of network security.

TP-Link provides various SMB Routers (Gateway Router Equipment). In this solution, we recommend the following TP-Link SafeStream routers when selecting a gateway router:

	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-Net NAT Subnets Number	16	8	16
Maximum Number of WAN Ports	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：Power Supply Selection (Access Layer Switch Must Support 802.3af/at Standard 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	TL-SG3424P	T1600G-52PS	T1600G-28PS	TL-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

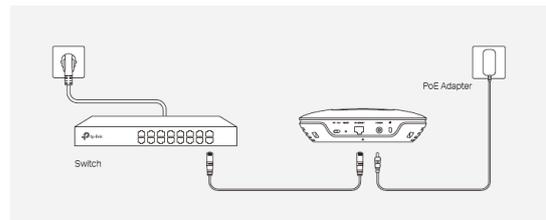Find out more about TP-Link PoE switches by visiting our official website.

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 more recently developed standard, IEEE 802.3at, offers up to 30W on each port. Although 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 required CAPs such as CAP1750. However, the 802.3at standard PoE switch is able to power 802.3af CAPs such as CAP300.

Please note that external power adapters can be used as an alternative to PoE switches for power supply. However, if you are using an external power adapter, you need to consider the number and location of power outlets.
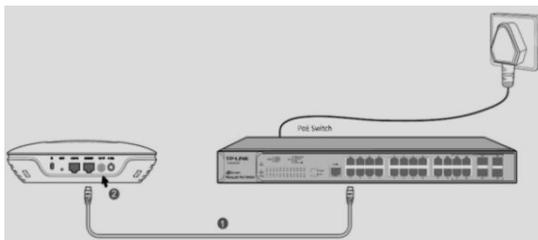
Standard PoE Power Supply　　　　　　　　External Adapter Power Supply

C. Wireless Network Deployment and Configuration Guide

1. Wireless Network Deployment and Configuration Guide 1：Solution Selection
   Here we discuss wireless networking solutions using TP-Link CAPs (FIT Mode) & AC Controllers. They use CAP products to expand wireless networks based on the existing wired network. The AC Controller is used to manage the CAP centrally. The main benefits of the solution are:

   1) Set up is simple and convenient, without the need to change the existing wired network
   2) CAPs work in FIT Mode, and the AC Controller supports L3 Management. The AC Controller can discover and manage CAPs in different subnets and monitor the working status of each CAP in real time.
   3) The AC controller, as a hardware device, can run independently with good 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:450Mbp 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 makes network management and maintenance easy.
      - 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:

		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 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 CAPs**

Solution 1: Multi-site Management and Deployment of CAP Wireless Network via VPN Tunnel

Continuing from Section B, "Wired Network Deployment and Configuration Guide", the headquarters and branches can have cross-NAT data exchange after a VPN tunnel is built successfully between the headquarters and branches. At the moment, the CAPs and AC Controller are in the same LAN. For the AC Controller to automatically discover CAP products, however, you still need to inform the CAPs of the AC Controller's IP address.

The process can only be implemented through DHCP Option 138 and Option 60, which means the DHCP Server in your network must support both DHCP Option 138 and Option 60. We can inform the CAP of the IP address of the AC Controller when the DHCP server is assigning IP addresses for CAPs with Option 138 and use Option 60 to establish a connection between the controller and CAPs. Please be aware that different manufacturers have different capabilities and configurations regarding DHCP Option 138 and Option 60. If you are unsure, please contact the manufacturer of your DHCP Server for more information. Here, we recommend using a TP-Link JetStream T2600 series switch. For detailed configuration information regarding Option 138 and Option 60 on TP-Link switches, please refer to FAQ-1346.

Solution 2: Multi-Site Management and Deployment of CAP Wireless Network via NAT Port Forwarding

Continuing from Section B, "Wired Network Deployment and Configuration Guide", the headquarters and branches have been connected over the internet, and the relevant ports on the gateway router have already been opened for the AC Controller. For the AC Controller to automatically discover CAP products, you still need to inform CAPs of the AC Controller's IP address. (In this case, the IP address required is the WAN IP of the gateway router at headquarters.)

The process can only be implemented through DHCP Option 138 and Option 60, which means the DHCP Server in your network must support both DHCP Option 138 and Option 60. We can inform the CAPs of the IP address of the AC Controller (the WAN IP of the gateway router at headquarters) when the DHCP server is assigning IP addresses for CAPs with Option 138 and use Option 60 to establish a connection between the controller and CAPs. Please be aware that different manufacturers have different capabilities and configurations regarding DHCP Option 138 and Option 60. If you are unsure, please contact the manufacturer of your DHCP Server for more information. Here, we recommend using TP-Link a JetStream T2600 series switch. For detailed configuration information regarding Option 138 and Option 60 on TP-Link switches, please refer to FAQ-1346.

4) Wireless Network Optimization

In the previous step, after the AC Controller has discovered CAPs from different sites, you can start to configure the SSID and passwords of the CAPs in the list. To learn more about the configuring CAPs using the AC Controller, please refer to FAQ-1334.

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:

- 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).
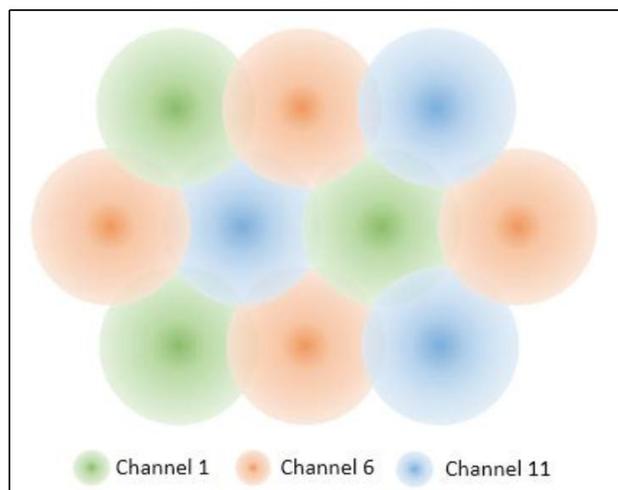
- Transmission Power Adjustment

  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.

Transmit power is too weak   Transmit power is too strong
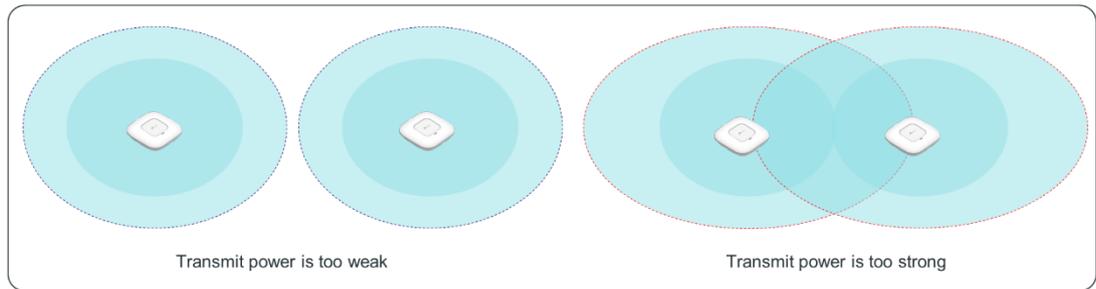
- **Load Balance**

  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 the Wireless 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 products or services 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 an accounting service. You can build your own CAP accounting system and charge the users according to their online time.